6213.05
W52

Western Electrician

EVERY SATURDAY.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ARCHITECTURE
NOV 17 1894
LIBRARY.

Volume VII. Numbers 1-26. INDEX. July 5—December 27, 1890.

Accumulator, The Improved Schoop. Illustrated 151, 152
Accumulator, The Reynier Elastic. Illustrated..... 331
Accumulator Car at Dubuque, Ia., The Edco..... 212
Air Ship, Mt. Carmel..... 340
Air Ships to be Operated by Electricity..... 193
Aluminum, Reducing 327
Aluminum Factory, Electric Plant an 264
Allegheny City, Pa., Municipal Electric Station at. Illustrated..... 316
Alternating Current Apparatus, Some Experiments Upon, by Harris J. Ryan. Illustrated. (American Institute of Electrical Engineers.....10, 11, 12
Alternating Currents, Some Points About, by Prof. H. S. Carhart..... 20, 21, 32
Alternators, A New Method of Analyzing Armature Reactions of, by Charles Steinmetz..... ...310, 311
Alternator at the Edinburgh Exhibition, English. Illustrated..... 33
American Institute of Electrical Engineers. 7, 8, 9, 10, 11, 12, 24, 254, 255, 256, 257, 258, 296, 297 .....310. 311, 323, 347, 348, 349
American Names for Electrical Units..... 20
American Street Railway Association.....193, 203
American Street Railway Association—Report of the Annual Convention:
Members and Delegates.....220, 221
The President's Address..... 221
Treasurer's Report..... 221
Executive Committee's Report 221
Electric Motive Power Technically Considered. By W. L. Allen.....221, 222
The Edco Storage Battery Car. By D. H. Bates, and Discussion.....222, 223
Wenstrom Electric Railway System, and Discussion 223
Wheless Electric Railway System.....223, 225
Julien Storage Battery System, and Discussion 225
Short Electric Railway System..... 225
Birmingham Street Railway System..... 225
Edison Electric Railway System..... 225
Thomson-Houston Electric Railway System 225, 226
Public and State Treatment of Corporations... 226
Novel Schemes for the Development of Street Railways..... 226
Election of Officers..... 226
The Banquet 226
Mayor's Address of Welcome..... 226
Excursion to Niagara Falls..... 226
Exhibits, Convention Notes and Personals 226, 227, 228
Ammeter and Voltmeter, The National Detachable Safety Fuse Box. Illustrated..... 249
Arc Lamp, Enholm. Illustrated.. .....304, 305
Arc Lamp, Multi-Carbon. Illustrated.....329, 330
Arc Lamp, Pieper. Illustrated..... 306
Arc Lamp, Russell Disk Carbon. Illustrated..... 44
Arc Lamp Litigation, Double Carbon..... 18
Arc Lamps on Edison Circuits.. 167
Arc Stations, Safety Precautions in.....42, 43
Armature, New Edison Eickmeyer Street Railway.... 187
Armature Shaft to the Core, Flexible Coupling of an. Illustrated 31
Armatures, Rapid Method of Forming Cores for Gramme. Illustrated. 141
Assembling Room, Western Electric Company's Factory, Chicago. Illustrated 303
Australia, Development of Electrical Interests in..... 128
Australia, Electric Lighting in..... 273
Australian Cable..... 263

Balloon, Signaling by Electric Light from a. Illustrated..... 129
Baltimore, Edison Plant on the Steamer. Illustrated. 150, 151
Baltimore Masonic Temple, Electrical Display at the. Illustrated. (Westinghouse Electric & Manufacturing Company.)..... 277
Baltimore, Municipal Lighting at..... 253
Banquet, Farewell..... 77
Battery, Ajax Dry, Illustrated. (Electrical Supply Company.) 323
Battery Connection. Illustrated..... 346
Battery, Medical. Illustrated. (River & Rail Electric Light Company.)..... 127
Battery, Weston's Standard. Illustrated..... 264
Battery Street Car Systems, Two Storage. Illustrated. 35
Battery Strip, The Delany. Illustrated..... 277
Batteries, Comparison of two European Secondary, by Dr Paul Schoop. Illustrated..... 32, 33
Batteries, Schoop Storage 60
Batteries, Portable Lamp with Renard Primary. Illustrated..... 263
Beach (Supt. F. G.), and the Central Union Telephone Company..... 263
Beggs, John I., President of the Association of Edison Illuminating Companies, with Portrait..... 149
Bell, New Box. Illustrated..... 346
Bell, Telephone Company, Victory for the... 48
Bells, Bridging, by John J. Carty. Illustrated and Discussion (National Telephone Exchange Association).....161, 162, 163
Belting, Power without. Illustrated..... 18
Belvedere, The Columbian. Illustrated 273
Bergmann's Thermal Telephone. Illustrated..... 262
Binding Post, Safety. Illustrated. (M. C. Chase)... 257
Birmingham Street Railway System..... 225
Blathy Alternating Current Meter. Illustrated ...19, 20
Bloomfield Electric Railway. Illustrated. (United Electric Traction Co.)..... 141
Blow Pipes, Electric..... .....199, 200
Boiler, The New Root Water Tube Steam. Illustrated (Abendroth & Root Manufacturing Company) 253
Book Table, The..... .....13, 60, 61, 293, 316
Brake Arm, The Chubbuck (Great Western Electric Supply Company.) Illustrated..... 163
British Association. Address of Sir Frederick A. Bell, President 188
Bridges by Motors, Operating Chicago's..... 219
Brush Arc Lamp, New. Illustrated 250
Brush Company, Victory for the (Opinion of Judge Brown in the Double Carbon Lamp Suit against the Western Electric Company).....97, 98
Buffalo Electrical Society..... 341
Bugs, War on Forest. Illustrated..... 330
Business Mention (Notes). 15, 16, 28, 40, 52, 64, 76, 88, 102, 135, 147, 148, 164, 178, 190, 202, 215, 216, 232, 246, 260, 272, 285, 286, 302, 313, 314, ...326, 338, 351, 352
Busy Board at the Chicago Telephone Exchange. Illustrated..... 287

Calumet Electric Railway. Illustrated.....339, 340, 341
Calumet Electric Street Railway, Chicago.....69, 192
Car Heater, Electric. Illustrated. (C. B. Hanna).. 305
Car Motor Gearing Street. Illustrated..... 319
Carbons, Hydro-carbon Vapors in Arc Light. Illustrated 68, 69
Carbons, Splicing..... 328
Cars, Safety of Passengers on Electric. (Communication) 84, 85
Census, Electrical Industries and the..... 193
Census, Electric Roads and the..... 126
Census Bill.....90, 91
Central Lighting Station as an Investment, by B E. Sunny and Discussion. (Chicago Electric Club). 228, 229, 242
Central Office Apparatus, The Housing and Care of, by W. R. Patterson and Discussion (National Telephone Exchange Association).....159, 160, 161
Central Passenger Railway Company's Power House at Louisville, Ky. Illustrated..... 166
Chelsea Storage Battery Electric Light Plant..... 293
Chelsea Storage Battery Station.....4, 5
Chemical Reaction, Production of Electricity by. Illustrated..... 143, 144
Cheyenne Shops of the Union Pacific Railroad, Electricity in the. Illustrated 279
Chicago, Alternating Incandescent System in the Lyceum Theater..... 167
Chicago, Another Electric Railway Organized in..... 218
Chicago, Electric Railways for..... 331
Chicago, First Electric Street Railway in. Illustrated.....339, 340, 341
Chicago, Litigation over Electric Wires and Poles in 315, 316
Chicago. Municipal Lighting in.....233, 234
Chicago, New Telephone Company at..... 126
Chicago, Projected Electric Road... .....29, 30
Chicago & Jefferson Urban Transit Railway Company..... 125
Chicago & Lake Shore Electric Railway Company... 65
Chicago Board of Trade Quotations..... 327
Chicago City Electric Light Plant..23, 91, 219, ...263, 277
Chicago City Electric Light Plant—Brush Station Illustrated..... 191
Chicago Edison Company ... .149, 150
Chicago Edison Company's Plans, Opposed 30
Chicago Edison Company's New Station. Illustrated, ... 275
Chicago Edison Plant Enlarged..... 44
Chicago Electric Club..... .....5, 9, 10, 191, 228, 229, 233, 242, 251, 264, 267, 268, 269, 280, 281, 299, 300, 301, 307, 309 310, 328, 330
Chicago Electric Club. Amendments to the Constitution and By-Laws of the..... 307
Chicago Electric Club Banquet..... 1
Chicago Electric Club Parties..... 330
Chicago Electric Club Social..... 328
Chicago Fire Underwriters, Electricity in the Service of the. Illustrated..... 192
Chicago South End Electric Railway..... 261
Chicago Telephone Company..... 303
Chicago Telephone Exchange, Storage Battery in the Illustrated..... 138
Chicago Telephone Service.....179, 180
Chicago Underground Electric Light Company..... 53
Chicago's Electric Road..... 59, 60
Chicago's Electrical Service..... 152
Chimes, Electric. Illustrated..... 248
Cincinnati Electric Light Suit in 2
Circuit-Breaker, Mercury. Illustrated..... 128
Circuits, Maintenance of High Tension, by Alex. Dow.....95, 96
City and South London Railway, London, England. Illustrated.....289, 290, 307, 319
Clamp Portable Desk. Illustrated, (Knapp Electrical Works)..... 264
Clowry, Col. R. C., and the World's Fair..... 149
Clowry, Col. R. C., Honored..... 93
Clutch, Electro-Magnetic. Illustrated..... ... 249
Clutching Device for Car Motors, Frictional. Illustrated 60
Coil Electrical Outfit, Toy Motor and. Illustrated, (The E. S. Greeley & Co)..... 304
Compensator for Electrical Measuring Instruments, Weston's. Illustrated 274
Conduit System, Loth. Illustrated 235
Conduits, Installing Interior. Illustrated... 331
Conduits, Interior, Illustrated (Interior Conduit and Insulation Co)..... 45
Conduits, Interior, (Exhibition Board). Illustrated.. 140
Conduits, Interior..... 347
Conduits and Conductors, Report of the Committee on Underground, (National Electric Light Association)..... 122
Contact Device for Electric Railways. Illustrated.... 67
Copper Market, The.. 90
Copper Prices, Advancing..... 19
Copper Question, The..... 132
Copper Refinery, Operation of an Electrolytic, by Dr. G. Gore.....282, 283
Copper Tariff, The. (National Electric Light Association)... 105
Corn Cutter. Operated by an Electric Motor. Illustrated 181
Cornell University, Improvements at..... 237
Corporate Organization, by Edward J. Hall, Jr., and Discussion. (National Telephone Association.) 157, 158, 159
Correspondence.....14, 15, 26, 27, 37, 38, 39, 49, 50, 51, 61, 62, 63, 74, 75, 85 86, 87, 99, 100, 123, 124, 132, 133, 134, 145, 146, 175, 176, 177, 188 189, 200, 201, 213, 214, 215, 230, 231, 243, 244, 245, 258, 259, 270, 271, 283, 284, 285, 301, 302, 311, 312, 313, 323, 324, ...325, 335, 336, 337, 349, 350, 351
Counting Machine, An Electrical..... 93
Coupling, Wire. Illustrated..... 317
Coupling of an Armature Shaft to a Core, Flexible. Illustrated 31
Crane, The Shaw Electric. Illustrated..... 2
Crane in the Cheyenne Shops of the Union Pacific Railroad. Illustrated 279
Crocker-Wheeler Motors at Cape May. Illustrated.. 187
Current. What Constitutes a Dangerous Electrical? by Nelson W. Perry, E. M.....73, 74, 80, 81
Cut-Out, A New Branch. (Great Western Electric Supply Co.) Illustrated..... 19
Cut Out Ceiling. Illustrated. (Star Electrix Co.).. 288
Cut-Out, Magnetic. Illustrated..... 306
Cut-Out, Storage Battery. Illustrated.....44, 45
Cut-Out, Thermal. Illustrated..... 56

Danger of Electric Wires..... 200
Davenport & Rock Island Street Railway, Electric Power for the..... 126
Death Penalty, The. by Dr. George F. Schrady..229, 230
Delaney Battery Strip. Illustrated..... 277
Dental Tool, Electrically Heated. Illustrated..... 250
Devold Power Transmission, by Gustave Monrath. Illustrated 207

23445

Deptford, Ferranti Alternating Gen.rators at. Illustrated....41, 42
Detroit, Telephone and Telegraph Company of. Illustrated....137
Dubuque, Ia., Storage Battery Car at....209
Dubuque Storage Battery Road....78
D'Unger Telephone. Illustrated....194
Durborow, M. C. (Allan C.)....262
Dynamo, A New Method of Analyzing the Magnetic Reactions of Armatures Applied to the Stanley Arc Light Alternating Current, by Thornburn Reid. Illustrated. (American Institute of Electrical Engineers)....256, 257, 258
Dynamo, Austin's Hand. Illustrated....197
Dynamo, Ferranti's Alternating Current. Illustrated....41, 42
Dynamos, The Detroit. Illustrated....79
Dynamo, Investigation of the Stanley Alternate Current Arc, by W. B. Tobey and G. H. Walbridge. Illustrated. (American Institute of Electrical Engineers)....254, 255
Dynamo, Detroit Motor Company's New, Illustrated....317
Dynamo, Preece. Illustrated....83
Dynamo, The Taunton. Illustrated....71
Dynamo, Tyne Alternating Current. Illustrated....33
Dynamo, Welding. Illustrated....56
Dynamo and New Projector, German Illustrated....47
Dynamo and Westinghouse Engine, Combined, Phœnix. Illustrated....36
Dynamo and Willans Central Valve Engine, Efficiency of the Edison-Hopkinson. Illustrated....265
Dynamos, Adjustable Stand for. Illustrated....152
Dynamos, English Constant Current. Illustrated....127
Dynamos and Motors for Continuous Currents, Low Speed Multipolar, by Frank A. Perret. Illustrated....295, 296

East Cleveland Electric Railroad....71
Eau Claire Railway, Light and Power Company's Power House Destroyed by Fire....304
Edco Storage Battery Car, by D. H. Bates (American Street Railway Association)....222, 223
Edison Companies' Convention, For the....145
Edison Companies at Minneapolis, Convention of the....127, 151
Edison Company's Plans, Opposed the....30
Edison Electric Light and Power Company, St. Paul, Minn. Illustrated....17
Edison Illuminating Companies, The Convention of the....
Election of Officers....167
Arc Lamps on Edison Circuits....167
The New Standard Edison Electrolytic Meter, by A. E. Kennelly and R. S. White....168
Insurance on Electric Risks, by S. E. Barton and Discussion....168, 169
Some Special Lamps made at the Edison Lamp Works, by F. E. Jackson....169, 171
National Code of Insurance Rules affecting Electric Light and Power Installations, by W. J. Jenks....171
Convention Notes....172
Edison Light and Power Company's Plant at Minneapolis, Minn. Illustrated....150
Edison Plant on the Steamer Baltimore. Illustrated....150, 151
Edison System (American Street Railway Association)....225
Edison Eickemeyer Street Railway Armature....187
Editorial (Notes)....6, 22, 34, 46, 58, 70, 82, 94, 112, 130, 142, 156, 170, 184, 196, 208, 224, 238, 252, 266, 278, 294, 308, ...320, 332, 344
Electric Adhesion Before the Railway Master Mechanics....9
Electric Light (Notes)....15, 27, 39, 51, 63, 75, 87, 101, 134, 135, 146, 147, 164, 177, 189, 201, 215, 231, 245, 259, 271, 285, 302, ...313, 325, 337, 351
Electric Light Car on the Pennsylvania Road. Illustrated....131
Electric Light in its Relation to the Consumer, The, by C. W. Naylor....239, 240
Electric Light Stations, Value of Details in (Address by A. J. De Camp, National Electric Light Association)....113, 114
Electricity, Dangers of, by Prof. Henry Morton and Discussion (National Electric Light Association)....105, 106
Elevator, Electric. Illustrated....67
Episcope, The. Illustrated....276
Electrolytic Action, Illustrating the Phenomena of. Illustrated....263
Electrolysis, Desilverizing Lead by....341
Electric Lighting System. Illustrated....3
Electric Motive Power Technically Considered, by W. L. Allen (American Street Railway Association)....221, 222
Electrical Engineering, English Postmaster General on....333
Electrocution of Kemmler....83, 84
Electrolytic Copper Refinery, Operation of an, by Dr. G. Gore....282, 283
Electrolytic Separation and Refining of Metals, The Art of, by Dr. G. Gore....269, 270
Elevator Service, Hale Electric Pump for. Illustrated....247
Engine, Combined Phoenix Dynamo and Westinghouse. Illustrated....36
Engine, Efficiency of the Edison-Hopkinson Dynamo and Willans Central Valve. Illustrated....265
Engine, Ideal Compound. Illustrated (Ide & Sons). 318
Evans Friction System. Illustrated (Evans Friction Cone Co)....78
Evans Friction System. Illustrated....3
Executed by Electricity, To be....293

Faults in Insulated Conductors, A Method of Localizing Partial or Dead Earth, by H. Cuthbert Hall. Illustrated....56
Ferranti Alternating Generators at Deptford, England. Illustrated....41, 42
Ferranti Mains....280
Ferranti System, London, Progress of Work on the. Illustrated....197, 198
Filament-Flashing Apparatus Illustrated....288
Filaments in Incandescent Lamps, Welding Broken. Illustrated....249, 250
Filaments, Preventing Vibration in Incandescent Lamp. Illustrated....31
Filter, Combined Heater and. Illustrated (Stilwell & Bierce Manufacturing Co). Illustrated....280
Fire Alarm and Call Bell, Combination, (J. W. Day Hardware Manufacturing Co). Illustrated....274
Fire Alarm Patents, Litigation Over....307
Fire Alarm Apparatus, Patent Litigation over....255
Fishing by Electric Light....334
Fixture, New Incandescent Lamp. Illustrated....140
Fixtures, Pantechnetheca. Illustrated. (Central Electric Company)....264
Fort Wayne Electric Club....192
Fountain at Lincoln Park, Chicago....131, 132
Fountain at Lincoln Park, Chicago. Illustrated 217, 218
Fountain at Chicago, Electric....65
Franchises, Must Pay for....195
Frankfort Electrical Laboratory. Illustrated....21
Friction System, Evans. Illustrated....3, 78
Furnace, Gas Retort and Self-Feeding Smokeless, (Ritter & Burke). Illustrated....219
Fuse, The Whittingham Magazine. Illustrated....183
Fuse Block. Illustrated....31
Fuse Box, Ammeter and Voltmeter, National Detachable Safety. Illustrated....249

Gas and Electric Lighting....10
Gas Interests, Electric Light and....263
Gas Undertakings Supply Electricity? Shall, by Arthur F. Guy....60
Gatling Gun, Crocker-Wheeler Motor on a. Illustrated....276
Gear, Reckenzaun Motor Reversing. Illustrated....56
Gearing, Street Car Motor. Illustrated....319
Gearing for Electric Locomotives, Rope. Illustrated. 248
Gearing with Wooden Teeth, Electric Railway. Illustrated. (Chadbourne, Hazelton & Co)....57
Geological Inspections, The Electric Light in. Illustrated....183
Ghost, An Electric....198
Globe Holder for Arc Lamps. Illustrated....346
Governor for Constant Current Motors. Illustrated....319
Grand Central Passenger Station, Chicago, Electric Light Plant in the....323
Grease Cup, Powell's Electric Car. Illustrated....291
Greasing the Trolley Wire. Illustrated....262
Greene, S. Dana, Complimentary Dinner to....73
Guaranty Loan Building, Minneapolis, Minn., Electric Light Plant in the. Illustrated....261

Hale Electric Pump for Elevator Service. Illustrated....247
Hammond, Ind., Electric Railway at....307
Hanger, Lamp. Illustrated. (Forest City Electric Works)....93
Hanger, Luscomb's Trolley Wire. Illustrated....333
Headlight, Surgeon's. Illustrated. (River and Rail Electric Light Co)....127
Headlight, Electric. Illustrated....71
Heater, Electric Car. Illustrated. (C. B. Hanna)....305
Heater and Filter, Combined. Illustrated. (Stilwell & Bierce Manufacturing Co.)....280
Heating, Electric. Illustrated. (Carpenter-Nevens Electro-Heating Company)....54, 55, 66
Heisler Electric Light Company....323
Henry, Inductance and Its Proposed Unit, the, by A. E. Kennelly. Illustrated. (American Institute of Electrical Engineers)....347, 348, 349
High Tension Circuits, Maintenance of, by Alex. Dow....95, 96
Holmes (C. B.) and Electric Railways....204
Hyde Park, Chicago, Overhead Wires for....305
Hyde Park Electric Company, Chicago....235
Hydrocarbon Vapors in Arc Light Carbons Illustrated....68, 69

Incandescent Lamps, Classification of. (Address by Dr. Louis Bell and Discussion. National Electric Light Association)....108, 109
Incandescent Lamps, Manufacturing. Illustrated....304
Indianapolis Electric Railway Power House. Illustrated. (Thomson-Houston Co.)....4
Indianapolis and Joliet, Electric Railways at. Illustrated. (Thomson-Houston Electric Company). 186
Inductance and Its Proposed Unit, the Henry, by A. E Kennelly. Illustrated. (American Institute of Electrical Engineers)....347, 348, 349
Insulated Conductors, A Method of Localizing Partial or Dead Earth Faults in, by H. Cuthbert Hall. Illustrated....56
Insulated Wires, Manufacture of. Illustrated. (Okonite Company)....92, 93
Insulation, Liquid, by David Brooks. (National Electric Light Association)....105
Insulation for Underground Conductors, Liquid, by David Brooks....175
Insulator. Illustrated....127
Insulator, Bain. Illustrated....319
Insulator, Curve. (Great Western Electric Supply Co.) Illustrated....140
Insulator, Bain Break. Illustrated....342
Insurance and Electric Light Interests, Report of the Committee on Harmonizing and Discussion. (National Electric Light Association)....106, 107, 108
Insurance of Electric Risks, by S. E. Barton, and Discussion. (Associatiou of Edison Illuminating Comdanies.)....168, 169
Insurance Rules Affecting Electric Light and Power Installations, A Natioual Code of, by W. J. Jenks. (Association of Edison Illuminating Companies) 171
Inter State Exposition, Chicago, Ill., Electric Light at the....143
Inventing, Science and Art of. (Abstract of a lecture delivered by Edward Thompson)....334, 335
Iridium Filament, Incandescent Lamp with. Illustrated....59
Isolated Plant, Largest....30

Japan, Electric Lighting in....269
Joliet, Electric Railways at Indianapolis and. Illustrated. (Thomson Houston Electric Co.)....186
Julien Storage Battery System. (American Street Railway Association)....225

Kansas City, Alternating Plant of the Sperry Associate Electric Light Co. Illustrated....1
Kansas City, Mo., Electric Light Plant in the Midland Hotel. Illustrated....327
Kearney, Neb., Electric Power at....255
Kemmler, Execution of....91
Kemmler Again Sentenced....18
Kemmler's Terrible Death....83, 84
Kemmler, Decision Against....1, 2
Knoxville Street Railway Company, Power Station of the. Illustrated. (Thomson Houston Electric Co.)....72, 73
Key-board at Brooklyn, N. Y., The Operation of the Double Cord, by George J. Davison, and Discussion. (National Telephone Exchange Association)....154, 155, 157

Laboratory, London Board of Trade. Standardizing. 2
Laboratory, Portable, Illustrated....166
Lamp, Edison Arc. Illustrated....218
Lamp, Enholm Arc. Illustrated....304, 305
Lamp, Fischinger Differential Arc. Illustrated....167
Lamp, Miner's....331
Lamp, Pieper Arc. Illustrated....306
Lamp, Multi-carbon Arc. Illustrated....329, 330
Lamp, New Brush Arc Illustrated....255
Lamp, Russell Disk Carbon. Illustrated....44
Lamp, Triple Carbon. Illustrated....91, 92
Lamp Filaments, Preventing Vibration in Incandescent. Illustrated....31
Lamp for Miners, Electric. Illustrated....317
Lamp Fixture, New Incandescent. Illustrated....140
Lamp Hanger. Illustrated. (Forest City Electric Works)....93
Lamp Keys, Attachment for Incandescent. Illustrated....319
Lamp-Post, Columbian Street. Illustrated. (Western Electric Co.)....211
Lamp with Iridium Filament, Incandescent. Illustrated....59
Lamp with Renard Primary Batteries, Portable. Illustrated....263
Lamps, Classification of Incandescent, by Dr. Louis Bell and Discussion. (National Electric Light Association)....108, 109
Lamps, Double Carbon....140
Lamps, Experiments with a Ruhmkorff Coil and Incandescent. Illustrated....69
Lamps, Manufacturing Incandescent. Illustrated....304
Lamps, Welding Broken Filaments, of. Illustrated....249, 250
Lamps as Press Recorders, Electric....199
Lamps Made at the Edison Lamp Works, Some Special, by F. E. Jackson....169, 171
Legislation, Report of the Committee on. (National Electric Light Association)....109
Launches, Electric. Illustrated....219
Light of the Future, The Artificial, by Dr. Edward L. Nichols. Illustrated. (New York Electric Club)....291, 292, 293
Lighting Station as an Investment, The Central, by B. E. Sunny and Discussion. (Chicago Electric Club)....228, 229, 242
Lightning Arrester, Hot Wire. Illustrated. (Foree Bain)....78
Lightning Arrester, Percussion Cap. Illustrated....68
Lightning Arrester, Rice. Illustrated....288
Lightning Arrester, Wood's. Illustrated....321
Lightning Conductors....23, 24
Lightning Conductors from a Modern Point of View, by Prof. Oliver J. Lodge....12, 13
Lightning Flashes, Photographing. Illustrated....43
Lightning in a Central Station....200
Lightning Stroke, Two Cases of, by Prof. H. S Carhart....198
Liquid Insulation (Address by David Brooks, National Electric Light Association)....105
Livingston Mont. Electric Light Company, Dynamo Room of the. Illustrated....66
Locomotives, Electric Mining. Illustrated....77, 78
Locomotives, Rope Gearing for Electric. Illustrated 248
London, England, City and South London Railway in. Illustrated....289, 290, 307
London Board of Trade, Standardizing Laboratory of the....2
London Subway, Proposed....334
London Theater, Electric Lighting in a. Illustrated. 93
Louisville, Central Passenger Railway Company's Power House at. Illustrated....166
Luscomb's Trolley Wire Hanger. Illustrated....333
Lyceum Theater, Chicago, Alternating Incandescent System in the....167

Magnetism, Induced....48
Masonic Temple, Chicago, Electric Light Plant

in the..... 330
Mat for Electric Cars. Illustrated. (J. A. Hood).. 229
McGuire Street Railway Car Truck. Illustrated.... 204
McLaughlin Storage Battery. Illustrated..... 35
McVicker's Theater, Chicago, Electric Light Plant in the..... 127
Melting Points of Metals, Electrical Apparatus for Determining the. Illustrated..... 288, 289
Metallic Circuits in Chicago, Complete..... 137
Meter, A New Standard Edison Electrolytic, by A. E. Kennelly and R. S. White..... 168
Meter, Blathy Alternating Current. Illustrated..19, 20
Meter, Brillie Continuous Current. Illustrated..... 59
Meter, Reckenzaun's Improved. Illustrated..... 211
Meter, Sir William Thomson's New Electricity. Illustrated..... 237
Meter, Wood Illustrated..... 329
Mica, Duty on..... 175
Midland Hotel, Kansas City, Mo., Electric Light Plant in the. Illustrated..... 327
Milliken Poles Used for Electric Railways. Illustrated..... 262
Milwaukee's Electric Roads..... 78
Mine, Electric Tramway in a. Illustrated..... ..90, 91
Mine, Electricity in a Silver..... .....241, 242
Mines and the Proposed Mining and Electrical Display at the World's Fair, Electricity in, by E. F. Browne, and Discussion. Illustrated. (Chicago Electric Club)..... ...309, 310, 322, 323
Miners, Electric Lamp for. Illustrated..... 317
Miner's Lamp..... 331
Mining, Cheap Electric Power in 31
Mining, Electricity in, by Frank C. Loring..... 318
Mining Locomotives, Electric. Illustrated 77, 78
Mining Work, Alternating Current Motors for. Illustrated..... 65
Mining Work Electricity in..... ..242, 243
Minneapolis, Water Power at..... 340
Minneapolis, Edison Light and Power Company's Plant at. Illustrated..... 150
Minneapolis, Minn., Electric Light Plant in the Guaranty Loan Building. Illustrated..... 261
Minneapolis, Electric Light Plant in the Pillsbury Mills. Illustrated..... 315
Minneapolis and St. Paul, Electric Railways in. With Map Showing Projected Routes.....205, 206
Minneapolis Exposition.....77, 165, 166
Minneapolis Exposition, Electric Welding at the. Illustrated..... 209
Minneapolis Exposition, Tower of Light at the. Illustrated..... 151
Miscellaneous Notes..... .....40 52, 63, 76, 87, 101, 102, 147, 177, 178, 190, 201, 232, ...260, 271, 272, 302, 325, 326, 337, 338
Motor, Adaptability of the Electric..... 33
Motor, An Electric Street Railway, by John W. McNamara, and Discussion. (New York State Street Railway Association.).....172, 173, 174
Motor, Corn-Cutter Operated by an Electric. Illustrated..... 181
Motor, New Constant Current. Illustrated 235, 236
Motor, Perret Low Speed. (Elektron Mfg. Co) Illustrated..... 45
Motor, River and Rail. Illustrated..... 35
Motor, The Electric. (Notes.).....15, 27, 28, 39, 51, 63, 75, 87, 101, 134, 135, 147, 177, 189, 190, 201, 215, 231, 232, 245, 259, 260, 271, ...285, 302, 313, 325, 337, 352
Motor, The Electric, by James A. Wotton 48
Motor, Thomson's Constant Current. (Communication from Prof. H. S. Carhart). 263, 264
Motor, United Electric Traction Company's Street Car. Illustrated..... 182
Motor, Westinghouse Electric Railway. Illustrated.....203, 204
Motor and Coil Electrical Outfit, Toy. Illustrated (The E. S. Greeley & Co.)..... 304
Motor Gearing, Street Car. Illustrated..... 319
Motor in Chicago, The Electric 54, 55
Motor on a Gatling Gun, Crocker-Wheeler. Illustrated 276
Motor Rates, A Proper Basis for Determining Electric, by H. L. Lufkin, and Discussion. (National Electric Light Association).....115, ...116, 117, 118, 119, 120
Motor Reversing Gear, Reckenzaun. Illustrated.... 56
Motors, Governor for Constant Current. Illustrated. 319
Motors, Operating Chicago's Bridges by..... 219
Motors, Starting Coil for Constant Potential. Illustrated..... 342
Motors at Cape May, Crocker-Wheeler. Illustrated. 187
Motors for Mining Work, Alternating Current. Illustrated 65
Multipolar Dynamos and Motor for Continuous Currents, Low Speed, by Frank A. Perret. Illus. 295, 296
Municipal Control of Electric Plants.....305, 306
Municipal Lighting, by M. J. Francisco, and Discussion. (National Electric Light Association)..110, ...111, 113, 121
Musical Sounds by Electricity, Producing. Illustrated.....139, 140
Muskegon Electric Railway. Illustrated..... 193
Municipal Lighting in Chicago.....233, 234
Museum Train by Electricity, Lighting a.....290, 291

Nashville Electric Club..... 53
National Detachable Safety Fuse Box, Ammeter and Voltmeter. Illustrated..... 249
National Electric Light Association. .....53 .....68, 97, 131, 141, 261, 277, 327
National Electric Light Association. Report of the Proceedings of the Eleventh Convention at Cape May, N. J.
Members and Visitors..... 103
The President's Address.....103, 104
Electrical Industries and the World's Fair. By J. P. Barrett, and Discussion 104, 105
The Copper Tariff..... 105
Liquid Insulation 105
Dangers of Electricity. By Prof. Henry Morton, and Discussion.....105, 106
Report of Committeee on Harmonizing Insurance and Electric Light Interests, and Discussion 106, 107, 108
Classification of Incandescent Lamps. By Dr. Louis Bell, and Discussion.....108, 109
Report of Committee on Legislation..... 109
Address by George S. Bowen.....109, 110
Census Bill..... 110
Municipal Lighting. By M. J. Francisco, and Discussion..... .....110, 111, 113, 121
Editorial 112
Reports of the Committee on Resolutions.... 113
Value of Details in Electric Light Stations. Address by A. J. DeCamp, and Discussion. 113, 114, 115
The Proper Basis for Determining Electric Motor Rates. By H. L. Lufkin, and Discussion. Illustrated.....115, 116, 117
Standards of Economy in the Generation of Power, By H. H. Swetland, and Discussion..... 120
Proposed Constitution, and Discussion....120, 121
Report of Secretary and Treasurer... 121
Action on the Death of Miles W. Goodyear and C. McIntire..... 121
Report of Finance Committee.....121, 122
Report of Committee on Underground Conduits and Conductors..... 122
Report of the Committee on the Relation between Manufacturing and Central Station Companies 122
Election of Executive Committee..... 122
Exhibits and Convention Notes.....122, 123
National Electric Manufacturing Company's Transformer. Illustrated 306
National Telephone Exchange Association at Detroit, Convention of the..... 137
National Telephone Exchange Association... ....53. 131
National Telephone Exchange Association. Report of the Twelfth Convention.
Members and Visitors..... 153
Group of Attendants at the Convention..... 153
Secretary's Report..... 153
Treasurer's Report..... 153
President's Address..... 154
Election of Officers..... 154
The Operation of the Double Cord Key Board at Brooklyn, N. Y , by Geo. J. Davison, and Discussion 154, 155, 157
Corporate Organization, by Edward J. Hall, Jr., and Discussion. Illustrated...157, 158 159
Place of Meeting..... 159
The Housing and Care of Central Office Apparatus, by William A Patterson, and Discussion.....159, 160, 161
Some General Remarks on Telephone Exchange Construction and Equipment, by F. A. Pickernell, and Discussion.....160, 161
Bridging Bells, by John J. Carty, and Discussion. Illustrated.....161, 162, 163
Operating Transmitters by Edison Current.... 163
Convention Notes.... 163
The Drive about Detroit..... 163
The Banquet..... 163
The Steamer Ride..... 163
Nationalism, First Steps Toward, by Edward Bellamy..... 199
Nationalism in Chicago, Alleged 144, 145
Natural Bridge, to be lighted by Electricity..... 194
Navigation, Submarine..... 129
Navy, Electricity in the..... 198
Navy, Electricity in the. (Discussion of the Paper by Gilbert Wilkes, by Members of the American Institute of Electrical Engineers)..... 24
Net, New Pelagian. Illustrated..... 19
Newark High School, Electrical Exhibit at the. Illustrated 44
New Orleans, Overhead Wires in..... 311
New York, Electric Wires in Paris, and 316
New York Electric Club.....141, 291, 292, 293
New York Electrical Society.....240, 241, 334, 335
New York State Street Railway Association..... 143
New York State Street Railway Association Report of Eighth Annual Convention.
President's Address 172
The Electric Street Railway Motor, by John W. McNamara, and Discussion..172, 173, 174
Election of Officers..... ... 174
New Zealand, Telegraph in..... 193
Niagara, To Utilize the Power of..... 195
Northwest Chicago Electric Street Railway Company, ... 181

Ohio State Tramway Association—Report of the Columbus Convention..... 297, 298, 299
Oil Purifier. Illustrated. (Illinois Electric Material Co.)..... 96
Okonite Wires, Method of Making Insulated. Illustrated.....92, 93
Omnibus, Electrical..... 36
Osteotome, An Electric. Illustrated..... 195
Oven, The Talmage Electric. Illustrated..... 342
Overhead Electric Railway Construction in Indianapolis. Illustrated. (Thomson-Houston Company)..... 205

Pantechnetheca Fixture. Illustrated. (Markle Engineering Co.)..... 264
Paris and New York, Electric Wires in..... 316
Paris Underground Metropolitan Railway System. Illustrated..... 343
Patent Department..... 79
Patent Litigation..... 83
Patents, Electrical. (Issued in the United States)... 16, 28, 40, 52, 64, 76, 88, 102, 135, 136, 148, 164, 178, 190, 202, 216, 232, 246, 260, 272, 286, ...313, 314, 326, 338, 352
Pattee Lamp-hour Recorder. Illustrated. (Great Western Electric Supply Co.)..... 3
Pendent, The Bush. Illustrated..... 342
Pennsylvania Road, Electric Light Car on the. Illustrated 131
Percussion Cap Lightning Arrester. Illustrated..... 68
Perret Low Speed Electric Motors. Illustrated. (Elektron Mfg. Co.) 45
Photography, Electric Light and. 331
Phonograph Record, A Valuable..... 60
Photographing the Electric Spark. Illustrated..... 95
Physicians, Electrical Apparatus for. (Law Telephone Co.) Illustrated. 143
Pillsbury Mills, Minneapolis, Electric Light Plant in the. Illustrated..... 315
Pioneer Press Building, St. Paul, Minn., Electric Light Plant in the. Illustrated..... 53
Pittsburg Exposition, Electrical Display at the..... 186
Pittsburg Exposition, Westinghouse Exhibit at the. Illustrated..... 180
Poles and Wires, Electric 203
Poles for Electric Railways, Milliken. Illustrated... 262
Poles for Electric Railways, Wood or Metal.....96, 97
Poles, in Rochester, N. Y..... 191
Poles for Overhead Electric Railway Work, Latticed Iron. Illustrated. (Electric Merchandise Co.).. 32
Pole-Top, New Design of. Illustrated. (Great Western Electric Supply Co.)..... 55
Polyphone Illustrated..... ..43, 44
Portable and Bracket, Bassett Combination. Illustrated. (Electrical Supply Co.)..... 319
Power at Red Cliff, Colo., Electric Transmission of. (Hawkeye Electric Manufacturing Co) Illustrated 274, 275
Power, Standards of Economy in the Generation of, by H. H. Swetland and Discussion. (National Electric Light Association)..... 120
Power House, Indianapolis Electric Railway. Illustrated. (Thomson-Houston Co.)..... 14
Power Transmission, Devold, by Gustave Monrath. Illustrated..... 207
Power without Belting. Illustrated..... 18
Printing Telegraph Receiver, Electric Winding Mechanism for. Illustrated..... 31
Probe, Electric. Illustrated 20
Projectiles, Electric Welding Applied to the Manufacture of, by Lieut. W. M. Wood..... 241
Projector, German Dynamo and New. Illustrated... 47
Pulley, Arc Lamp. Illustrated. (Great Western Electric Supply Co.)..... 23
Pulley with Variable Diameter. Illustrated..... 330
Pullman Palace Car Company..... 229
Pump, Triplex Electric. (Goulds Manufacturing Co.) Illustrated..... ... 71
Pump for Elevator Service, Hale Electric. Illustrated..... 247
Push Button, Dining Room. (Great Western Electric Supply Co.) Illustrated..... 195

Quotations, Chicago Board of Trade 327

Rae Electric Railway System.....339, 340, 341
Rail Bond, Copper. Illustrated. (Great Western Electric Supply Co.)..... 79
Railroad Service, Electric Lighting in, by M. B. Leonard..... 24, 25, 26
Railroads by Electricity, Working, by Willis E. Hall.....48, 49
Railroads for the Holmes Syndicate, More Electric... 140
Railroad Tracks, Apparatus for Detecting Irregularities in. Illustrated.....67, 68
Railways, The Electric 209, 210, 211
Railway Bonds, Electric..... 43
Railway Companies, Telephone and Electric.....204, 205
Railway Equipment, Future Improvements in....247, 248
Railway Motor, An Electric, by John W. McNamara, and Discussion. (New York State Street Railway Association)..... ...172, 173, 174
Railway Telegraph Superintendents, Association of the..... 12
Railway Travel, Speed in..... 321
Railway Power House, Indianapolis Electric. (Thomson-Houston Co.) Illustrated..... 4
Railway Switch, Overhead Electric. Illustrated. (Electric Material Co.)..... 69
Railway Work, Latticed Iron Poles for Overhead. Illustrated. (Electric Merchandise Co.)..... 32
Railways, C. B. Holmes and Electric 204
Railways, Contact Device for Electric. Illustrated.. 67
Railways, Electric, by Theo. P. Bailey, and Discussion. (Chicago Electric Club). 280, 281, 299, 300, 301
Railways for South America, Electric..... 277
Reckenzaun's Improved Meter. Illustrated..... 211
Recorder, Pattee Lamp-Hour. Illustrated. (Great Western Electric Supply Co.)..... 3
Red Cliff, Colo., Electric Transmission of Power at. Illustrated. (Hawkeye Electric Mfg. Co.). 274, 275
Registration by Telephone..... 317
Regulating a Constant Current Dynamo, Novel Method of. Illustrated..... 182, 183
Regulator, Potential. Illustrated.....47, 48
Regulator for Dynamos and Motors. Illustrated.... 331
Relay, Edison's Carbon. Illustrated.....128, 129
Renard Primary Batteries, Portable Lamp with. Illustrated 263
Resistances, Accurate Measurement of..... 48
Reynier Elastic Accumulator. Illustrated..... 331
River and Rail Storage Battery. Illustrated..... 35
River and Rail Electric Light Company. Illustrated 126, 127

Rheostat, (Who is the Inventor?) Illustrated..... 42
Rheostat, Water. Illustrated..... 333
Rice Lightning Arrester. Illustrated..... 288
Riding School, An Electric. Illustrated..... 80
Road, Constructing an Electric. Illustrated..... 165
Rochester, N. Y., Electric Railway at. Illustrated.. 328
Rochester, N. Y., Electric Poles in..... 91
Rope Gearing for Electric Locomotives. Illustrated. 248
Rope Transmission. Illustrated. (Link Belt Machinery Co.)..... 81
Ruhmkorff Coil and Incandescent Lamps, Experiments with. Illustrated..... 69

Safety Precautions in Arc Stations.....41, 42
Schoop Accumulator, The Improved. Illustrated. 151, 152
Schoop Storage Batteries..... 60
Secondary Batteries, Comparison of two European, by Dr. Paul Schoop. Illustrated.....32, 33
Self-Induction, Unit of..... 323
Sewage, Electric Treatment of, by W. Webster..346, 347
Shade, Combination Cone. Illustrated. (Great Western Electric Supply Co.)..... 83
Shade Holder. Illustrated..... 342
Shaw Electric Crane Illustrated..... 2
Sheet Metal, Electricity in Shaping. Illustrated.... 219
Short Electric Railway System. (American Street Railway Association)..... 225
Signal, Low Water. Illustrated..... 55
Signal, United States Automatic Block. Illustrated.. 265
Signaling by Electric Light from a Balloon. Illustrated..... 129
Sioux City Electric Company, Dynamo Room of the. Illustrated..... 179
Slate Quarries in the United States..... 124
Smoke Nuisance in Chicago..... 65
Snow Plow and Snow Sweeper, New Thomson-Houston. Illustrated..... 185
South America, Electric Railways for 277
South Chicago Cable or Electric Cars for..... 248
South End Electric Railway Company, Chicago..218, 261
South Side Electric Light Company, Chicago..... 141
Sperry Associate Electric Light Company, Kansas City, Alternating Plant of the. Illustrated..... 1
Spokane Falls Electrical Society.....55, 56
Sprague, William, Death of..... 212
Springfield, Ill., Street Railway War at 78
St. Louis, Union Depot Street Railway at. Illustrated.....125, 126
St. Louis Electrical Exposition..... 128
St. Louis Exposition, Electrical Exhibitors at the.... 85
St. Louis Electric Railways..... 91
St. Louis River, To Utilize the Power of the..... 323
St. Paul, Minn., Edison Electric Light and Power Company. Illustrated..... 17
St. Paul, Minn., Electric Light Plant in the *Pioneer-Press* Building. Illustrated..... 53
St. Paul, Electric Railways in Minneapolis and. With Map Showing Projected Routes.....205, 206
St. Paul, Minn., Gas Light Company's Electric Light Plant. Illustrated.....233, 234
St. Paul Telephone Exchange, Improvements in the.. 13
Stand for Dynamos, Adjustable Illustrated..... 152
Stanley Alternate Current Arc Dynamo, Investigation of the, by W. B. Tobey and G. H. Walbridge. Illustrated.....254, 255
Stanley Arc Light Alternating Current Machine, A New Method of Analyzing the Magnetic Reactions of Armatures Applied to the, by Thorburn Reid. Illustrated. (American Institute of Electrical Engineers).....256, 257, 258
Starting Coil for Constant Potential Motor. Illustrated..... 342
Steam Heaters, Danger from.....31, 32
Stock Certificates, Duplicate..... 19
Storage Battery Car, The Edco, by D. H Bates. (American Street Railway Association).....222, 223
Storage Battery Car at Dubuque, Ia..... 209
Storage Battery Car in Chicago..... 289
Storage Battery Cars for Chicago..... 236
Storage Battery Electric Light Plant, Chelsea 293
Storage Battery in the Chicago Telephone Exchange. Illustrated..... 138
Storage Battery in Traction Work, by J. K. Pumpelly. (Chicago Electric Club) Illustrated.... 5
Storage Battery Rack for Electric Railways. Illustrated..... 71
Storage Battery Station, The Chelsea.....4, 5
Storage Battery Street Car Systems. Two. Illustrations..... 35
Storage Battery Traction, by William Bracken..... 212
Storage Battery Traction..... 349
Storage Batteries with Gelatinous Electrolyte, Schoop 311
Street Car Construction, Improvement in..... 212
Street Car Systems, Two Storage Battery. Illustrated..... 35
Subway, Proposed London..... 334
Sun Electric Light, Chicago, Purchased..... 237
Switch, Double Break Single Pole. Illustrated. (Star Electrix Co.)..... 237
Switch, Self-Acting. Illustrated. (Detroit Electrical Works)..... 18
Switch, Snap. Illustrated. (Knapp Electrical Works). 91
Switch, Single Pole. (Star Electrix Co.) Illustrated. 250
Switch, Stevens Positive Gravity. Illustrated. (Electric Merchandise Co.)..... 204
Switch for Incandescent Circuits. Illustrated. (Illinois Electric Material Co.) 96
Switch-board, Union Depot Street Railway Company's. Illustrated..... 126
Switch-board at the Detroit Telephone Exchange. Illustrated..... 137
Switch-board Connections, Union Stock Yards Telephone. Illustrated..... 138
Switch for Overhead Electric Railway. Illustrated. (Electric Material Co.) 69
Switch-board for Telephone Exchanges, Glass. Illus. 234
Switzerland, Electric Work in..... 41

Target Board at the Chicago Telephone Exchange, The New. Illustrated..... 287
Telegraph, The (Notes).....28, 40, 51, 63, 88, 101, 135, 147, 190, 201, 245, 271, ...285, 325
Telegraph, Government and the..... 229
Telegraph and Cable Lines..... 14
Telegraph Bill, Postal..... 49
Telegraph History, Interesting..... 199
Telegraph in New Zealand..... 193
Telegraph in South Africa, The 198
Telegraph Operators, Collapse of the Brotherhood of. 253
Telegraph Operators in the Mackay System Quit Work..... .....187, 188
Telegraph Operators, Meeting of Chicago..... 191
Telegraph Receiver, Electric Winding Mechanism for. Illustrated..... 31
Telegraph Scheme, Opposed to the Postal 319
Telegraph Statistics..... 280
Telegraph System, Government..... 306
Telegraphers, Reunion of..... 128
Telegraphers, Reunion of the United States Military Telegraph Corps and Old Time. Tenth Annual Convention.....174, 175
Telegraphers, Set-Back for the.....236, 237
Telegraphy and the Central Strike, Municipal..... 132
Telegraphy, Submarine—Abstract of a Lecture by Herbert Laws Webb.....279, 280
Telephone, The (Notes) 51, 89, 135, 147, 177, 245, ...285, 337
Telephone, Ader. Illustrated..... 139
Telephone, Bergmann's Thermal. Illustrated..... 262
Telephone, D'Unger. Illustrated..... 194
Telephone, Novel Use of the..... 185
Telephone, Registration by..... 317
Telephone, Use of the (Abstract of a lecture by John J. Carty) 307
Telephone and Telegraph Construction Company of Detroit. Illustrated..... 137
Telephone at Christ Church, Birmingham, England.. 195
Telephone and Electric Railway Companies.....204, 205
Telephone Company at Chicago, New..... 126
Telephone Company, Chicago, The Subscribers'..212, 213
Telephone Company in Chicago, A New..... 175
Telephone Convention..... 131
Telephone Exchange, Burnap Automatic..... 341
Telephoning between London and Paris..... 192
Telephone Exchange Construction and Equipment, Some General Remarks on, by F. A. Pickernell and Discussion. (National Telephone Exchange Association).....160, 161
Telephone Exchange, Improvements in the St. Paul. 13
Telephone Exchange, New Target Board at the Chicago. Illustrated..... 287
Telephone Exchange, Storage Battery in the Chicago. Illustrated..... 138
Telephone Exchanges, Glass Switch-Board for. Illustrated..... 234
Telephone Exchanges, Labor-Saving Outfit for Chief Operators in. Illustrated..... 166
Telephone Rates in Chicago..... 188
Telephone Rates in Washington..... 205
Telephone Service, Chicago.....179, 180
Telephone Switch-Board Connections, Union Stock Yards. Illustrated..... 138
Telephone System Paris..... 310
Telephone Systems, Signal Bell Electro-Magnet for Bridged Circuit. Illustrated..... 194
Telephone Transmitter, Closed Magnetic Circuit Induction Coil in a. Illustrated..... 139
Telephone Work in Europe. (Interview with M. G. Kellogg).....303, 304
Telephoning to Ships at Anchor..... 141
Telephony and Insanity..... 138
Telpher Line at Edinburgh. Illustrated..... 181
Temperature Compensator for Electrical Measuring Instruments, Weston's. Illustrated..... 274
Tesla Alternating Current Motor for Mining Work. Illustrated..... 65
Theater, Electric Lighting in a London. Illustrated.. 93
Thermo-Chemistry in Relation to Electromotive Force, by Prof. J. E. Siebel. (Chicago Electric Club) 9, 10
Thomson-Houston Electric Company's Statistics. 212
Thomson-Houston Electric Railway System.....225, 226
Thomson-Houston Electric Railway Work..... 230
Thomson-Houston Overhead Electric Railway Construction in Indianapolis. Illustrated..... 205
Thomson-Houston Road in Europe, First..... 140
Top, Electric. Illustrated..... 128
Tower of Light at the Minneapolis Exposition. Illustrated..... 151
Traction in the United States from an English Standpoint, Electric..... 209
Train, Oliver Wendell Holmes and the Electric..... 73
Tramway in a Coal Mine, Electric. Illustrated...90, 91
Transformer, Efficiency of the, by Calvin Humphrey and William H. Powell. Illustrated. (American Institute of Electrical Engineers).....7, 8, 9
Transformer, National Electric Manufacturing Company's. Illustrated 249, 306
Transformer, Protect the Consumer? Does Earthing the Secondary Circuit of a, by Sydney F. Walker 35, 36
Transformer, the Hedgehog, by J. Swinburne. Illustrated..... 144
Transmitters by Edison Current, Operating. (National Telephone Exchange Association). 163
Tripp Electric Car Truck. Illustrated..... 205
Trolley Devices, Improvement in. Illustrated..... 81
Trolley Wheel. Illustrated..... 328
Trolley Wire, Greasing the. Illustrated..... 262
Trolley Wire Hanger, Luscomb's. Illustrated..... 333
Truck, McGuire Street Car. Illustrated..... 204
Truck, Tripp Electric Car. Illustrated..... 205

Tubes by Electro Deposition, Process of Making Metallic. Illustrated 328, 329
Turbine Water Wheel. Illustrated..... 211

Underground Conduits and Conductors, Report of the Committee on. (National Electric Light Association)..... 122
Underground Electric Light Company, Chicago..... 53
Underground Electric Work, by David Brooks...321, 322
Underground Electrical Work, by F. E Degenhardt, and Discussion. Illustrated. (Chicago Electric Club).....251, 267, 268, 269
Underground Electrical Work. Communication from F. E. Degenhardt 306, 307
Underground Metropolitan Railway System, Paris. Illustrated 343
Underground Wires, by Herbert Laws Webb..... 295
Underwriters, Electricity in the Service of the Chicago Fire. Illustrated..... 192
Undulations, Apparatus for Experiments with Electric. Illustrated..... 47
Union Depot Street Railway at St. Louis. Illustrated 125, 126
United Electric Traction Company's Street Car Motor. Illustrated..... 182
Union Pacific Railroad, Electricity in the Cheyenne Shops of the. Illustrated..... 279
Union Stock Yards Telephone Switch-board Connections. Illustrated..... 138
Unit, the Henry, Inductance and Its Proposed, by A. E. Kennelly. Illustrated..... .....347, 348, 349
United States Automatic Block Signal. Illustrated.. 265
United States Military Telegraph Corps and Old Time Telegraphers Society, Reunion of the..174, 175
Units, American Names for Electrical..... 20

Vienna Palace, Electric Lights in a. 341
Volta's Poverty..... 329
Voltmeter, The National Detachable Safety Fuse Box, Ammeter and. Illustrated. 249
Voltmeters, The Compensation of Alternating Current, by J. Swinburne..... 199

Wade, Death of Jephtha H., with Portrait..... 83
War, The Civilian Electrician in Modern—Abstract of a Lecture by Lieut. Bradley A. Fiske. (New York Electrical Society). 240, 241
Warships, Electricity on..... 273
Water Rheostat. Illustrated..... 333
Weems Rapid Transit System. 30
Welding, A Wrinkle in Pipe. Illustrated.....60, 236
Welding, Wrinkle in. Illustrated..... 236
Welding Applied to the Manufacture of Projectiles, Electric, by Lieut. W. M. Wood..... 241
Welding at the Minneapolis Exposition. Illustrated. 209
Welding Broken Filaments of Incandescent Lamps. Illustrated.....249, 250
Welding Dynamo. Illustrated..... 56
Welding in a Carriage Factory. Illustrated.....29, 30
Welding Under Water, Electric, Illustrated..... .. 195
Wenstrom Electric Railway System. (American Street Railway Association).....222, 223
Western Electric Company's Factory, Chicago, Assembling Room in the. Illustrated..... 303
Western Electric Company, Double Carbon Lamp Suit Against the. (Decision of Judge Brown in favor of the Brush Co.).....97, 98
Western Engineering Society, Chicago..... 262
Western Union Company's New York Building Burned 42
Western Union Fire..... 57
Western Union Poles Chopped Down..... 181
Weston's Standard Battery. Illustrated..... 264
Weston's Temperature Compensator for Electrical Measuring Instruments. Illustrated..... 274
Westinghouse Electric Company..... ..36, 37
Westinghouse Electric Railway at Greensburg, Pa. Illustrated. 236
Westinghouse Electric Railway Motor. Illustrated.....203, 204
Westinghouse Exhibit at the Pittsburg Exposition. Illustrated..... 180
Wheless Electric Railway System. (American Street Railway Association)..... ...223, 225
Whittingham Magazine Fuse. Illustrated..... 183
Who is the Inventor? Illustrated.....42, 71, 72
Winding for Constant Potential, Compound, by Dr. Louis Bell. Illustrated. (American Institute of Electrical Engineers).....296, 297
Winding Machine, Electro-Magnet. Illustrated.... 194
Windmill Electric Light Plant of Charles F. Brush. Illustrated..... 345
Window Cleaners by Electricity, Operating..... 79
Wire, Charged with Stealing..... 167
Wire Tappers in the Toils, Alleged..... 340
Wires, Method of Making Insulated. Illustrated. (Okonite Co.).....92, 93
Wisconsin Electric Club..... ....263, 289, 315, 327
Wood Meter. Illustrated..... 329
Wood's Lightning Arrester. Illustrated..... 321
World's Columbian Exposition, Electrical Section of the. Illustrated 89, 90
World's Fair, Columbian Belvedere at the. Illustrated 273
World's Fair, Col. Clowry and the..... 149
World's Fair, Electrical Committee of the..... 183
World's Fair, Electrical Department, by Exposition. 333, 334
World's Fair, Electrical Department of the..218, 234. 334
World's Fair, Electrical Industries and the, by J. P. Barrett and Discussion. (National Electric Light Association).....104, 105
World's Fair, Electricity and the..... 193
World's Fair, Electricity in Mines and the Proposed Mining and Electrical Display at the, by E. F. Browne and Discussion. Illustrated. (Chicago Electric Club).....309, 310, 322, 323

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, JULY 5, 1890. No. 1.

ALUMINUM BRASS AND BRONZE COMPANY,

MANUFACTURERS OF

COWLES' ALUMINUM AND SILICON COPPER ALLOYS,

IN INGOTS, SHEETS, RODS, WIRE AND CASTINGS.

Sheet Copper, Sheet Brass, PURE ALUMINUM.

STEWART BUILDING, 53 Chambers St., New York. ROLLING MILLS, Bridgeport, Conn.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

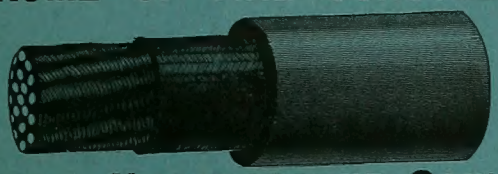
SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { BAKER, BALCH & CO., Seattle, Wash. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufactures can be found at our Agencies.

THE ACME OF FINE CONSTRUCTION.

OUR WIRES  OUR CABLES

STANDARD UNDERGROUND CABLE CO.,

Westinghouse Building, PITTSBURGH, PA.

G. L. WILEY, Manager, New York. F. E. DEGENHARDT, Manager, Chicago.

MAGNOLIA METAL.

—INDORSED BY THE—

United States and German Governments.

BEST ANTI-FRICTION METAL

For Dynamo, High-Speed Engine, Steamship, Car, and all Machinery Bearings.

MAGNOLIA ANTI-FRICTION METAL CO.,

Owners and Sole Manufacturers,

London Office: 75 Queen Victoria St. Chicago Office: 41 Traders' Building. 74 CORTLANDT ST., NEW YORK.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

DAY'S KERITE INSULATION.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling. Aerial Use, All Sizes Subterranean Use, Submarine Use *Lead Encased Wires.* Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., NEW YORK.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. For Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff St., New York. 133 and 135 Wabash Ave., Chicago, Ill. FACTORIES: ANSONIA, CON

THE EDISON MACHINE WORKS,

MANUFACTURERS OF

Weatherproof Wire. Insulated Iron Wire. Magnet Wire. Rubber Covered House Wire.
Annunciator Wire. German Silver Wire. Office Wire. Flexible Brush Holder Cable.
Gas Fixture Wire. Arc Lamp Cords. Tinsel Cords. Flexible Cords.
Telephone, Telegraph and Electric Light Cables.
PARAGON TAPE.

JAMES F. KELLY, General Sales Agent, - 19 Dey Street, NEW YORK.

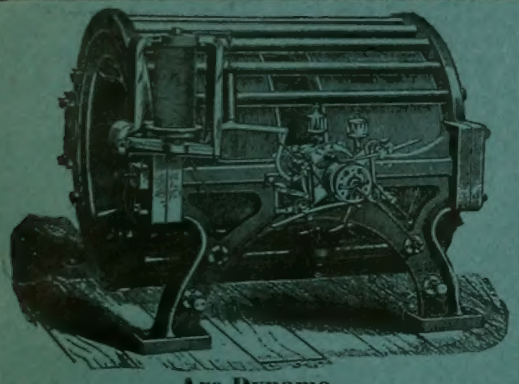
WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

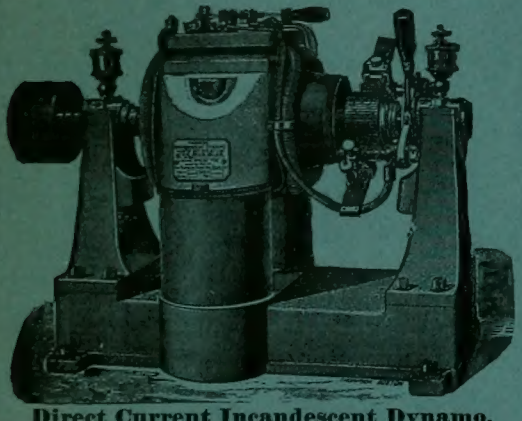
620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
234 Montgomery St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.



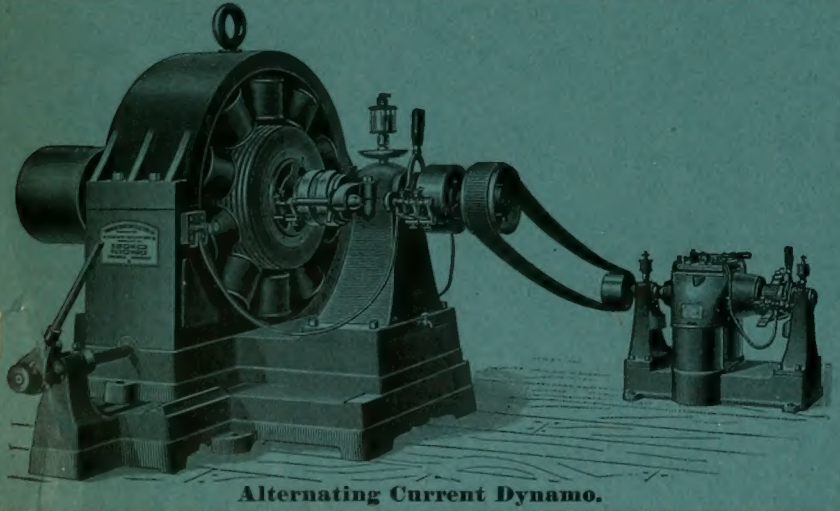
Arc Dynamo.

No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent, are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.



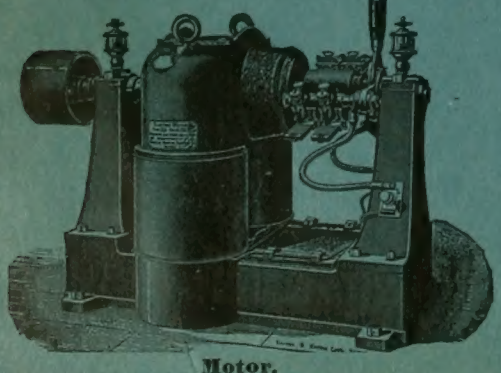
Direct Current Incandescent Dynamo.

Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.



Alternating Current Dynamo.

The problem of long distance incandescent lighting is practically solved by the alternating current dynamo, and to meet the demand for a machine of this character we have constructed what is unquestionably the most perfect alternater offered the public today, embracing as it does, all the features that combine to make a perfect dynamo—automatic regulation, perfect mechanical construction, highest efficiency, and economy of operation.



Motor.

The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

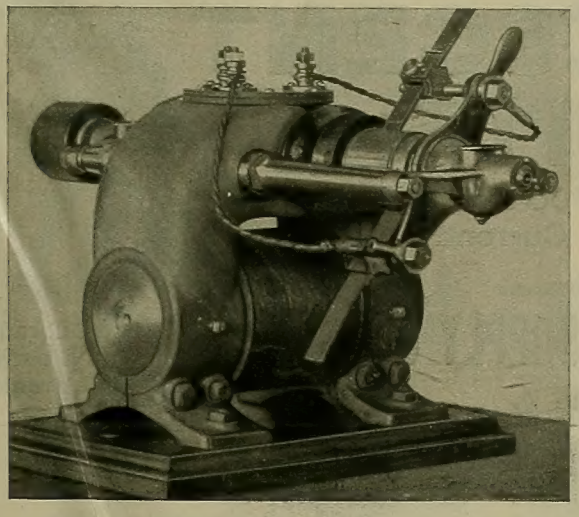
LIGHTNING ARRESTER.—All of our installations are protected from destruction and injury by our lightning arrester, which we will fully guarantee to operate successfully in every instance. The Company guarantees to repair or replace apparatus injured by lightning where these arresters fail to operate.

JENNEY

ELECTRIC **MOTOR** COMPANY,

OFFICE:

222 S. ILLINOIS ST., INDIANAPOLIS, IND.



WHAT IS THE **Matter** WITH THIS?

AUTOMATIC,
BEAUTIFUL,
CHEAP,
DURABLE,
EFFICIENT.

EVERY MOTOR GUARANTEED.

Send for Catalogue.

THE MITCHELL VANCE CO.,

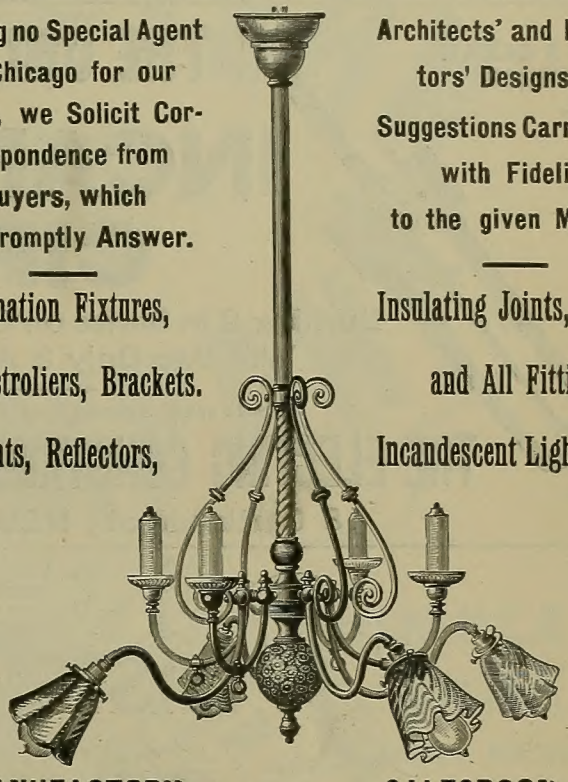
(Successors to MITCHELL, VANCE & CO.)

DESIGNERS AND MAKERS OF

ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.



Combination Fixtures,
Electroliers, Brackets.
Pendants, Reflectors,

Insulating Joints,
and All Fittings for
Incandescent Lighting.

MANUFACTORY,
24 and 25th St. and 10th Ave.,

SALESROOM,
836-38 Broadway and 13th St.,

NEW YORK CITY.

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

To Arc and Incandescent

POWER COMPANIES.

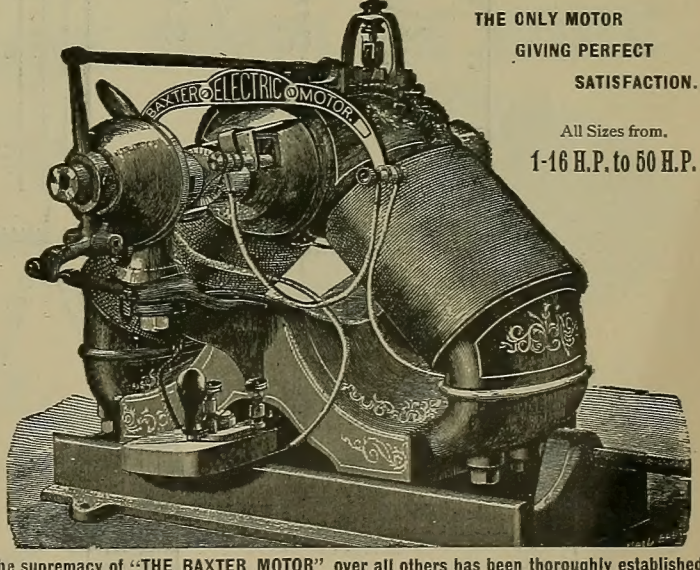
THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.



The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

P. MINTURN SMITH, Pres't. WILLIAM D. PERRY, Vice Pres't. JAMES W. EASTON, Elect'n. S. N. ROBINSON, Secretary. CHARLES TREMAINE, Treas'r.

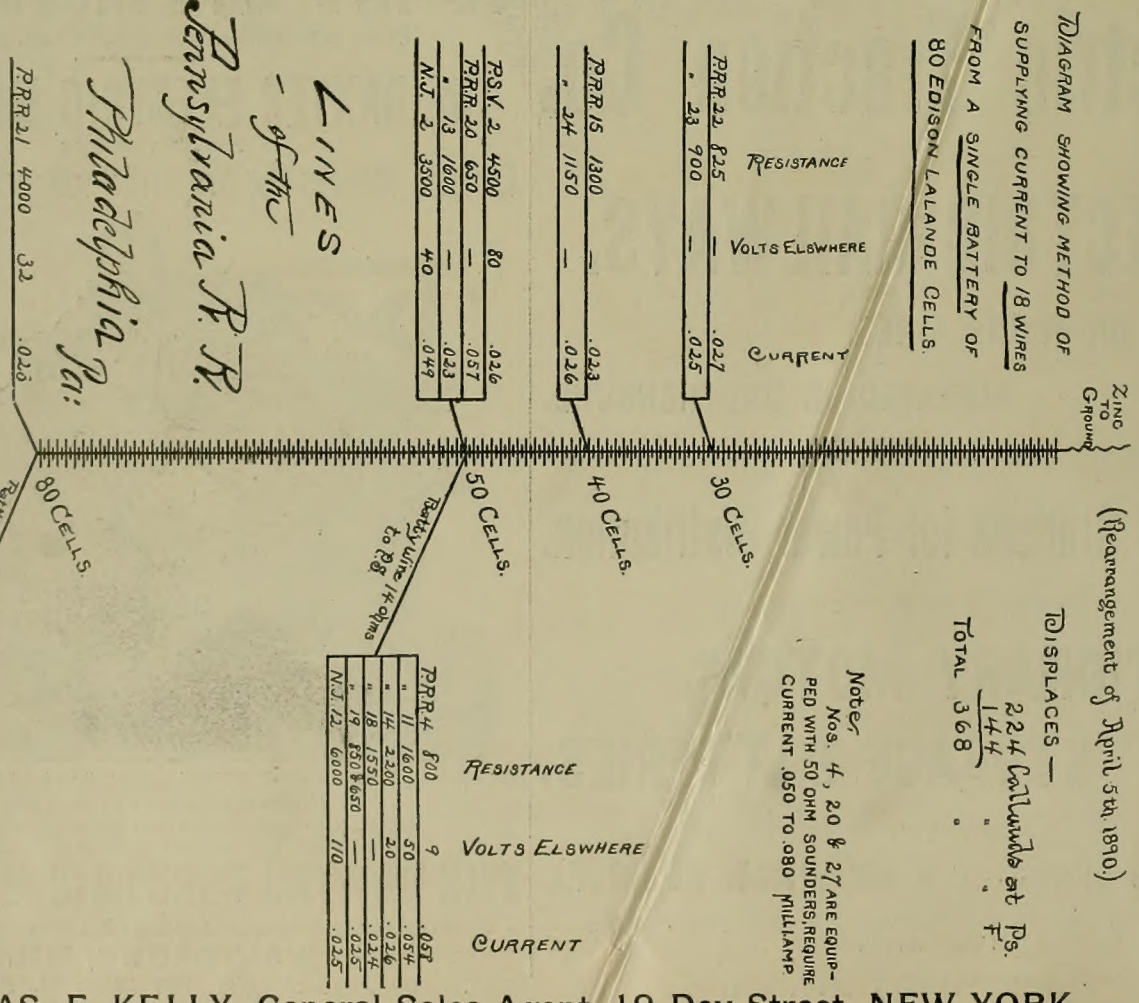
THE EASTON ELECTRIC CO

Electrical Apparatus for Arc and Incandescent Lighting. Factory Brooklyn.

Office 45 Broadway, New York.

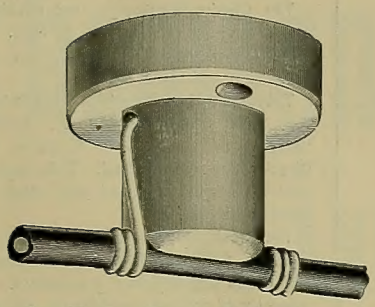
J. H. REID, General Agent, Room 9, Metropolitan Block, CHICAGO.

THE EDISON-LALANDE BATTERY.



JAS. F. KELLY, General Sales Agent, 19 Dey Street, NEW YORK.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,



Cutter's E. L. Porcelain Insulator.
SEND FOR SPECIAL CIRCULAR.

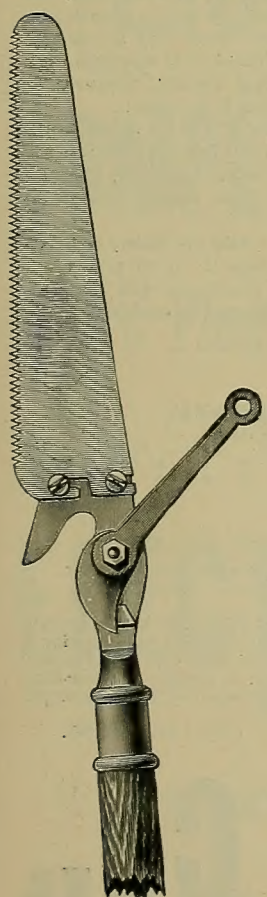
190-192 Fifth Ave., CHICAGO.

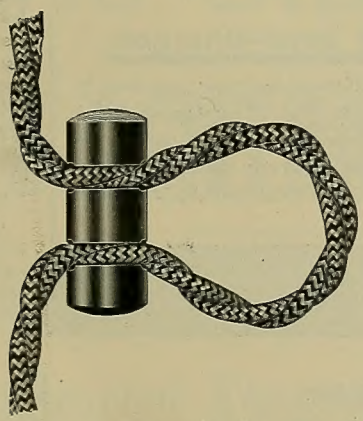
ELECTRIC LIGHT AND POWER SUPPLIES.

SIMPLEX WIRE,
NO SEAM. NO LEAK.

Always of the First Quality.

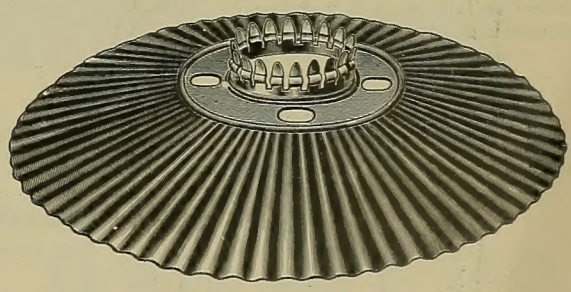
Low Quotations to all Customers.





Improved Lamp-Cord Adjuster.
SEND FOR SPECIAL CIRCULAR.

— FOR —
Electric Light Mains,
Electric Power Mains,
Electric Railway Mains,
USE SIMPLEX WIRE.



Cutter's Combination Tin Shade.
SEND FOR SPECIAL CIRCULAR.

BRYANT SWITCHES,

For Incandescent Circuits.
SINGLE OR DOUBLE POLE,
10-50 AMPERES.
POSITIVE SNAP ACTION.

"K. K." LINE WIRE.

IN ALL SIZES,
GOOD VALUE,
LOW PRICES.

Improved Tree Trimmer.
SEND FOR SPECIAL CIRCULAR.

BERNSTEIN INCANDESCENT LAMPS,

FOR ALL SYSTEMS.

GOOD FIGURES ON POLES.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 10 AMPEBES.

ADVANTAGES OF THE CROSBY DRY BATTERY

FOR OPEN CIRCUIT WORK.

THE CROSBY DRY BATTERY is the best Open Circuit Battery in the market. It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing more work than any other. In addition to this, it is the most reliable, most compact, most durable and simplest cell yet discovered. It is so constructed that it is not destroyed or seriously injured by short circuiting, and we are prepared to prove at any time that its power of recuperation is proportionately greater than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks, and all the uses to which Open Circuit Batteries may be put, it has no equal, whether it be compared with Liquid or other Dry Batteries. We guarantee depolarization, absence of offensive crystallization and perfect cleanli ess.

The Crosby Battery is the only Dry Battery sold semi-charged. It does not work until wanted.

The preference as between Liquid and Dry Batteries shou'd always be given to the latter, provided the amount of working power required and a constant current can be obtained. No form of Dry Battery has as yet been placed before the public, except the Crosby Dry Battery, which will do the work of Wet Batteries and give a constant supply of Electricity sufficient for reliable Open Circuit work at all times. The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with wh ich their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance, and easily broken and injured. The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids, and, after once being properly connected, requires no attention whatever, while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.

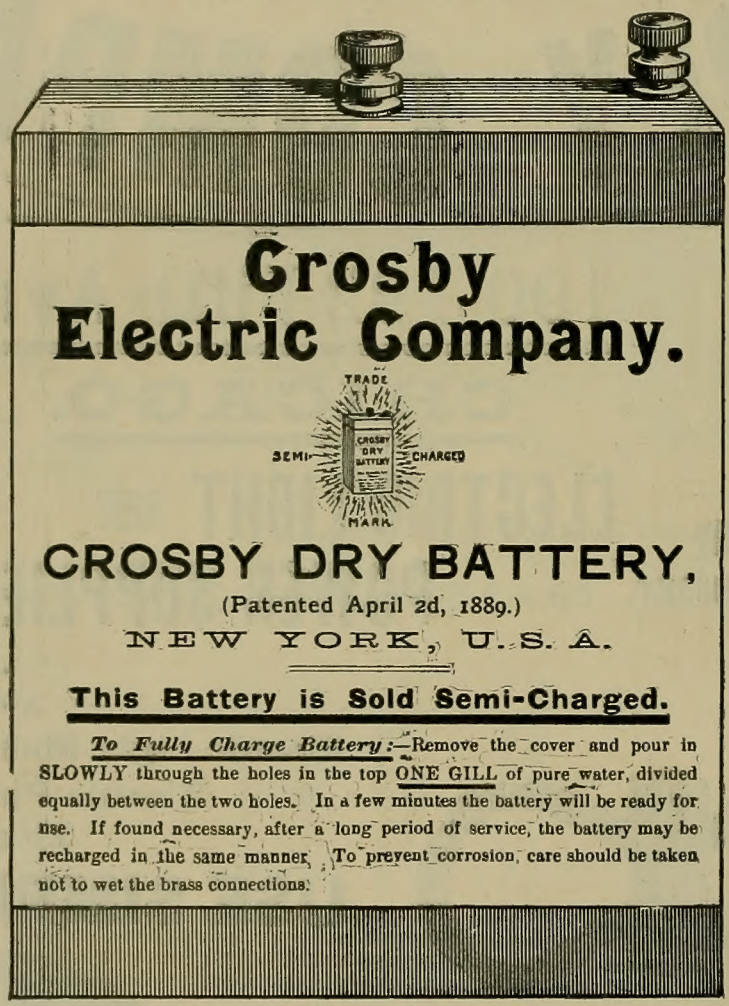
The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for Open Circuit Work. If, however, through an accident, it becomes Short Circuited, it recoups itself. This cannot be said with equal truth of any other Dry Battery known.

The Crosby Dry Batteries are manufactured in different sizes and forms, to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in the Crosby Dry Batteries varies from one to ten amperes, according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.



CYLINDRICAL.

SIZE IN INCHES.

	Height.		Diam.
No. 3	7¼	x	2½

RECTANGULAR.

SIZE IN INCHES.

	Height.		Width.		Length.
No. 2	5	x	1½	x	4½
No. 3	9	x	1½	x	8

TELEPHONE.

SIZE IN INCHES.

	Height.		Width.		Length.	Price.
Long Distance	7½	x	2½	x	4¾	$2 00
Telephone	7½	x	2	x	4¾	1.50

N. B.—OTHER SIZES AND SHAPES TO SUIT PURCHASERS.

[COPY.]

OFFICE OF FLEMMING & ELECTRO MEDICAL INSTRUMENT MANUFACTORY,
No. 1009 ARCH STREET, PHILADELPHIA, March 8, 1890.

CROSBY ELECTRIC COMPANY, New York.

GENTLEMEN:—The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan. 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29, when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan. 30; 7:30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated —371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing. Very respectfully,

(Signed) OTTO FLEMMING.

THE CROSBY ELECTRIC CO.,

Judge Building, Fifth Avenue and Sixteenth Street, NEW YORK.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

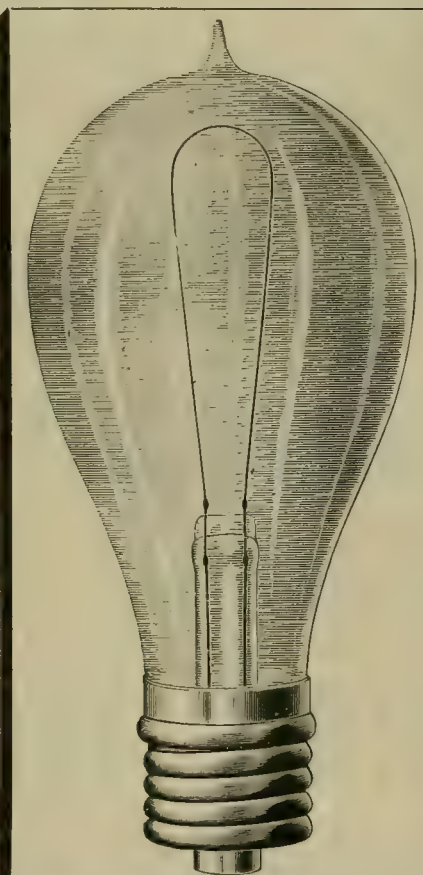
INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

UNITED
EDISON MANUFACTURING CO.,
65 FIFTH AVENUE, NEW YORK.
EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.



The Edison Incandescent Lamp.

No. 2.
No. 2 is the Thomson-Houston.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

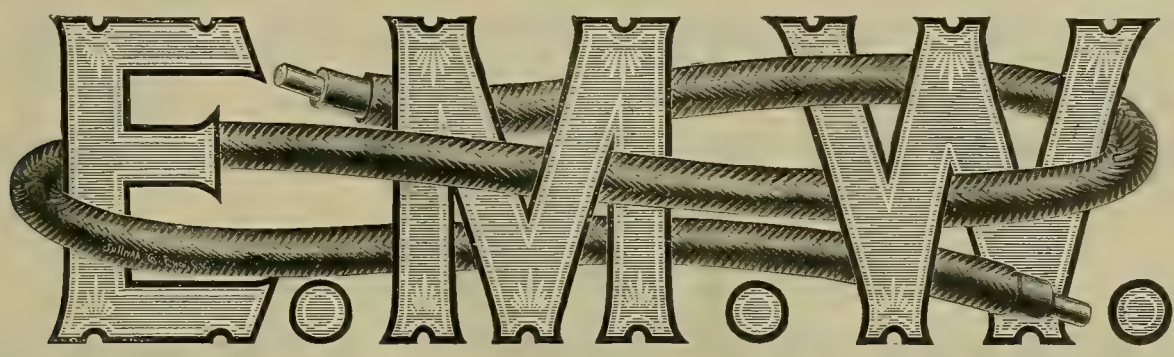
DURABLE. EFFICIENT. ECONOMICAL.

SEND FOR CIRCULARS AND PRICES.

UNITED EDISON MANUFACTURING CO.,

Main District Offices:

Eastern District, 65 Fifth Avenue, New York City. Mountain District, 730 17th St., Denver, Colo.
Central District, Rialto Building, Chicago, Ill. Pacific District, Chronicle Bldg., S. Francisco, Cal.
Canadian District, Toronto, Canada.



THE BEST SOLID RUBBER CORE WIRE ON THE MARKET.

In order to meet the demand for an **ABSOLUTELY RELIABLE, YET LOW-PRICED** solid rubber core-wire, The Edison Machine Works have produced a new line of this class of goods made up in all sizes, from No. 0000 to No. 20. It is the equal in quality, finish and durability of their other well-known wires. Once tried, it will always be used in preference to any other.

IT IS THE NE PLUS ULTRA.

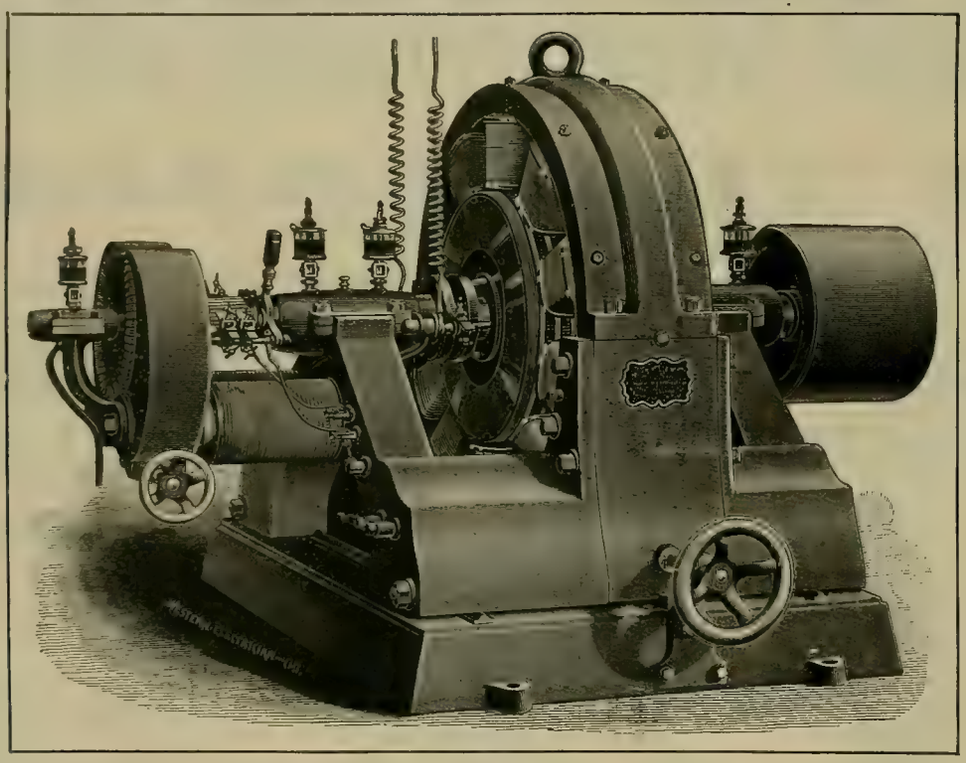
FOR PRICES, SAMPLES, AND OTHER INFORMATION, ADDRESS

THE EDISON MACHINE WORKS,

JAS. F. KELLY, Gen. Sales Agent, 19 Dey Street, NEW YORK.

THE BEST OF ALL

THE NATIONAL
TRANSFORMER SYSTEM
OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

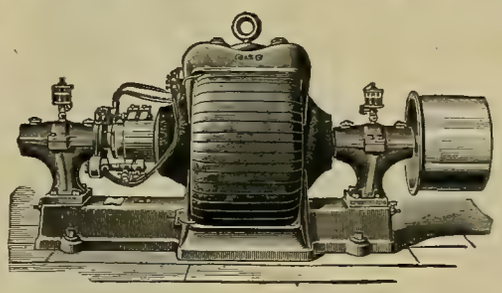
BAKER, BALCH & CO., Gen'l Agts.,
Seattle, Washington.
THOMAS WOLFE, Southwestern Agent,
Union Depot Hotel, Kansas City, Mo.
P. H. POLGLASE, Agent,
205 N. 17th St., Omaha, Neb.
LITTLE, McDONALD & CO., Gen'l Agts.,
141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.,
1517 Larimer St., Denver, Colo.
CHAS. M. BLANCHARD, Agent,
Girard Building, Philadelphia, Pa.
L. N. COX, Agent,
16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent,
Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts.,
531 Wood St., Pittsburgh, Pa.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 8,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

The Western Power Construction Co.

CAPITAL: $500,000, PAID UP.

SPECIALTIES

THE CONSTRUCTION OF COMPLETE POWER PLANTS FOR

Electric Light, Railway Duty and Power.

McINTOSH & SEYMOUR ENGINES,

COMPOUND AND HIGH PRESSURE.

WALDO P. ADAMS, General Manager.

MAIN OFFICE: 144 Adams St., ROOKERY BUILDING CHICAGO.

COPYRIGHTED BY H. W. HILL

HILL
Clutch Works,
CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

DR. GASSNER'S
DRY BATTERY
FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3½ in.
17.	"	7½ "	3⅜ " x 1¾ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.

THE CURTIS STEAM PRESSURE REGULATOR

Has been in general use now about seven years, and has from the first taken the lead of all others, and stands unrivalled to-day for its reliability and durability. It is used wherever the pressure of steam or any other fluid NEEDS TO BE REDUCED AND CONTROLLED on Steam Heating and Drying, Electric Light Plants, Marine Engines, Railroad Car Heating Steam, Pumps, Natural Gas, Air and Water, in the United States, and in the leading countries of Europe, and is sold and endorsed by the trade universally.

The Curtis Regulator Co., 90 Beverly Street, Boston, Mass.

GENERAL AGENCIES.

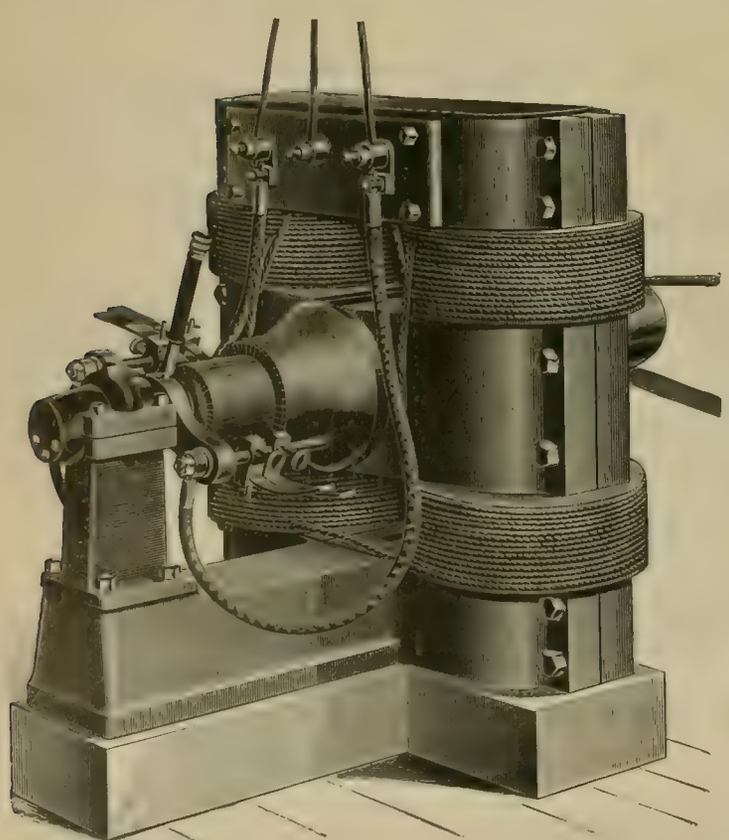
NEW YORK, 109 Liberty st. CHICAGO, 218 Lake st.
PHILADELPHIA, 2035 N. Front st. MINNEAPOLIS, 210 Third st.

YOU WILL OBLIGE Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

GEORGE P. BARTON,
LAW OFFICE,
225 DEARBORN STREET CHICAGO, ILL

PATENT AND TRADE MARK CASES.

FOREE BAIN,
ELECTRICAL EXPERT AND MANUFACTURER.



I have more Electric Motors in Practical Operation in Coal Mines than all other manufacturers combined. They aggregate over 350 H. P. to date. These installations are not experimental—the Motors are in actual service cutting coal, some of them have been working 20 hours per day for more than one year, and during this time not one of them have required repairing. No short circuits; no burnouts.

I have secured patents on a full and complete system of Mining by Electricity. Contracts solicited.

84 Market St., - CHICAGO.

Chicago, May 19th, 1890.

CENTRAL ELECTRIC COMPANY,
116 & 118 Franklin Street, CHICAGO.

Gentlemen:

Please furnish this company

1,000,000 FEET

No. 14 B. & S. braided Okonite wire.

CHICAGO EDISON CO.,

By Chas. B. Holmes,
Purchasing Agent.

THAT'S WHAT TALKS. The Chicago Edison Co. have tried all the low-priced imitations of Okonite, and the above order comes as the result of dearly bought experience.

CANDEE WIRE holds the same relative position among weather-proof wires. We are General Western Agents for both.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable System.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.
Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.
CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

E-D-I S-O-N
Miniature Incandescent
ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,
Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,
And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

COLUMBIA
Incandescent Lamp Co.,
1912--1914 Olive Street, St. Louis, Mo.,
MANUFACTURERS OF
INCANDESCENT LAMPS.
Lamps Made to Fit any Socket.
Send us a trial order. Satisfaction Guaranteed.

WILL YOU BUY

An Incandescent Lamp, claimed to take a SMALL AMOUNT of CURRENT at first, but which really takes DOUBLE THAT AMOUNT after a comparatively SHORT SERVICE;

OR,

An Incandescent Lamp taking a MODERATE and UNIFORM AMOUNT of current, and giving LONG LIFE at its rated candle power

?

YOU HAVE NO USE FOR THE FORMER.
WE MAKE AND SELL THE LATTER.

Sawyer-Man Electric Co.,
510-534 WEST 23d ST., NEW YORK.

OFFICES IN ALL THE PRINCIPAL CITIES.

CINCINNATI HEADQUARTERS
ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.
WEATHERPROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE · FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.
The JONES-BROS-ELECTRIC-CO. 28 30 & 32 WEST COURT ST.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

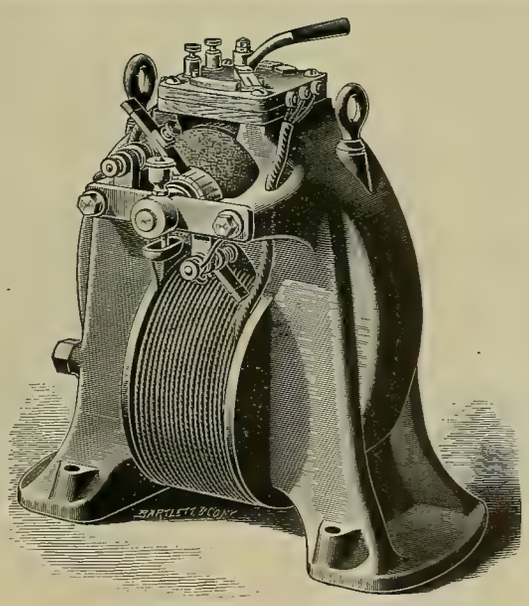
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

WANTED!

A practical dynamo builder. Must understand constructing Gramme armatures. None but a competent man wanted. Single man preferred. Address, stating wages, "MANUFACTURERS," care WESTERN ELECTRICIAN, Chicago, Ill.

PURDUE SCHOOL
—OF—
ELECTRICITY.

New laboratory, fitted with best appliances, dynamos, storage batteries, and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue. **Purdue University,**
LA FAYETTE, IND.

FOR SALE.

One 14½x16 latest type Buckeye double valve high speed engine. Run from October last to June 1st. First-class condition and complete. Sell because we have no further use for an engine of this size.
JAS. F. AYER,
Gen'l Supt.,
Municipal Electric Light & Power Company.
ST. LOUIS, MO

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

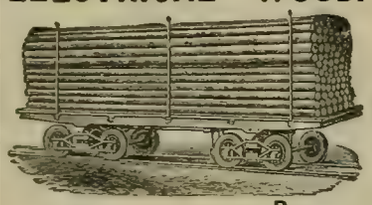
LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.85; $2.00 Iron Box Bells, 3 inch, 85c; 75c. Bronze Push Buttons, 25c; 25c. Wood Push Buttons, assorted, 7c; 50c. Switches, one point, 10c; 10c Bell Hangers' Staples, per lb 35c; $1.00 Leclanche Batteries, best made, 14c; $3.75 Spark Coils, 8 inches, $1.40; $10.00 Medical Batteries, $3.50. Send for Catalogue No 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

MICA
ALL SIZES AND QUALITIES
For Electrical Purposes.
EUGENE MUNSELL & CO.,
218 Water St., New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,
Room 410, Com'l Bld'g, St. Louis, Mo.

THE E. S. GREELEY & CO.,
GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.

ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.

MINIATURE INCANDESCENT LAMPS.

THE WESTON STANDARD
Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS
WESTON ELECTRICAL INSTRUMENT CO.,
Office and Factory, 114 William Street, **Newark, N. J.**

IT KNOCKS THEM ALL!

BISHOP RUBBER COVERED WIRES.
BALATA INSULATED DROP CORD.

Prof. Henry Morton says: "These wires showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas."

THE "BISHOP"
Always Leads the Procession.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, - 341 ROOKERY BUILDING, CHICAGO.

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS } Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS } Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address
INTERIOR CONDUIT & INSULATION CO., 16 & 18 BROAD STREET, NEW YORK.
Edw. H. Johnson, President.

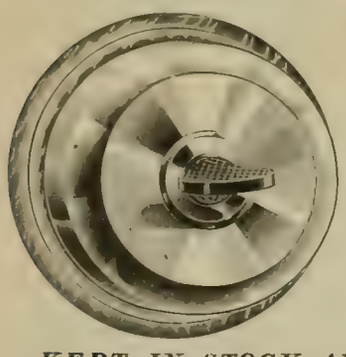
—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.
28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH
FOR INCANDESCENT WORK



Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,
12th and Market Sts.,
Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

—THE—
Celebrated P. AND B.
ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,
SOLE MANUFACTURERS,
59 Maiden Lane, - NEW YORK.

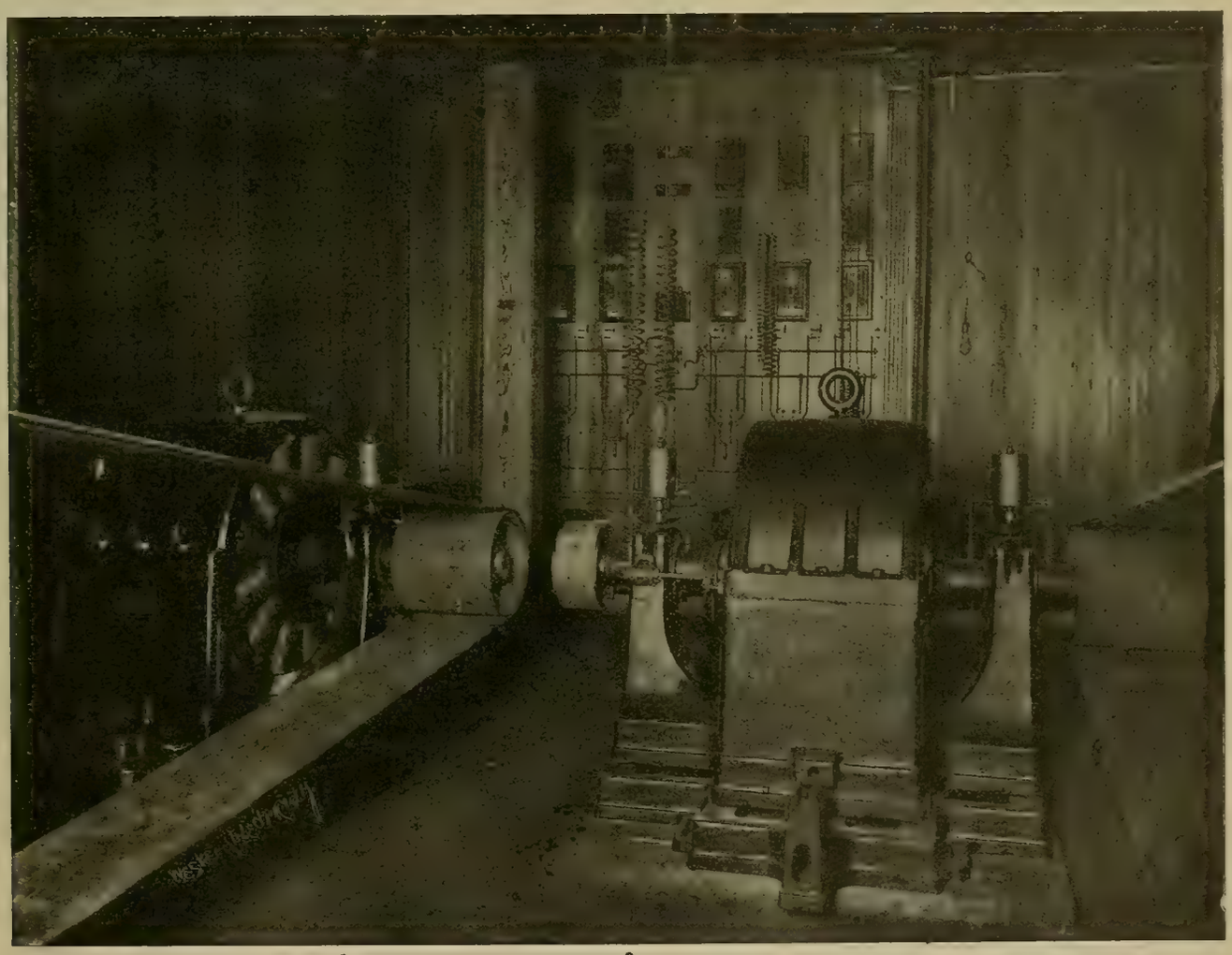
Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, JULY 5, 1890. No. 1

Alternating Plant of the Sperry Associate Electric Light Company, Kansas City.

The Sperry Associate Electric Light company of Kansas City, Mo., was organized in 1886 and is operating a Westinghouse station under the Sperry franchise. A view of the dynamo room is given in the accompanying cut. The plant is located at the works of the Kansas City Electric Light company, but is totally distinct from it, having its own boilers, engine and dynamos. The engine used is of the Westinghouse type



ALTERNATING PLANT OF THE SPERRY ASSOCIATE ELECTRIC LIGHT COMPANY.

and has a capacity of 150-horse power. It is located in the rear of the engine room of the Kansas City company's works. It is directly connected with the dynamos which are in a separate room and about fifteen feet from the engine. Two large pulleys on opposite sides of the engine operate the dynamos. The dynamos are Westinghouse incandescent and are of 1,500 light capacity each, making a total of 3,000 light capacity. The boiler is a Babcock & Wilcox of 275 horse power. The switchboard contains 15 switches and is one of the most attractive features in the dynamo room. The plant is valued at about $30,000. The president of the company is the Hon. Frederick Howard, and the secretary and treasurer is James Scammon. It is expected that the plant will have to be enlarged before the close of the year.

Chicago Electric Club Banquet.

The Chicago Electric club held its annual banquet at the club rooms June 27. Although the evening was extremely sultry there was a large attendance both at the dinner and the literary meeting. The members began to arrive about 7 o'clock, and dinner was served shortly after that hour. Covers were laid for seventy-five ladies and gentlemen. The tables were decorated with flowers. One of the most striking ornaments in the room was a star composed of incandescent lamps, surrounded by flowers. During the dinner music was provided by a mandolin orchestra.

At the conclusion of the banquet the members gathered in the assembly room, where the literary meeting was held. Vice-president Kempt occupied the chair. The first paper read had been prepared by Prof. J. E. Siebel. His topic was "Thermo-Chemistry in Relation to Electromotive Force." The paper is published elsewhere in this number. J. K. Pumpelly followed with a paper on "Storage Batteries in Traction Work," which is presented elsewhere in this issue. The club adopted resolutions thanking Mr. Pumpelly and Prof. Siebel for their papers. After the literary meeting the members of the club and their guests adjourned to the ball room, where dancing was enjoyed.

Decision Against Kemmler.

Kemmler's case was again before the Court of Appeals of New York state last week. The point involved was the constitutionality of the clause in the electrical execution law providing that the death penalty shall be inflicted at a state prison under the direction of the warden. W. Bourke Cockran argued for Kemmler that the legislature had no power to legislate so as to take away any of the duties or powers of any sheriff of any county, as it did in the present case, and to invest another officer, a warden of a state prison, with such powers.

He claimed that the law was unconstitutional and void because it assumes to deprive the sheriff of Erie county of powers conferred on him by the constitution. He submitted that the provision of the constitution which guarantees to the electors of the various counties of the state the right to select sheriffs by popular suffrage confers upon them the right to select an officer who shall forever execute the powers which were

vested in the sheriff when the constitution took effect, and that when such officer is shorn of any of his powers that provision is violated. Counsel argued that the act, so far as it attempts to give the custody of the relator to the warden, being void, and the relator being detained by a person not having a shadow of authority and being confined out of the county of his conviction and in an unauthorized building, it follows that he is illegally restrained and deprived of his liberty. Counsel asked that the court should reverse the order of the General and Special Terms and make an order directing the warden to discharge the relator from custody.

Attorney-General Tabor began his argument by reviewing the course of the counsel for Kemmler in going through all the courts in the country in behalf of his client, when Chief-Justice Ruger cut him short by remarking that further argument was unnecessary, as the court was ready to render a decision at once. This decision, in effect, is that the court believes that the legislature had the power to make the law in question and that the decision of the lower court be affirmed.

Electric Light Suit in Cincinnati.

Counsel for the city of Cincinnati last week filed an answer to the suit of the Brush Electric Light company, which sought to enjoin the city from collecting the $50,000 deposited as a guarantee that the company would carry out its contract to light the city with electricity, according to its bid at so much a post. The company asserted that there was an illegal advertisement for bids by the city clerk, and that the whole proceedings were, therefore, irregular. The city, in its answer, asserts that the company refused to enter into the contract within thirty days, to the damage of the city to the amount of $50,000.

The Shaw Electric Crane.

The accompanying cuts illustrate the chief features in the construction of the electric crane invented by A. J. Shaw of Milwaukee. The improvements consist, generally speaking, in the combination of independent electric motors controllable from a common point, with the bridge trolley and the hoisting drum. Fig. 1 shows the general arrangement of motors and gearing. In Fig. 2 are represented the circuits by which the motors are supplied. As the majority of readers will understand, in the practical use of traveling cranes it is often desirable that three operations be simultaneously carried on—that is, a travel of the bridge upon the supporting rails, a traverse of the trolley or car upon the bridge, and a raising or lowering of the chain or cable which winds upon the hoisting drum—and it happens even more frequently that two of these three operations require to be simultaneously performed. To attain this end various plans have been devised. In some use is made of endless chains or cables passing about band-wheels, and receiving motion from a steam engine, gripping devices being employed to connect the bridge with the cable or to set the hoisting drum in motion. Others, and those now most generally in use, receive motion from a polygonal shaft extending from end to end of the track over which the bridge travels, clutches and reversing-gear being employed for transmitting motion from this shaft to the bridge-trucks, the trolley and the hoisting mechanism in the required directions. These and other plans proposed are attended with various drawbacks and difficulties, which increase rapidly as the capacity of the crane is increased. In the Shaw combination shifting-clutches, gripping devices and reversing gear generally, are wholly dispensed with through the employment of reversible electric motors. These are disposed as shown, two on the car or trolley, and one at the side of the bridge. Current is supplied to the several machines through broad, flat strips of copper, supported on and insulated from the girders or timbers at the end of the bridge. The relative position of the brushes for carrying off the current from the conductors is shown at *B* in Figs. 1 and 2. From the brushes the current passes to resistances and the reversing switches, then to and from the motors and back to the source of supply.

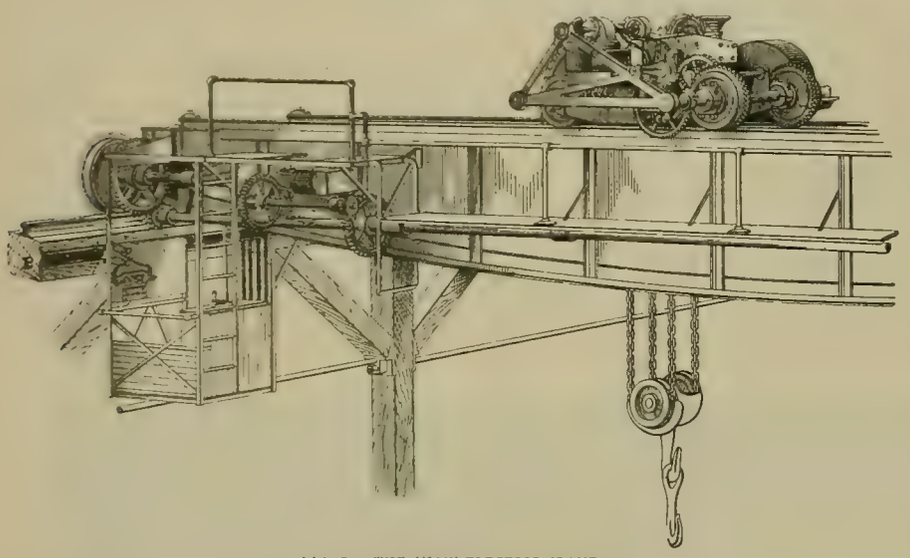


FIG. 1. THE SHAW ELECTRIC CRANE.

In Fig. 2 are represented the connections of one of the reversing and speed controlling devices to be used with the crane. Bearing in mind that the inventor reverses the current through the armature to secure a change in the direction of rotation, and also that *R* in the cut indicates a resistance, the action of the switches to obtain various speeds will be understood.

It may be mentioned that Mr. Shaw has been engaged in experimenting in this line for some time, and one of his cranes is in operation at present time at the Allis Machine works in Milwaukee.

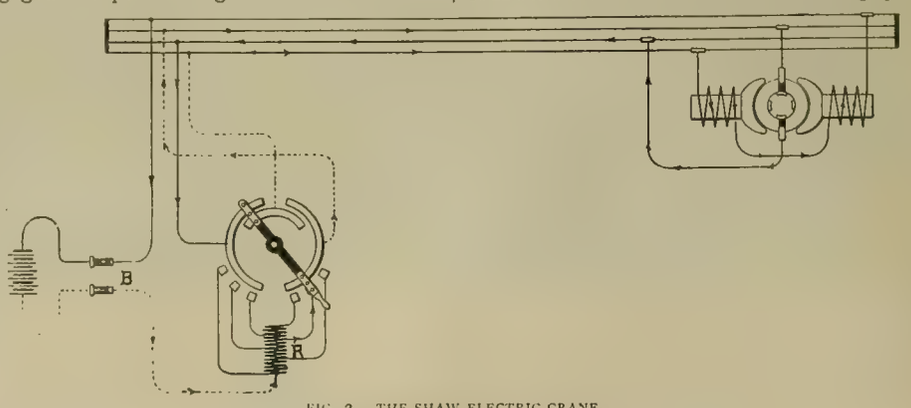


FIG. 2. THE SHAW ELECTRIC CRANE.

The rapid transit system of Salt Lake City will comprise 55 miles of electric street railways before the season closes.

Ground was broken for the extension of the People's Line railway to Lake Contrary at St. Joseph last week. The line will be constructed from Eleventh street and Atchison to Second street, and then extend out the lake boulevard. It is expected that the line will be in operation by September 1.

London Board of Trade Standardizing Laboratory.

Major P. Cardew in his paper on "The Treatment, Regulation, and Control of Electric Supply by the Legislature and the Board of Trade," read at a recent meeting of the London Institution of Electrical Engineers, refers to a standardizing laboratory now being established in London by the Board of Trade. The following is an abstract of his remarks: "You are probably aware that the Board of Trade have, in deference to the wishes of the large body now interested in practical applications of electricity, as expressed by a powerful deputation to the president last year, undertaken to provide something in the nature of a testing establishment for instruments intended for the measurement of electrical quantities, analogous to the Standards Department of the Board of Trade for weights and measures of the more gross and material quantities. They have also taken powers under the Weights and Measures Act of last session to undertake such testing and verification, and to charge fees for it; so that these verifications, whatever their scientific value, will possess a legal value. A general scheme for the scope and working of this laboratory was drawn up very carefully last year by a committee of your institution. The general idea embodied in this, in which I personally entirely concurred, is that the thing should grow from small beginnings. Now I can promise that there will be nothing grandiose about our laboratory. What we hope to do in this laboratory is, first of all, to get the true values of the electrical units, within a very small possible percentage of error. We are not tied to the so-called legal units, which I may remark have no legal value in England; but, with the assistance of Lord Rayleigh and the standardizing committee of the British association, we hope to get even nearer the truth than was arrived at with this set of units. Secondly, having got there, we hope to keep there by well devised checks and frequent reference to the fundamental measurement. This, as we are at present advised, will be the measurement of current by the quantity of silver deposited from solution in a determined time. Thirdly, as soon as we are satisfied that sufficient accuracy and permanence have been arrived at with our instruments and methods, we shall be ready to receive instruments, either for simple verification in the case of ordinary commercial instruments, at a small charge for each reading, or for thorough testing and certification in the case of instruments submitted as sub-standards. The rules and charges have not yet been drawn up, but it is probable that instruments will be required to be marked with a clear and intelligible scale—whether of degrees or volts or amperes, etc., is quite immaterial; the extreme range of the instrument must be given approximately, and whether it is intended for alternating or continuous currents or pressure, or for both. The reading given by the instrument on its own scale for each current or pressure asked for will be taken, probably, in all cases both with increasing and with decreasing readings. No extreme accuracy will be guaranteed for these readings but it is hoped not to exceed an error of ¼ per cent. from the true value. Of course, in the case of ordinary commercial instruments, we should give no sort of guarantee that the instrument will remain constant for any time, or under different conditions. Sub-standards will be subjected to long and vigorous testing, including the determination of their variation under different temperature and the permanence of their constants. I am afraid, however, that in most cases there will be some difficulty in giving any guarantee of the constancy of an instrument after it has passed out of our hands.

"The power for laboratory purposes will be supplied from two batteries of accumulators—one of four very large cells simply to give steady continuous currents up to 2,000 amperes; the other, consisting at first of 100 smaller cells, will be used directly for continuous pressures up to 200 volts, and also to run the machinery. The machinery referred to is two pairs of dynamos, one of each pair being energized by the cells as a motor and driving the one connected to it as a generator. One of these generators will be an alternate current machine, and the other a high-pressure continuous current machine. In connection with the alternate current machine we shall have a set of transformers. In this way we hope to get currents practically as steady as if taken direct from the accumulators, and in the case of alternating currents and pressures any frequency within the limits of practice. The limits we propose to work up to first are:

Continuous current	2,000 amperes
Continuous pressure	2,000 volts
Alternating current	500 amperes
Alternating pressure	2,000 volts

"The building and alterations necessitated are now nearing completion, and we hope to have the laboratory in working order in about two months' time."

Pattee Lamp-Hour Recorder.

The rapid progress which central station lighting for large areas has made of late years has brought incandescent lamps into many places distant from the stations, especially since the competition between the direct and alternating current systems of distribution has tended to stretch out the area supplied by each plant. In this way many places which had not installed an isolated plant have been given the luxury of incandescent lamps. The usual basis of charges for the current supplied has been the number of lamp-hours at the consumer's place. In many places, especially in large business

PATTEE LAMP-HOUR RECORDER.

houses where the lights are manipulated by gang switches, the lamps controlled by each switch are all turned on or off together. Then it is only necessary to keep count of the number of hours they were burning in order to compute the charges. It is desirable, however, ordinarily, that a meter be used, and the most advantageous form is that which gives the number of hours directly. This is a feature of Pattee's electric lamp-hour recorder, which is shown in the cut. In the illustration the door to the enclosing case is opened. A clock-work with two powerful springs, intended to run the recorder 720 hours, has three dials registering the hours, tens and hundreds. The inverted horse-shoe magnet, mounted on a brass plate below the clock, has its coils connected in series with the german silver resistance shown right beside it, the whole being connected in shunt with the lamps. The armature of the magnet is hung from a slender rod, and by its weight acts through a bell-crank lever as a brake to the escapement wheel of the clock. When the current to the lamp is turned on, the armature is drawn up, and acting on the lever and brake, at once, releases and starts the escapement. As soon as the current is stopped, whether by the switch near by or by the shutting down of the station, the armature falls and stops the clock work which runs, only when the lamps are burning. The dial readings give the number of hours directly.

The whole apparatus is well built, and there is no apparent liability that any of the parts will get out of order. The german silver wire is wound on a bobbin with perforated heads, and between the layers are air spaces. The turn buckle shown in the middle of the rod to which the armature is fastened, serves to adjust the play of the armature and its distance from the magnet poles. The lever, slide and brake are very neatly arranged, giving a positive start to the escapement and stopping it instantaneously.

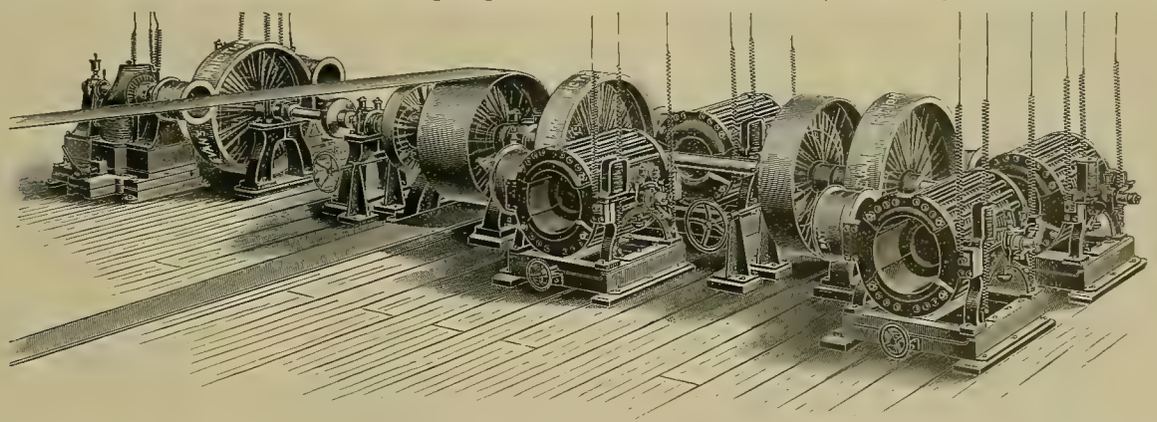
The recorder is mounted in a walnut case like a clock, the dial being visible through a glass plate. A clock assures the current supplier that the instrument is not being tampered with, while the direct-reading dial gives the consumer confidence in the correctness of the readings.

As ordinarily built, the coils have such a resistance that on a 110 volt circuit, the energy consumed is only 10 watts. By suitably varying the resistance, the Pattee recorder can be adapted to currents of any pressure. Moreover, it can be adapted for use with multiple, series, series-multiple or multiple-series, lines and also alternating currents. The meter is put on the market by the Great Western Electric Supply company, Chicago.

Evans Friction System.

The arrangement of the dynamos in one of the stations of the North Attleboro, Mass. Steam & Electric company, in which the Evans friction system is used, is represented in the accompanying cut. The line shaft is driven from a compound Ide engine by means of a belt, as shown. The two machines at the extreme left of the cut are each 60-horse power Thomson-Houston railway generators, both running on the same circuit. The power of these two machines varies from practically nothing to 120-horse power many times an hour. The four dynamos shown at the right of the cut are Thomson-Houston machines, each a capacity of 50 1,200-candle power arc lamps. Each machine is run fully loaded. The speed of the line shaft is 300 revolutions. The driving pulleys are 56 inches in diameter. The speed of the railway generators is 1,150 revolutions and that of the arc dynamos 820 revolutions.

The Attleboro company is now putting in another large engine and will belt to a continuation of this line of shafting. On this extension additional dynamos will be placed and all will be driven by the Evans' system. The dynamos in the present instance are arranged so that one pulley drives two machines in such a manner that each can be stopped and started independently of the other machines. By putting two dynamos on one pulley the pressure on the shaft bearing is relieved, and the plant takes up the least possible amount of space. This station is located at Farmers, Attleboro, Mass.



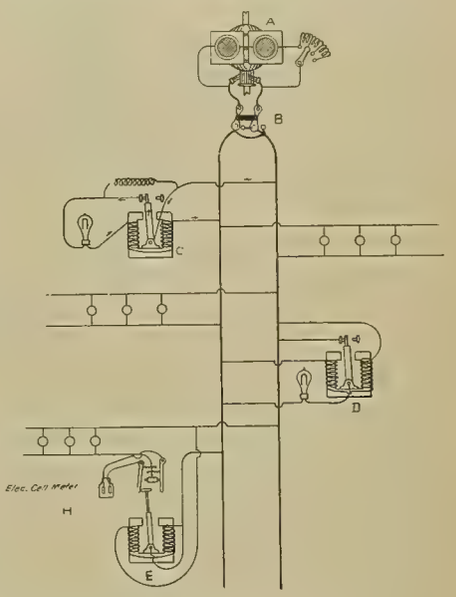
EVANS FRICTION SYSTEM.

The first engine for the Minneapolis electric railway power house will be completed this week. It is expected all will be ready in about a month. The work will be pushed to a speedy completion. Last week 750 men were engaged in laying track in Minneapolis.

Electric Lighting System.

The accompanying cut illustrates an electric lighting system recently patented by T. A. Edison. The object of the invention is to provide means for operating electrical apparatus located at different points in an electric light circuit from the source of supply without the employment of a circuit separate from the light circuit, and more especially to provide means of this character for turning on and off from the source of supply certain lamps—as, for instance, street lamps, whether of the incandescent or arc type—thus avoiding the expense and inconvenience of operating them separately by hand.

The inventor accomplishes this by the use of polarized apparatus located in connection with



ELECTRIC LIGHTING SYSTEM.

the lamps or other devices to be operated, the polarized apparatus being actuated by a reversal in the polarity of the current at the source of supply. The cut is a diagrammatic representation of the system. In the figure *A* is a dynamo from which extend the main conductors.

Near the machine, *A*, a current reversing switch, *B*, is inserted in the line of the main conductors, so that the polarity of the current in the lamp circuit outside of the switch can be changed at will.

C, *D*, and *E*, each represent polarized apparatus. Any number of these U-shaped electro magnets, between the poles of which are located the free ends of pivoted polarized armatures, may be employed, located at any desirable points in the electric light circuit. Now it will be seen that when the current is flowing in one direction the pivoted polarized armature will be moved one way by the magnet, and a reversal of the current will cause the movement of the armature in the other direction. In this manner, it is claimed, the lamps or other devices may be cut in or out of circuit at will. At the left in the cut is shown, the method whereby the current will be maintained of one polarity through apparatus which would be affected by a change in current direction—as, for instance, in an electrolytic cell meter.

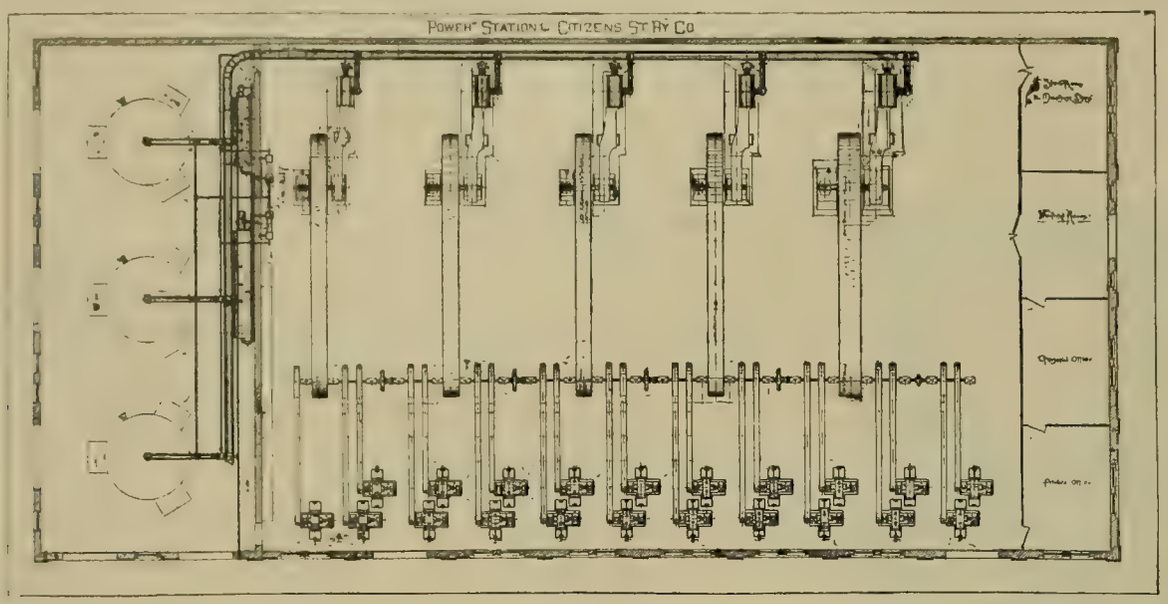
Electric Railway Power House.

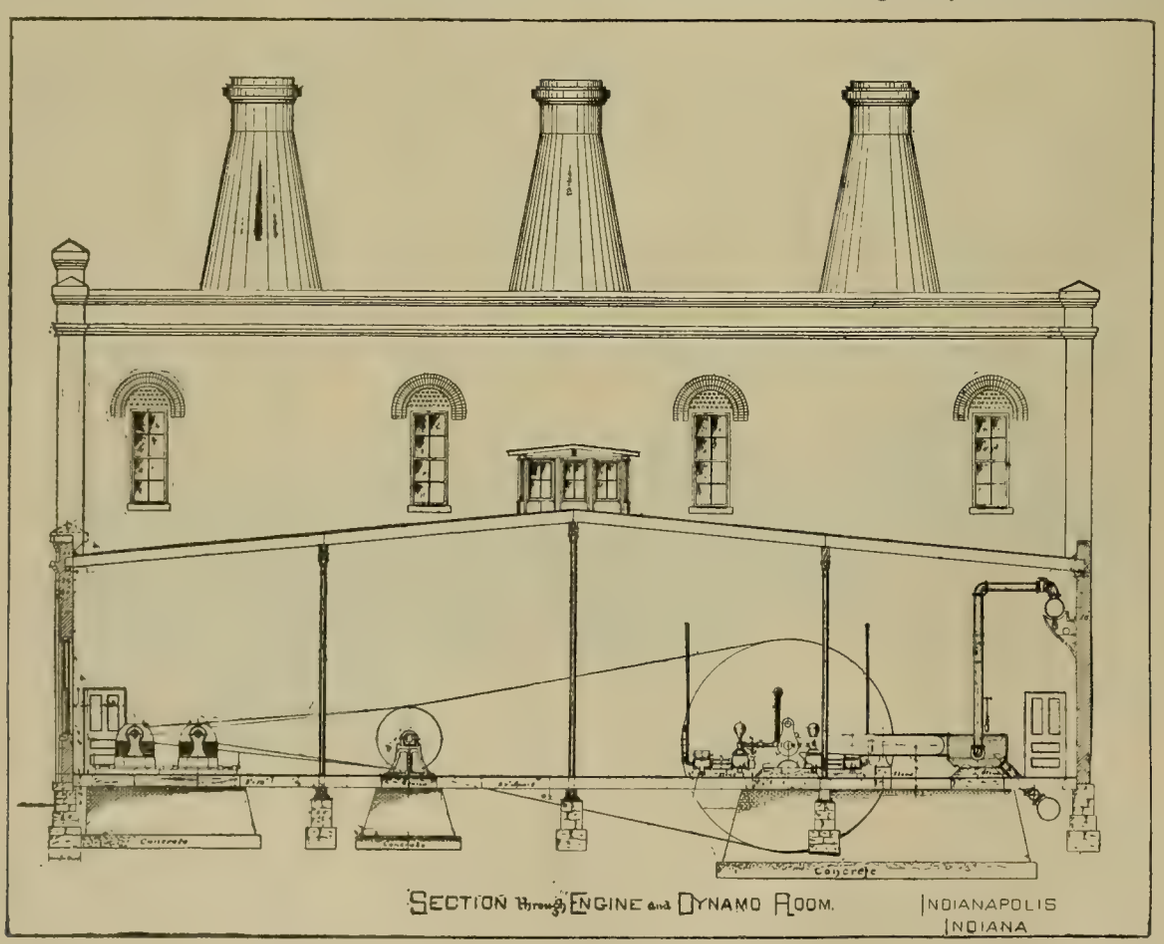
The power station of the Citizens' Street Railway company at Indianapolis, Ind., is a handsome brick structure, as represented in the illustration. It is of sufficient capacity to contain twenty-three Thomson-Houston railway generators, and at the same time affords room for offices and general machine shop. The boiler plant is to consist of three Hazelton boilers, fitted to burn natural gas, and also arranged with furnaces to burn coal, as shown by the three extensions to each boiler on the plan. The gas burners in each boiler are located in such a manner that they do not interfere in the slightest with the coal furnaces. It is possible to make a change from gas to coal at a moment's notice. This is a very great advantage over the ordinary practice, as it is customary to place these burners on the grates. Whenever it was desired to use coal it was then necessary to remove them, which is by no means an easy task.

The engines are so arranged and connected that any number can be run at the same time, and any one can be started and stopped while the remainder of the plant is in operation. The shafting is made of the best quality of hammered steel, and is supported by ball and socket self-oiling bearings. This, it is stated, is the first system that has been equipped upon this plan, and it is found to be highly satisfactory. The steam piping for this plant is of ample capacity and so arranged that when the whole plant is in operation every detail will be of proper size and proportion.

The feed water for the boilers is first passed through a Hoppes purifier, which removes the impurities and heats the water at the same time to the boiling point. The water is then pumped by Barr duplex pumps into the boilers. The entire feed water system is arranged in duplicate, so that in case of accidental injury operations would in no way be interfered with.

The general arrangement of this installation is shown by the cut representing a section across the engine and dynamo room. The entire installation rests upon masonry, consisting of a concrete base with the brickwork on top laid in cement, and everything about the plant is constructed in the most substantial manner possible. The engine, which has just been put in operation, was built by the Wheelock company of Worcester, Mass. The entire installation was planned and erected by L. H. McIntire of the railway engineering department of the Thomson-Houston Electric company. The work of installing the plant was in charge of W. S. Twining.





The Chelsea Storage Battery Station.

In a recent number of the Western Electrician a general description was given of the plant and working arrangements of Chelsea, Eng., Electricity Supply company's storage battery station and sub-stations. The following description of the method of mounting and starting the cells is taken from the London *Electrician:* Those who have had to do with storage cells are sufficiently familiar with the difficulties of handling them, and any practical person can get a fair idea of these difficulties by picturing to himself a glass box on the top of a high shelf, full to the brim with a strong solution of sulphuric acid, in which is immersed about 2cwt. of lead plates. Added to this is the fact that the storage battery man has to deal not with one cell standing by itself with space all around it, but with tiers of shelves arranged one above the other, on which cells are packed with the smallest clearance which safety

considerations will allow. A slip of a spanner, or of a ladder, or of the suspension hook of the traveler, might result in the shelves and connections beneath being deluged with 10 per cent. solution of sulphuric acid. It will be seen, then, that the overhauling of a cell is a matter requiring time and care for its execution; and the fact, stated by the company's engineer, that two men have been found sufficient to do all that has been necessary for three sub-stations, having an aggregate of 1,365 cells, is *prima facie* evidence that up to the present the amount of attention required by the cells is not great.

The cells are supported by upright frames of cast-iron, between which are fixed wooden bearers of a length sufficient to take, in some cases, three, and in others four cells in a row. The iron work is served with three good coats of red paint, and the wooden bearers with an equal number of coats of shellac varnish, while the spaces between the ends of the bearers and the ironwork are filled up with a mixture of bitumen and tar, with the object of preventing spilled acid or the spray which is caused by the breaking of the gas bubbles from getting between and causing destruction of wood and iron alike. Each cell stands upon a wooden tray filled with sawdust, which is supported by four Johnson & Phillips oil insulators, which rest upon the wood bearers above described. As far as is practicable, the cells are arranged so as to keep the difference of potential between those on adjacent shelves at a low value.

The time of first starting up a storage battery is well known to be a critical one for the cells. The charging ought to commence immediately after the acid is poured in; but as this process of filling a large number of cells necessarily occupies several hours, in practice only the last cells filled have this advantage. The method adopted of filling up the large number of cells at each sub-station in the shortest possible time has been to provide a lead-lined tank above the level of the cells in which the acid is poured direct from the carboys. An india-rubber hose is connected to the tank, by means of which the cells are filled in rapid succession. The filling of the cells at Clabon Mews occupied about six hours, after which charging was continued for upwards of thirty hours without cessation. This battery has now been in constant use for fifteen months, and at the time of our visit had the appearance of being in good order; nor were any of the well-known signs visible—in the shape of bent lugs or other unavoidable marks—of cells having been taken out and overhauled. The negative plates were scaling to some extent, and we noticed some positive plates which appeared to have lost some of the paste from the surfaces of the squares; but the space which is now provided at the bottom of the cells prevents the falling scale from giving trouble by short circuiting. We saw no signs whatever of buckling of the plates; and the opinion we formed after a close and careful inspection was that the battery was in thoroughly good working order. It may be mentioned that the back e. m. f. cells are generally made up with grids only, pasted plates being put into a sufficient number of cells to supply the current required for the various automatic apparatus.

The Storage Battery in Traction Work.[1]

By J. K. Pumpelly.

When I had the honor of addressing you a short time ago, I attempted to show how useful storage batteries could be made, and to what extent economy could be effected by them. The question was then asked, why it was that storage batteries had thus far failed to realize the predictions made concerning them. This question I propose to answer, basing my remarks upon actual tests that have been made in street car traction, the most difficult probably of all work they have been set to accomplish. Allow me before we proceed to consider dry data that have been lately compiled with great care and expense, to lead you along a line of thought which, a short time ago, occurred to me, while watching the incandescent light hanging over my head late at night, long after the dynamo had ceased its rapid revolutions, when the fires had gone out beneath the great boilers, and the engineer had retired to his well-earned rest. Where did this light come from? Even the most advanced electrician might have asked this question. I was seated in my library at this late hour, but knew, of course, that four floors below me and several hundred feet away, fifty-five boxes, filled with water and lead and a little sulphuric acid, stood on shelves in rows, connected together like yoked cattle at the plow, and that at the opposite ends of these boxes were wires, to which the glass over my head was fastened, and through which passed a little thread of carbon fibre, and inside of this glass was what nature abhors—a vacuum.

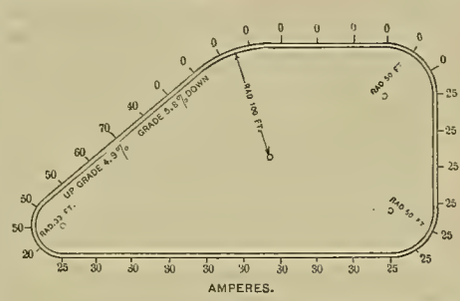
This little thread of carbonized fiber gave a steady, unchanging light throughout the room. What made it? The mysterious forces of nature had been at work. Electricity created by the dynamo had pushed its way into the liquid surrounding these plates of lead, piled up in the little boxes, and had torn apart the atoms and molecules of hydrogen and oxygen, of which water is made. It forced the one to seek something to contend with, at one side of the box, and the other at the opposite side of the box. There it held them, constantly keeping up this tearing asunder of atoms hour after hour, until there were no more atoms to be torn apart or fight with. These atoms constantly struggling to recombine, find a means through a bridge of wires, and although powerful obstacles are in the way in the shape of the arched carbon fiber, the struggle is so great that in the effort to cross the resisting bridge, light and heat are the results. And so these contending atoms, hundreds and even thousands of feet away, exerted nearly a twelfth of a horse power over my head.

To return, why with all this force at hand, and under control of man, has there been such failure in street car work? Let us study well the problem, and by the experience of practical, earnest men determine whether we ought not to charge ourselves with much of the failure; we may find that the obstacles to success come from the outside, and not from the batteries themselves.

[1] Read before the Chicago Electric Club, June 27, 1890.

We have given our young horse too much to do. Could we have understood the language of our straining, overworked street-car horse or the more patient mule, we would have known long ere this how varying is the traction work on a street car. To show this I will read extracts from A. Reckenzaun's very elaborate paper on electric traction:

"Henry Hughes deduced from experiments on tramways a tractive resistance of about 26 pounds per ton; often more, occasionally less. Such high resistances as these are readily accounted for, when it is considered that the flanges of the wheels frequently take a bearing on the bottom of the grooves, or on the dirt imbedded therein, at the same time that the wheels roll on the surface of the rail, for thus the wheel rolls on two different radii simultaneously, and grinding of surfaces in contact must result. It may even occur that one wheel is running on its proper bearing surface, while the other, belonging to the same axle, has its flange touching the bottom of the groove, when, by virtue of different circumferential velocities, additional friction is introduced. Sometimes the rails are a little out of gauge. All these circumstances augment the tractive force requisite with grooved rails. The horse, if he could speak, would be a good witness, but failing his verbal evidence, the dynamometer has been consulted. Better than the mechanical dynamometer, however, is the ammeter. A dead beat ammeter indicates instantly the slightest variations of tractive resistances, and I venture to say that it will be through the judicious and more frequent applications of this instrument that material improvements both in the permanent way and in the rolling stock of electric tramways will be effected.



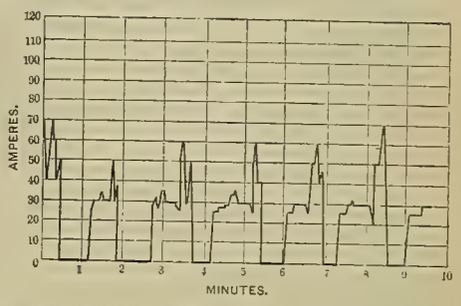


FIG. 1. STORAGE BATTERY IN TRACTION WORK. FIG. 2.

"In order to ascertain the amount of energy used on electric cars, I have made, in conjunction with the Electric Car company of America, a long series of systematic tests both on an experimental track built for this purpose, as also on the public roads under all sorts of conditions of traffic. Whilst on the experimental track we could run at any speed we liked, and without stoppages; on the public streets we were confined to the speed of horse cars in front and behind us, besides taking up and putting down passengers and regulating our vehicle to the general traffic of some of the busiest streets of Philadelphia.

"This experimental track was laid in an irregularly shaped yard, as shown in the diagram Fig. 1, and it was intended to represent as difficult a line as is likely to occur in actual practice. Its entire length was 1,005 feet, the ends being so joined that the cars could circulate continually. Five and a quarter journeys round this track represented a mile run. There were four curves, two of 50 feet radius, one of 33 feet and one of 100 feet. Tangent with the 33-foot curve was a gradient of 4.89 per cent. rise, which descended on the other side at the rate of 5 8 per cent., and joined the curve with a radius of 100 feet. If we have to overcome a gradient of 1 per cent., or 1 foot in 100, the resistance due to gravity will also be 22.4 pounds per ton; therefore we shall require about 5 horse power to pull this car up a gradient of 1 in 100. With a 2 per cent. rise the power will be three times as great as on the level, and roughly speaking, each per cent. of grade demands as much energy as the propulsion of a given weight on a horizontal road if the speed is to be constant."

Fig. 2 shows the current needed to supply power on the road.

These tests were made on a street car carrying 80 cells. The electromotive force in starting was 160 volts, and the average throughout the entire trip was 157 volts, *i. e.*, 160 volts at starting and 154 at the end of the trip occupying with stops, a period of 6 hours. You will see by the practical notes of Mr. Reckenzaun, that the condition of the track and roadbed, and the quickness, watchfulness and coolness of the switchman on the car platform has much to do with the success of electrical traction, especially when a stored power is used. This last quality in the driver or man who controls the output of current, who knows by experience what he needs and what is wasteful, can make the use of storage batteries, economical or otherwise. A car has lately been equipped with batteries, which is completely controlled by the switchman. It is owned by the Millborough Land company of Kentucky. The 100 cells of battery are connected in parallel of 25. The switch is divided into 4 sections with resistance between the sections to prevent flashing when rapid changes are made under a strong current. At the start 25 cells of the battery are switched on. The counter e. m. f., which rises as the armature revolves, permits the throwing in of 50 cells and then 75. When the car is well in motion the entire battery of 100 cells is switched on in series. Thus it can be seen that although a current of 50, 60 or 80 amperes is needed to start a loaded car, the current is divided so that the several sets of batteries help each other by taking a portion of the load. Still the question is asked: Why, if the success is such as represented on the above-mentioned road, are not all doubts settled and the storage battery generally adopted? It is certainly the ideal method for street car traction, each car being independent of the others. There are two reasons: First, the batteries used are not durable enough. The plates fail to resist the jar of the car on the roadway, and large demands for current for which the battery is called upon. Touching the two opposite plates destroys the efficiency of the entire set, and nothing can be done to remedy the evil for the time, but to take out one disabled cell and substitute another. Now this tendency of the plates to get together is constant, and comes very likely from the unequal expansion of the lead support, which holds the active material and which is a conductor. There is also a tendency of the blocks of active material to flake off or to fall out under a jar. These pieces or flakes often catching between the two plates which are never over ¼ inch apart short circuit the battery and render it useless. Fine crystals of lead sulphate are slowly forming like the zinc of spicular formation between the plates and in this way doing the damage in the most mysterious manner, for these crystals can hardly be seen.

The second reason is to be found in the weight of the battery, and as constant efficiency depends very much on the weight of the lead and lead oxide of which the battery is made to-day, it can not be avoided unless the managers of the road look at it in the right way and arrange shorter trips and more frequent changes. For instance, suppose a six hours' trip of 40 or 50 miles, like the example mentioned above, requires a battery of 150 ampere-hours capacity. To obtain this capacity we must have at least 80 batteries weighing 35 or 40 pounds each; all this weight besides the car, motor and load must be propelled by the forces excited in the battery itself. What would be the most practical and sensible way to improve this condition? Surely to shorten the trips, and as we learn by experiment that it needs a battery of 150 ampere-hours capacity to run 50 miles at 8 miles an hour, why not use, then, a 100 ampere-hour battery weighing, say, 25 pounds, and run 30 mile trips? The batteries being lighter could more quickly and easily be slid into and out of the car, more quickly charged, and cost less money per cell. If the trip occupied 4 hours to run 30 miles, then 4 hours would be sufficient to charge the exhausted battery with 100 amperes, the dynamo delivering a current in charging of 35 amperes per hour, which would be a fair normal current for a properly-constructed battery. Most of the batteries of this size and weight will not bear a charging current of 35 amperes, and this has been one of the troubles that the experimental street railways have had to contend with. I am sure, however, that a battery is now on the market which will take such a current.

A word regarding the economy of traction by storage battery compared with that by means of the overhead wire. It takes an engine of at least 250 horse power, and a dynamo of the same power, constantly running to propel seven cars over the above-mentioned route. To charge 560 batteries that is, one set of 80 cells each for seven cars, would need an engine of 58 horse power, a dynamo of the same power, delivering a current of 35 amperes, and this dynamo would have to run 4 hours.

The dynamo for the overhead system must keep the e. m. f. constant whether seven cars are running or a less number. We find that 10 per cent. yearly on the first cost of the batteries will about make up for any deterioration, and that amount will keep in good order the overhead wires. It might be of interest to mention that the Patton motor system now being tried at Pullman is attracting the attention of street railroad men, not only because it can be made quite independent of short stations, but it does not require the charging batteries, and street cars too lightly made or too old to support a set of heavy batteries can be used as trailers. In this system the locomotive car is something like the grip car in appearance. It carries in the center a gas engine of 7½ horse power, with a tank sufficient to supply fuel for many hours, and a dynamo of 7½ horse power, while underneath are 60 storage cells and a motor of 15 horse power. In front there is still room to seat 20 or 30 persons.

By referring to the data on traction just read you will appreciate the principle and economy of this plan. We learn that an average run on the generally used lines of street railway requires 4½ horse power, and only in starting, ascending grades, or turning short corners is much more power needed. The current necessary to do the work is taken from the battery when the pull comes.

It is found that on a level track two loaded cars can be drawn at the rate of 12 miles an hour, around curves and up 3 per cent. and 4 per cent. grades, and often when the longest runs have been made on a level, needing only 4½ horse power, and the cells have become charged, the engine is shut off and many miles are run with the battery alone. Now, if a 7½ horse power engine and dynamo will do the work, by the use of the most condensed and convenient form of fuel, seven cars would need only 52½ horse power in engines. It is claimed that this car, with one loaded car attached, can be run at a cost of 1¼ cents per hour. The size of the oil tank, which it would be convenient to carry, would be the only limit to the distance run. Of course stations at proper distances could be made to renew the tanks. In a short time every day work, the only real test, will show just how practical and economical this system can be made.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building. - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DU KERSON, }
J. B. O'HARA, } Associate Editors.
F. L. PERRY, }
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 504 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers, in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Alternating Plant of the Sperry Associate Electric Light Company, Kansas City, Illustrated	1
Chicago Electric Club Banquet	1
Decision against Kemmler	1, 2
Electric Light Suit in Cincinnati	2
The Shaw Electric Crane, Illustrated	2
London Board of Trade Standardizing Laboratory	2
Pattee Lamp-Hour Recorder, Illustrated	3
Evans' Friction System, Illustrated	3
Electric Lighting System, Illustrated	3
Electric Railway Power House, Illustrated	4
The Chelsea Storage Battery Station	4, 5
The Battery in Traction Work, by J. K. Pumpelly, Illustrated (Chicago Electric Club)	5
Editorial	6
Efficiency of the Transformer, by Calvin Humphrey and William H. Powell, Illustrated	7, 8, 9
Electric Adhesion, before Railway Master Mechanics	9
Thermo-Chemistry in Relation to Electromotive Force, by Prof. J. E. Siebel (Chicago Electric Club)	9, 10
Gas and Electric Lighting	10
Some Experiments Upon Alternating Current Apparatus, by Harris J. Ryan, Illustrated (American Institute of Electrical Engineers)	10, 11, 12
The Association of Railway Telegraph Superintendents	12
Lightning Conductors from a Modern Point of View, by Prof. Oliver J. Lodge	12, 13
Improvements in the St. Paul Telephone Exchange	13
The Book Table	13
DEPARTMENTS.	
Correspondence	14, 15
The Electric Light	15
The Electric Motor	15
Electrical Patents	16

THE last meeting of the American Institute of Electrical Engineers was of unusual interest to those who are engaged in the study of alternating current apparatus. Two papers bearing on this subject, which were presented, are published in this issue.

IN another column is presented a description and illustrations of a new electric crane. In this machine the inventor uses electricity to produce the three movements required. Three separate motors are employed, one to move the crane proper, another to shift the trolley, and a third to operate the hoist. The fact that the crane was designed by one who has made a specialty of such work with, it is understood, the most excellent results, will make the study of the details of the mechanism all the more interesting.

MOTORNEERS who have had experience with horses and the cable systems are enthusiastically in favor of the electric car. In giving his opinion, a St. Louis motor man who has had charge of a street car for twenty odd years, expressed his preference for the electric system in this way: "There is no hard work for the muscles on an electric car, though a man's brain is kept wondering why certain movements of the very convenient levers produce certain results. Another immense advantage is the ringing of the bell by the foot instead of the hand. When there is a close call on a cable grip the man wants both his hands to work his levers and cannot get one of them away up above his head to jerk the bell cord, while on the electric car he can sound the gong with his heel, use one hand to shut off the power, and the other to apply the brake."

REFERENCE has been made heretofore to the ill-feeling existing between St. Paul and Minneapolis merchants over the census. Last week another illustration was presented when a leading electrical concern in Minneapolis sent to Chicago for supplies rather than to St. Paul, although they could have been obtained at the latter place in a couple of hours, while two days were required to get them from Chicago. The purchasing agent of the company remarked at the time that he would wait two weeks rather than buy in St. Paul.

The decisions of the courts have not furnished reasons for rejoicing on the part of trusts, yet there seems no inclination to desist from forming combinations. The latest was incorporated at New Jersey by New York, Philadelphia, Chicago and London capitalists last week. It will be known as the American Gas Investment company, and has a capital of $50,000,000. The objects as set forth in the charter are "to construct, acquire, own, manage and operate works for the manufacture, distribution and supply of light, heat and power by gas, electricity or otherwise, and to acquire the stocks and securities of other corporations formed for any similar purpose, and to deal in the same." This is the company recently referred to in the WESTERN ELECTRICIAN, which in connection with the English Gas trust hopes to control the lighting business of the world.

THE New York court of appeals has again decided against Kemmler in the last proceeding which was instituted to save him from electrocution. The court was asked to pass upon the point raised by the prisoner's counsel, whether the provision of the electrical execution act, by which the warden of the state prison, instead of a sheriff, is directed to conduct the execution, was not unconstitutional. The court decided the point without hearing the argument of the attorney-general. He thought that the legislature had the power to take from the sheriff the duty of conducting an execution and vest it in another officer. Up to the present time every question raised by Kemmler's counsel has been decided against him. Unless some new question is raised he will now be resentenced. While the electrical execution law has thus far been sustained at all points where it has been attacked by Kemmler's counsel, the validity of that portion of the act which forbids newspapers to print the facts about the execution of a sentence of a court of law is yet to be judicially settled.

AT the last meeting of the American Institute of Electrical Engineers a paper on the "Efficiency of the Transformer" by Calvin Humphrey and H. W. Powell, was read. The investigation made by the writers was on the general subject of transformers, but particular attention was paid to the behavior of iron in converters when subjected to the action of an alternating current of high periodicity. The investigation was mainly as to the commercial efficiency of the transformer, and was supplementary to a similar test made with a 10-light transformer by Prof. Ryan and Mr. Merritt. A 40-light converter, however, was used in this case, although the method of experiment was substantially the same. Without reviewing the details of the test it will suffice to say that in the case of the 40-light transformer which was, it may be stated, of more recent manufacture, the loss on open circuit was found to be about one-half as great as in the case of the 10-light converter. It is interesting to note that its efficiency stood at 96.2 per cent. for normal load and the "all day" efficiency averaged about 90 per cent. When these figures are compared with the 86 per cent. and 40 per cent. obtained by Mr. Ryan with the 10-light converter, one might be inclined to feel greatly encouraged over the progress made in transformer construction, although the contrast so greatly in favor of the large converter might not unnaturally dismay those operating a number of small converters. It should be remembered, however, that the 40-lighter is of "more recent manufacture." In this connection Messrs. Humphrey and Powell reach the most important conclusion that "the loss due to the reversal of polarity of the iron, may be reduced almost indefinitely by a proper study of the magnetic properties of the iron used." The paper, illustrated with a number of diagrams, is given in another column.

THE Chicago *Tribune* has recently been making a crusade against the dim car lamp which fails so lamentably to illuminate railway coaches. Its New York namesake has joined in the protest and remarks: "On some of the railroad lines of the country, gas is used as an illuminant with pretty satisfactory results, but the proper agent for this purpose undoubtedly is electricity. Experiments which have been made in this direction show that the electric light can be used to great advantage on railway trains. . . . A great many travelers desire to read while going from their offices to their homes, in spite of the warnings of oculists, and the owners of the means of transportation should feel in duty bound to furnish light enough for the purpose." The Chicago paper gives this bit of advice to its readers: "The next railway strike should be a strike of all the people of the United States against the obnoxious car-lamp." The statement in regard to the superiority of the electric light in railway coaches is, of course, entirely correct, though the intimation that electric train lighting is still in an experimental stage would scarcely be generally conceded, in view of the splendid work which has been done in this field in the last year or two.

LIGHTNING is at best an erratic something. For years after Franklin's historic experiment with the kite it was supposed that the old-fashioned low resistance lightning rod well grounded, was an almost absolute protection. But accidents still happened and scientists gradually awakened to the fact that the world's knowledge on this subject was at best but limited. The theories of to-day, however, seem to point toward a more perfect solution of this all-important problem. In a paper presented in another column, entitled "Lightning Conductors, from a Modern Point of View," Prof. Lodge, of England, gives his opinion as to the best means of protection from lightning. "Attention is now being directed," says Prof. Lodge, "not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between."

It is pointed out, contrary to the old-time theory, that the use of "a rod of copper an inch or a foot thick may be too heroic a method." Prof. Lodge bids us remember that an electric discharge, "like the recoil of a spring is very apt to overshoot itself and is by no means likely to exhaust itself in a single swing." Hertz's experiments would appear to substantiate this theory. The "sheathing" of an object, as suggested by Clerk Maxwell, is deemed by Prof. Lodge an absolute protection. But such a plan is impracticable except in a few cases, as for instance, in a wire covered ocean cable. An approximation to the "cage" or "sheath" system may be obtained, thinks Prof. Lodge, by laying wires along all the prominent portions of a building. This plan is being carried out, he states, at the Edinburgh Electrical Exhibition. Prof. Lodge points out that low resistance has no particular advantage. The path of a flash, he says, is a question of impedance, and the impedance of a conductor to sudden rushes of current depends very little on cross sections and scarcely at all on material. In this article a number of suggestions are offered and those of our readers who may be interested in the subject will find Prof. Lodge's paper worth a careful perusal.

Efficiency of the Transformer.[1]

By Calvin Humphrey and William H. Powell.

In pursuing this particular line of investigation, it has been our endeavor to throw some light, if possible, upon the general subject of transformers and upon the action of iron when magnetized and demagnetized by an alternating current of high periodicity.

And in order that the results obtained might have a practical bearing, the conditions of working were made to conform as closely as possible to the conditions under which transformer systems are operated in this country.

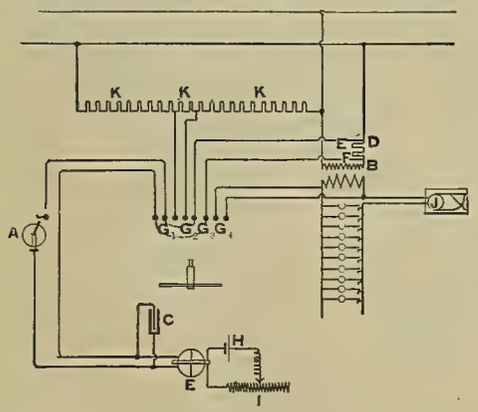
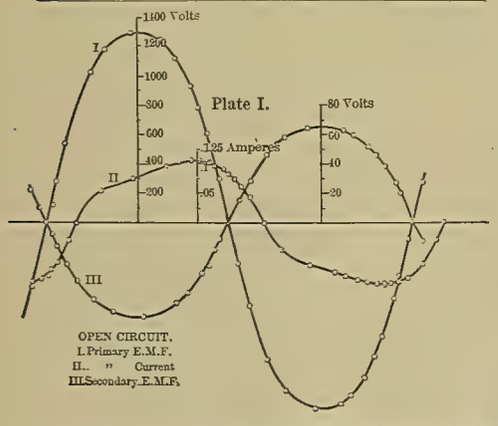


FIG. 1.

The question of the economy of the commercial converter as a transformer of energy has been frequently taken up, both from practical and theoretical standpoints, but with widely varying and conflicting results. The losses in the transformer of the closed circuit type have been considered large and inevitable, so much so, in fact, that Mr. Swinburne has introduced in England a new form of open circuit transformer, known as the "Hedgehog." It has been Mr. Swinburne's endeavor to obviate the dissipation of energy in hysteresis and Foucault currents in a part of the magnetic circuit, by having that circuit closed through

OPEN CIRCUIT. PLATE I.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
18.5	21. Volts	450 Volts.	.104 Amperes
18.2	9.	190	.102
18.	0.	0	.096
17.8	9.	100	.084
17.6	16.5	310	.074
17.3	28.	545	.036
17.	39.	760	.0±
16.5	51.5	1020	.0±
16.	59.	1170	.056
15.	65.	1285	.074
14.	61.5	1223	.094
13.5	57.	1130	.102
13.	47.	925	.104
12.7	40.	780	.104
12.4	27.5	565	.102
12 2	20.	330	.098
12.	9.	245	.096
11.8	0.±	70	.088
11.6	0.±	0	.078
11.3	14.	300	.056
11.	27.5	560	.046
10.5	44.	890	0
10.	56.	1103	.03
9.	63.5	1265	.072
8.	63.5	1285	.09
7.5	60 5	1215	.098
7.	53.5	1085	.104
6.7	47.5	945	.110
6.4	40.	810	.110
6.2	29.	610	.108
6.	26.	545	.106
5.8	18	385	.104
5.5	0 +	110	.098
5.	14.	260	.074



air. But as will be seen later, the perfection of the transformer is to be met in a better grade of iron, rather than in any radical change in design.

The results presented in this paper are of especial interest as being supplementary to the work of Prof. Ryan and Mr. Merritt in the same line, which was presented to the Institute last December. The 10 light transformer which they tested was found to have a remarkably heavy loss on open circuit which was shown to be due almost entirely to hysteresis in the iron. The transformer gave an efficiency of 86 per cent. at normal load, and an "all day" efficiency of about 40 per cent.

In our work on a 40 light transformer of the same design, with the two coils placed side by side in a core of laminated plates (see Fig. 1), but of more recent manufacture, the loss on open circuit was found to be about one-half as great as in the 10 light transformer. Its efficiency reached 96.2 per cent. at normal load, and the "all day" efficiency would be about 90 per cent.

The method employed in the work is substantially Prof. Ryan's method. The instantaneous values were obtained by means of a commutating device attached to the alternator. This device consisted of a wooden disc, mounted rigidly on the shaft of the alternator, with a steel piece at one point in its periphery, which made contact with a small piano wire brush once every revolution. The holder carrying the piano wire brush was attached to a second wooden disc carrying a pointer which moved over a scale and indicated the position of the brush for a given reading. By means of a clamp screw this second wooden disc, carrying the brush and pointer, could be conveniently set at any point. Now since the steel contact in the wooden disc is fixed relatively to the armature, it must share the ever varying e.m.f. of the armature. Then evidently if the brush which completes the circuit through the contact be altered in position, values can be obtained for different points on the curves of e.m.f. and current.

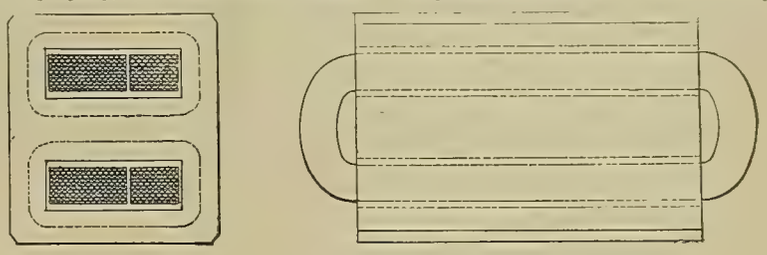


FIG. 2.

The Ryan quadrant electrometer was used to measure the primary e.m.f., secondary e.m.f. and primary current. A condenser was connected in multiple with the electrometer. The primary current was measured by the fall of potential through incandescent lamps placed in series with the primary of the transformer. These lamps were carefully calibrated with the standard instruments of the laboratory, in order to know their resistance at different temperatures. Then, knowing the resistance of the lamps and the potential difference at their terminals, the current flowing at once becomes known.

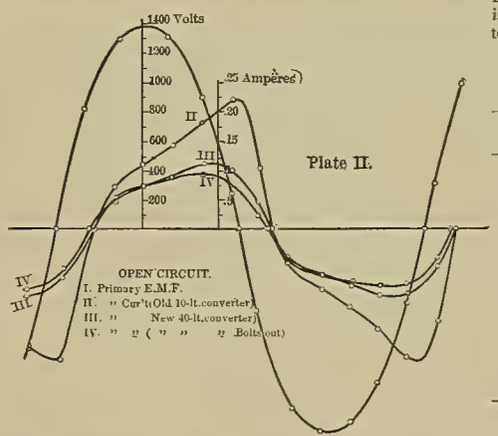
To measure the primary e.m.f., twenty-two 50 volt lamps were placed in series across the primaries. The electrometer was connected around two of these lamps, and the whole number calibrated in order to know just what part of the total impressed e.m.f. was measured. The secondary e m.f was measured direct. The secondary current was measured by means of an electro-dynamometer, which was carefully calibrated both before and after the experiments and was found to be constant. The commutating device was placed in series with the electrometer. Wires were run from the terminals from which measurements were desired, to a convenient switch-board.

In obtaining the Ewing card of hysteresis of the iron core of the transformer, current from a storage battery was sent through the secondary circuit, and the magnetization set up in the core was measured by the "*kick*" on a ballistic galvanometer in the primary circuit. The current in the secondary was gradually increased until the intensity of magnetization corresponded with the maximum magnetic density of the transformer when working on 1000 volt circuit. The current was then decreased, gradually, until zero was reached. It was then reversed and the method continued until a complete cycle of magnetization had been covered.

It is worthy of mention that this method, which gives something so definite and fundamental in the treatment of the alternating current, has only come into use within the past year, and the task of getting true instantaneous values of the complete waves of e.m.f. and current, which has always been considered too tedious for ordinary patience to deal with, was accomplished with ease in this work in forty-five minutes. A calibrated scale for the electrometer readings added very much to the facility with which observations could be taken.

PLATE II.

Open Circuit (Old 10-lt Converter.)			(40-lt Converter. Bolts Out.)		
BRUSH.	P. E. M. F.	P. C.	BRUSH.	P. E. M. F.	P. C.
19	825	.196	19	775	.098
18	6	.225	18	0	.089
17	840	.042	17	845	.0
16	1320	.075	16	1245	.048
15	1420	.117	15	1355	.074
14	1345	.143	14	1290	.09
13	1010	.18	13	965	.09
12	230	.22	12	235	.074
11	630	.1	11	590	.0
10	1115	.058	10	1140	.043
9	1395	.1	9	1325	.074
8	1420	.13	8	1312	.09
7	1195	.17	7	1103	.1
6	570	.217	6	520	.1
5	50	18	5	318	.058
4	1060	0	4	1014	0



The Ryan quadrant electrometer was used to measure the primary e.m.f., secondary e.m.f. and primary current. A condenser was connected in multiple with the electrometer. The primary current was measured by the fall of potential through incandescent lamps placed in series with the primary of the transformer. These lamps were carefully calibrated with the standard instruments of the laboratory, in order to know their resistance at different temperatures. Then, knowing the resistance of the lamps and the potential difference at their terminals, the current flowing at once becomes known.

To measure the primary e.m.f., twenty-two 50 volt lamps were placed in series across the primaries. The electrometer was connected around two of these lamps, and the whole number calibrated in order to know just what part of the total impressed e.m.f. was measured. The secondary e m.f was measured direct. The secondary current was measured by means of an electro-dynamometer, which was carefully calibrated both before and after the experiments and was found to be constant. The commutating device was placed in series with the electrometer. Wires were run from the terminals from which measurements were desired, to a convenient switch-board.

In obtaining the Ewing card of hysteresis of the iron core of the transformer, current from a storage battery was sent through the secondary circuit, and the magnetization

The marked improvement of the 40 light transformer over the 10 light is due, we believe, to an improvement in the magnetic properties of the iron and a fewer number of turns in the coils, made possible by the better grade of iron.

In the 10 light transformer, Foucault currents were very effectually weeded out by the interposition of sheets of paper between the laminated sheets of iron. In the 40-light, the oxide of iron on the surface of the plates was the only safeguard against Foucault currents.

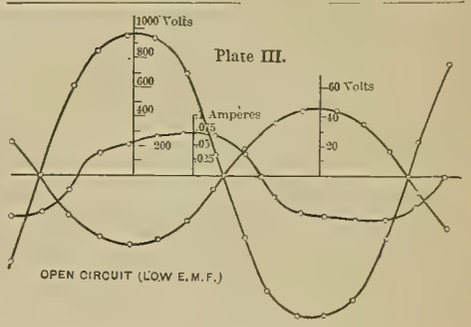
The form and extent of the open circuit curves show the loss due to hysteresis and the slight loss also due to Foucault currents. The presence of Foucault currents is indicated by the fact that the maximum of the primary current wave does not occur simultaneously with the zero of the primary e m.f., but a little before. It is found upon analysis of the primary curve into its elements, hysteresis and Foucault currents (see plate XIII), that the Foucault current component occurs 120 in advance of the theoretical magnetization curve, and not 90 in advance as has generally been assumed. Therefore when superimposed upon the hysteresis curve, it introduces a component in advance, and thereby decreases the lag of the primary current.

The primary current curve was again taken with the laminated plates loose and free to vibrate. The loss was about 10 per cent. less than in the former case (plate II). This is thought to be brought about by the decrease in the hysteresis loss, due to the increased mechanical shock, arising from the free vibration of the plates. The vibration *was* very perceptibly increased. The curve obtained is more regular in form, indicating less hysteresis loss.

PLATE III.

OPEN CIRCUIT, LOW E. M. F.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
19	24.5	595	.07
18	0.	0	.065
17	27.5	530	0
16	42.	870	.04
15	47.	965	.055
14	45.	950	.07
13	33.	715	.078
12	8.	180	.07
11	19.	420	04
10	39.	835	.0+
9	45.	960	.065
8	46.	945	.07
7	38.	8 0	.075
6	16.5	395	.07
5	8.	210	.05
4	35.5	755	0



The lag of the primary current behind the primary e. m. f. is seen to be greatest when the secondary circuit was open and decreases as a non-inductive load is introduced into the secondary circuit. This tendency of the lag of the primary current to decrease with increase of load continues until the curve of primary current comes into unison with the curve of secondary e.m f.

The secondary e.m.f. is in unison with the primary e m.f. on open circuit and gradually falls behind as the load increases on the secondary. This is doubtless due to

[1] Read before the 48th meetiug of the American Institute of Electrical Engineers, New York, June 17, 1890.

the leakage of lines of force arising from the enormous magnetizing forces at work in opposition to one another in the primary and secondary circuits.

When an inductive resistance is introduced into the secondary circuit, the lag of the primary current is greatly increased, as shown by the set of curves in plate X. The inductive resistance used in this case was due to a small alternating current motor. The curve of secondary current was also taken and found to lag behind the secondary e. m. f. and to be in unison with the primary current. About 5.5 amperes flowed in the secondary and yet the lag of primary current is as great as on open circuit.

Plate XI shows the relation of primary current and primary e. m. f. when the secondary was closed through the secondary of a 20-light transformer whose primary remained open. The current curve shows a distinctive lag from the inductive resistance and is altered in form to a great extent.

The outside loop in Plate XII is the loop of total loss hysteresis and Foucault currents—deduced from the open circuit curves in the following manner: The current which flows to maintain the counter e. m. f of the transformer on open circuit obviously includes the losses due to Foucault currents and hysteresis. If then a magnetization curve whose maximum has been computed, be drawn in 90 degrees behind the curve of primary e. m. f. and of the same form—since it is a function of the e. m f.—and a curve be plotted using ordinates of primary current as abscissæ, and corresponding values of lines of force from the theoretical magnetization curve, as ordinates, the outside loop in Plate XI is obtained.

The inside loop is the ordinary Ewing card of hysteresis loss found by carrying the iron slowly through a complete cycle of magnetization. The lines of force were computed from the "*kick*" on a ballistic galvanometer. This card has in it no Foucault current effects. If then we reverse the above method, and from the Ewing card and the magetization curve deduce a primary current curve, we shall have a curve representing hysteresis loss for this iron.

This was done, and it is of especial interest to note that the form of curve obtained in this manner is identical with the open circuit curve of the 10 light transformer in which Foucault currents were suppressed by the interposition of sheets of paper (see curve III, plate XIII). Having then two curves plotted to the same scale, one representing total loss and the other hysteresis loss, if we subtract ordinates of the latter from corresponding ordinates of the former, a curve representing the component due to Foucault currents will be obtained (curve IV, Plate XIII). It was in this manner that the analysis before referred to was made. The position of the Foucault current component accounts for the round corners in the outside loop of Plate XII.

From Plate IX will be seen the watt-curves for an open circuit loss, one for 990 volts and the other for 740 volts. From the value of the mean ordinates it is seen that the loss varies strictly as the square of the impressed e. m. f.

In Plate II is plotted to the same scale the current which flowed on open circuit in case of the 10-light transformer and the 40-light transformer.

Plates IV, V and VI, show the curves of primary e. m. f. and current and secondary e. m. f. for different loads, from which the watt-curves of Plate VII, are computed by taking the product of corresponding ordinates of primary e. m. f. and current.

The efficiency curve shown in Plate VIII is the ratio between the energy of the primary circuit as indicated by the mean ordinate of the watt-curve, and the energy of the secondary circuit as expressed by the product of the $\sqrt{\text{mean}^2}$ readings for e. m. f. and current over. The coercive force is equal to 0.8 C. G. S.

These considerations go to show that the loss due to the reversal of polarity of the iron, which perhaps must always be present, may be reduced almost indefinitely by a proper study of the magnetic properties of the iron used.

The watt-curve in plate XIV shows the relation between the total loss on open circuit and the loss if Foucault currents were eliminated.

PLATE IV.

SECONDARY CURRENT, [illegible] AMP.

BRUSH	S. E. M. F.	P. E. M. F.	P. C.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	.28
[illegible]	[illegible]	[illegible]	.86
[illegible]	[illegible]	[illegible]	1.85
[illegible]	[illegible]	[illegible]	1.88
[illegible]	[illegible]	[illegible]	1.87
[illegible]	1145	1195	1.74
[illegible]	[illegible]	[illegible]	1.64
[illegible]	[illegible]	[illegible]	1.43
[illegible]	[illegible]	[illegible]	1.07
[illegible]	[illegible]	[illegible]	.16
[illegible]	575	595	.88
[illegible]	[illegible]	[illegible]	1.09
[illegible]	[illegible]	[illegible]	1.11
[illegible]	[illegible]	[illegible]	1.57
[illegible]	1195	1250	1.60
[illegible]	[illegible]	[illegible]	1.66
[illegible]	[illegible]	[illegible]	1.58
[illegible]	[illegible]	[illegible]	1.55
[illegible]	[illegible]	[illegible]	[illegible]
5.5	10.	0	.31
[illegible]	[illegible]	[illegible]	.17

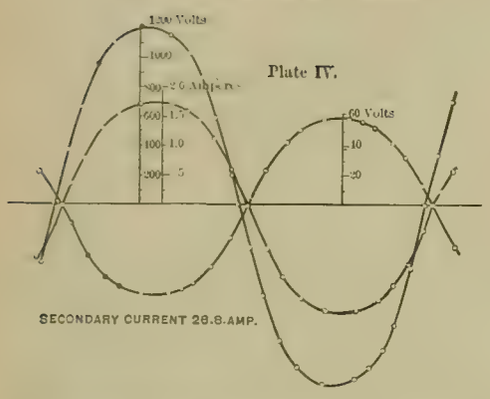


PLATE V.

SECONDARY CURRENT, 44 AMP.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
[illegible]	[illegible]	[illegible]	1.9
[illegible]	[illegible]	0	.37
[illegible]	10	45	.5-5
17.	[illegible]	745	1.3
[illegible]	[illegible]	[illegible]	1.93
[illegible]	[illegible]	[illegible]	2.4
[illegible]	55-5	[illegible]	2.77
[illegible]	[illegible]	[illegible]	2.67
13.5	[illegible]	1060	2.58
[illegible]	[illegible]	[illegible]	2.3
[illegible]	[illegible]	625	1.9
[illegible]	[illegible]	[illegible]	1.13
[illegible]	[illegible]	[illegible]	32
11.	0.	[illegible]	.48
[illegible]	11.	745	1.1
[illegible]	[illegible]	[illegible]	1.08
9.	40.	[illegible]	2.6
8.	54.	[illegible]	2.84
[illegible]	[illegible]	[illegible]	2.77
6.5	450	1195	2.07
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	2.23
6.	[illegible]	510	1.65
5.5	[illegible]	[illegible]	.97
[illegible]	[illegible]	[illegible]	0.

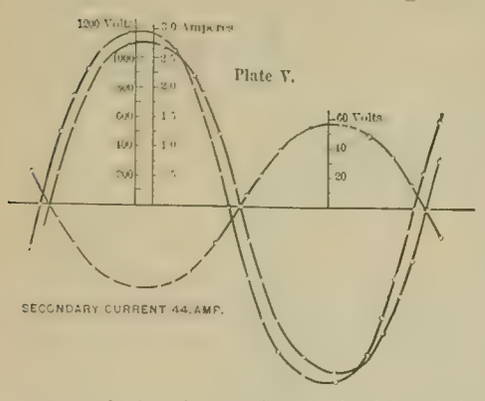


PLATE VI

SECONDARY CURRENT, [illegible] AMP.

BRUSH	S. E. M. F.	P. E. M. F.	P. C.
19	15.	745	8
18	11	[illegible]	1.66
17	21	745	1.23
16	17	[illegible]	3.45
15	[illegible]	1245	4.3
14	60	1195	4.35
13	1	[illegible]	3.8
12	[illegible]	240	1.85
11.	[illegible]	55	.4
10	40.	1.05	2.9
[illegible]	55	1225	4.1
8	50	1245	4.5
7	55	1170	4.25
6	17	175	2.83
5	0.	235	.05
1	[illegible]	[illegible]	[illegible]

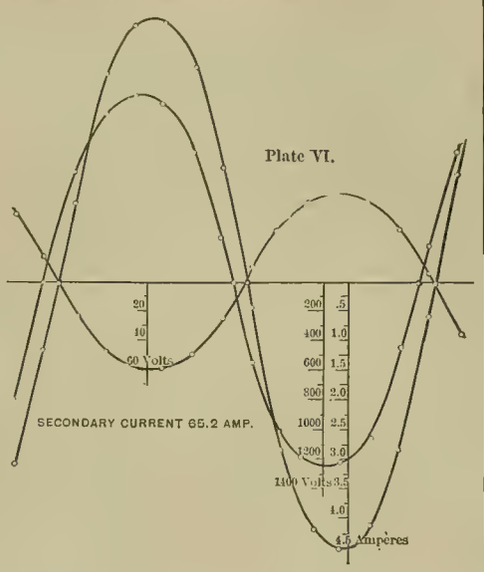
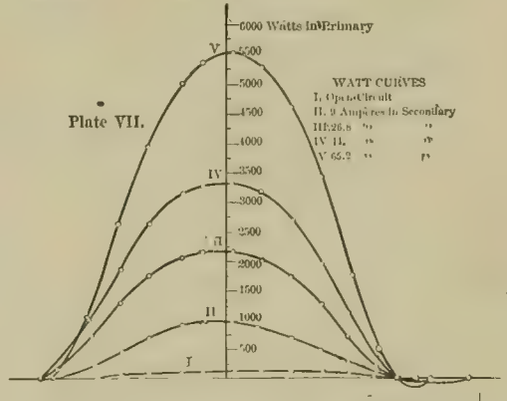


PLATE VII. WATT CURVES.

AMPERES IN SECONDARY

Open-Cir	9	26.8	44.	65.2	Brush.
—22.1	0	0	180	[illegible]	18.
7.9	148	[illegible]	960	1020	17
31.6	460	1230	1750	2050	16.5
63.8	795	1720	2600	[illegible]	16.
82.	880	2010	3080	4280	15.5
96.	970	2130	3250	5350	15.
105.	980	2160	[illegible]	5520	14.5
116.	1050	2620	3170	5250	14.
113.	760	1715	2700	4600	13.5
96.5	450	1220	1950	3140	13
65	150	600	1170	1800	12.5
22.8	50	115	253	413	12.
—10.5	0	0	350	—96	11.5
—25.2	[illegible]	[illegible]	250	[illegible]	11



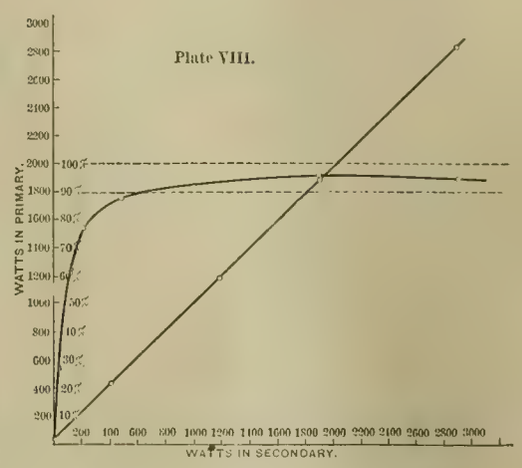
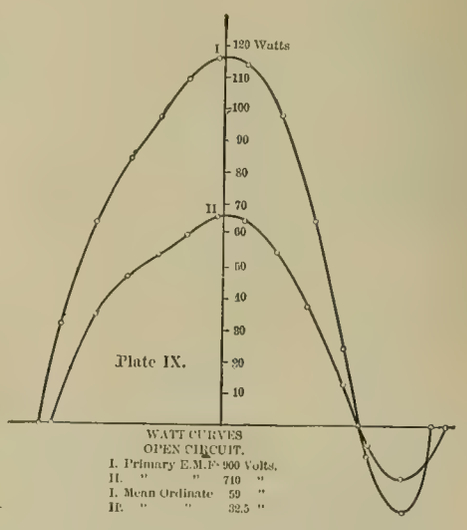


PLATE IX.

WATT CURVES. OPEN CIRCUIT.

No.	990 VOLTS.	740 VOLTS.
16.9	0.	
16.7		0.
16.5	30.5 Watts.	11.5
16.	64.	34.
15.5	82.	46.5
15.	96.	53.5
14.5	111.5	61.
14.	116.	66.
13.5	113.5	64.
13.	97.	54.
12.5	65.	35.5
12.	23.	12.5
11.7	0.	0.
11.5	—10.5	—7.5
11.	—25.	—17.
10.5	0.	7.
10.3		0.



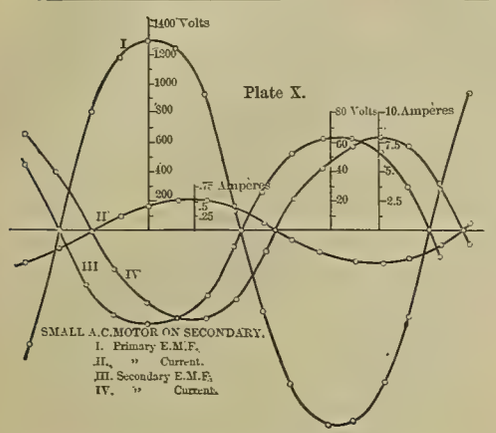
Electric Adhesion Before the Railway Master Mechanics.

A correspondent sends the following: At a recent convention of the American Railway Master Mechanics association, held at the Hygeia Hotel, Old Point Comfort, Va., there was exhibited a small working model illustrating the operation of the Ries electric traction increasing system as applied to steam locomotives. This exhibit attracted considerable attention and was the occasion of no little aston-

PLATE X.

SMALL ALTERNATING CURRENT MOTOR ON SECONDARY.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.	S. C.
19	30.	780	.53	7.36
18	0.	0	.35	4.48
17	40.	790	0	0.
16	60.	1195	.25	3.52
15	64.	1310	.43	6.2
14	61.	1240	.53	7.5
13	46.	930	.54	7.5
12	11.	140	.42	5.76
11	26.	570	.12	0.
10	55.	1115	.14	2.89
9	63.5	1305	.375	4.47
8	63.5	1310	.50	7.20
7	53.	1095	.55	8.32
6	27.5	560	.49	7.20
5	14.	290	.25	3.52
4	47.	950	.0	0.

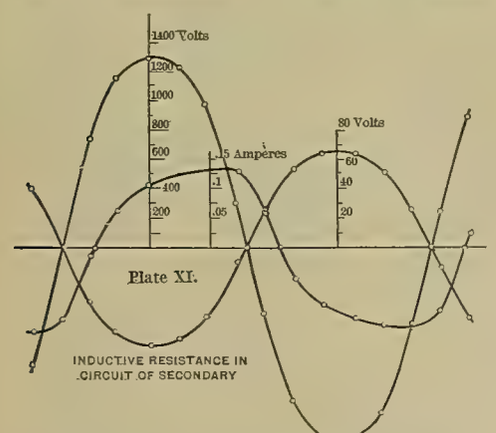


ishment among those of the master mechanics who hitherto believed that there was nothing to equal sand as a traction increaser. The passage of a low tension current between the driving wheels and rails enabled the locomotive to readily ascend grades varying from 20 to 45 per cent. in steepness, whereas without this current the revolving driving

PLATE XI.

INDUCTIVE RESISTANCE OF SECONDARY.

BRUSH.	S. E. M. F.	P. E. M. F.	P. C.
19	39.	790	.147
18	0.	0	.126
17	40.	770	0
16	61.	1185	.066
15	67.	1310	.108
14	63.5	1245	.126
13	48.5	950	.135
12	11.	230	.135
11	26.	515	.06
10	56.	1103	.05
9	66.	1315	.099
8	65.5	1295	.12
7	56.	1105	.126
6	26.	545	.126
5	14.	260	.108
4	48.	930	0



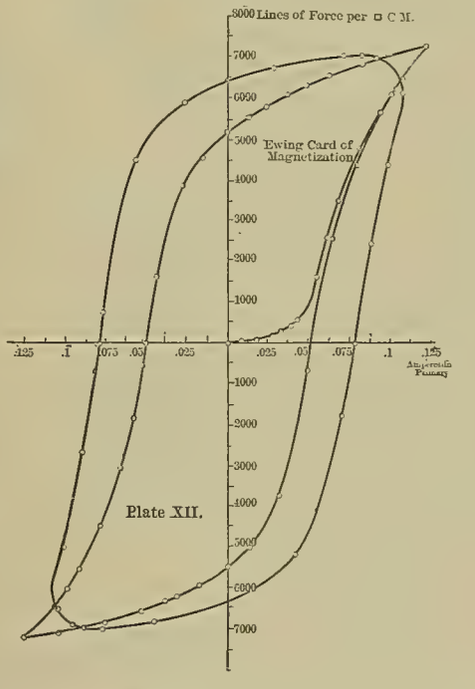
wheels were unable to make any headway on grades considerably less severe than the one first mentioned. The pulling capacity of the locomotive on a level track was very greatly increased by the passage of the current, and it was also shown, much to the surprise of the expert master mechanic, that the increased tractive adhesion resulting therefrom was not diminished when the rails were wet or coated with oil. The remarkable efficiency of the traction increasing current as a breaking agent was likewise exemplified by its promptness in arresting the momentum of the locomotive on a steep down grade while sliding rapidly from the top toward the bottom of the latter.

Drawings showing the application of the system to full-sized locomotives were exhibited, and were critically examined. The apparatus was in charge of Elias E. Ries, who was kept busy in explaining its operation. The system has already been successfully applied to railway locomotives, and further experiments in this direction are now being made.

It is claimed that by means of this system the traction power of locomotives may be increased fully 25 per cent. over what it is at present; that engines thus equipped will be enabled to draw longer and heavier trains, to mount steeper grades and to make better time; that the wear and tear upon the wheels and rails due to slipping and the use of sand is avoided; that light locomotives that have sufficient steaming power can do the work of heavier engines, thus avoiding the increased strain upon rails, road bed, bridges, etc., and in many instances render the reconstruction of the latter for heavier traffic unnecessary; that the condition of the weather cannot effect the schedule time by reason of lessened tractive adhesion, as at present; that trains may be brought under headway and stopped more quickly by reason of the absence of slipping of the drivers due to the

PLATE XII. EWING CARD.

No.	P. Current.	C. G. S. Lines per □ c. m.	No.	P. Current.	C. G. S. Lines per □ c. m.
1	01	36	24	—.015	4445
2	00	96	25	.027	3828
3	03	180	26	—.042	1660
4	.035	246	27	—.05	900
5	.04	312	28	—.056	1890
6	.045	420	29	—.067	3020
7	.053	635	30	—.073	4425
8	.058	1630	31	—.09	5565
9	.063	2548	32	—.095	6005
10	.07	3515	33	—.103	6615
11	.083	4775	34	.12	7200
12	.095	5945	35	—.103	7125
13	.105	6312	36	—.085	7028
14	11	6635	37	—.07	6812
15	.12	7120	38	—.05	6615
16	.102	7075	39	—.017	6410
17	087	6830	40	—.03	6270
18	.063	6555	41	—.015	6035
19	05	6350	42	0	5665
20	.04	6180	43	.033	3820
21	027	5892	44	.067	2550
22	.015	5634	45	.103	6240
23	0	5124	46	.12	7015



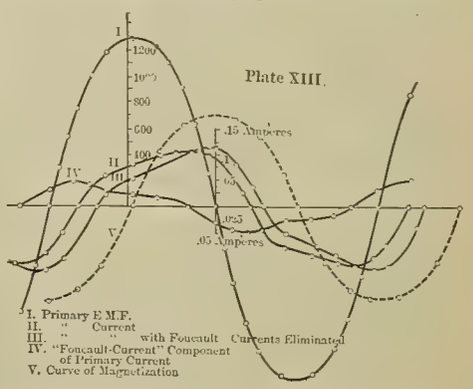
action of the current; that the consumption of the fuel for generating the traction current is considerably less than the saving in fuel effected by the absence of slipping alone; that in many cases the running of passenger and freight trains in separate sections may be avoided, as well as the expense and delays to traffic occasioned thereby; that a passenger or freight train drawn by a locomotive equipped with this system is safer and under more perfect control on steep grades, and finally, that the earning capacity of a line of road having its engines so equipped can be very largely increased.

While the work of transformation is in progress the people of Minneapolis and St. Paul will have an opportunity to cultivate appetites and tempers while stretching their limbs. The streets are torn up and neither electric nor animal power is used on the street railway lines. Comparatively few cars are in operation in the Twin cities and owing to the condition of the streets it is almost impossible to drive in any quarter of these cities The line connecting the two cities is about completed but cannot be operated until the rest of the plant is started. The track is laid and the poles and wires are up but the power stations are not completed.

Thermo-Chemistry in Relation to Electromotive Force.[1]

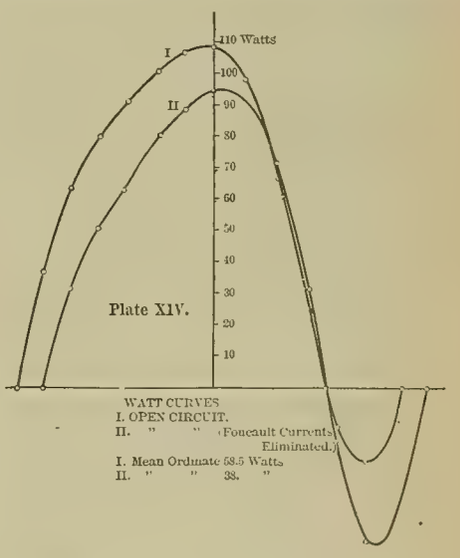
BY PROF. J. E. SIEBEL.

The quantative relations between the chemical changes taking place in a galvanic battery and the quantity of electric power generated by such a battery are well understood. The amount of heat generated in the whole circuit is equivalent to the total electric power or volt-amperes (electromotive force current strength) generated by the battery, and also equivalent to the amount of heat which would be produced by the chemical changes going on in the battery, had the same not been converted into electric energy. Attempts have also been made to establish relations between the electromotive force, and the chemical changes going on in a battery, and according to Sir William Thomson, the amount of heat due to the chemical changes going on in a battery while one molecule of zinc is dissolved is proportional to the electro-



motive force of such battery. This, indeed, happens to come out correctly in the case of some constant batteries having depolarizer, but it can be readily seen that it is not generally applicable. Take, for instance, the case of several elements each made up zinc as the electro-positive metal, acidulated water, and another more electro-negative metal, say iron, copper, silver, etc. In the case of each of the different elements so formed the electromotive force is a widely different quantity, while the heat equivalent to the chemical changes in the battery while one molecule of zinc is being dissolved is the same in all cases, since no chemical changes take place in the negative electrodes.

Considerations of this kind and the conviction based upon the result of certain deliberations, the drift of which it is not desirable to enlarge upon at present, that definite relations of some kind must exist between the chemical changes in, and the electromotive force of, a battery, have led me to the elaboration of a formula, which I think covers the subject quite satisfactorily. At present I will only consider its application to batteries consisting of two metals and diluted sulphuric acid. The electromotive force of such elements is, according to the inference drawn by me, nearly proportional to the difference of the heat which a molecule of each one of two metals would evolve by being acted upon by diluted sulphuric acid independent of the battery, under favorable conditions. In order to establish the correctness of this assertion I submit the following tabula, which also will more readily show the import of the rule referred to. The first column in the table gives



the names of the various metals, the second column, their electromotive force in juxtaposition to dilute sulphuric acid expressed in volts. In these figures the electromotive force of zinc may be considered as a number somewhat arbitrarily chosen, yet with reference to it the other figures represent the electromotive force as established by Hockin and Taylor (*Journal of Telegraphic Engineers*, 1879). The third column shows the relative amount of heat in calories generated by one molecule of the different metals in being dissolved by diluted sulphuric acid. It is readily seen that the heat evolved increases with the electromotive force evolved in volts multiplied by 1,000, produced by the

[1]Read before the Chicago Electric Club, June 27, 1890.

combination per molecule of the respective metal with sulphuric acid and the elements of water.

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	0.0155
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Not determined.	Not determined.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Not determined.	Not determined.
[illegible]	[illegible]	" "	" "
[illegible]	[illegible]	" "	" "
[illegible]	[illegible]	[illegible]	[illegible]

Although the figures in the fourth column are by no means exactly alike, as they should be in accordance with the theory propounded, yet they show plainly enough that a direct quantitative relation exists between the electromotive force and heat of combination. Moreover, it should be considered that it would have been a very easy matter to make them correspond entirely with my theory by substituting the values of some electromotive forces such as have been obtained by some other observers. Furthermore, it is also to be presumed that other atomic properties do in some measure affect the above relation. Indeed the fluctuations in column 4, in some measure, appear to follow the fluctuation in the atomic volume of the different metals.

So far as limited observations in regard to electromotive forces and thermo-chemical phenomena have enabled me to go, I find the above relations maintained in batteries composed of other materials than the ones selected above; morever, the application of the law of Sir William Thomson, above quoted, in regard to certain batteries, would seem to be a special case falling under the above generalization.

As stated, the values of electromotive forces in the second column of the above table are based on the determinations made by Hockin and Taylor. They were, however, reduced to zinc not amalgamated. In the case of sodium and potassium the electromotive force had to be corrected also, as a solution of sulphate of zinc was used instead of a diluted sulphuric acid in their case Carbon not being mentioned by them, this item was supplied from the observation of Branly (Ann. sc. de l'ecole normale, 2 p. 228, 1873). The thermo-chemical data in the third column were taken from a table in "A. Naumann's Thermochemic," 1882, page 481. The item relating to carbon, representing the heat evolved by carbon in combining with hydrogen, was taken from the same source, page 413, and it is placed in the negative, representing, as it does, not an actual change but a demonstration of an affinity or tendency, acting in opposite direction to that of zinc and other more electro-positive metals, the tendency of which is to form oxygen compounds under the circumstances in consideration It will also be noticed that the relative electromotive forces will not be changed by adding or subtracting the same number in case of each of the figures in the second column, and that by changing these figures in this manner the relations referred to may possibly be brought out more correctly.

Connected with the above subject, at least as regards the theoretical consideration involved in both, is a method of producing refrigeration by means of electricity planned some time ago. It contemplates the creation of cold in such a manner that the heat abstracted from the medium to be refrigerated is made a source of power, instead of being wasted, as is done in the refrigerating machines of the present. This it is proposed to bring about by the decomposition of water under high pressure by an electric current produced by a dynamo or otherwise.

The gases so produced, that is, hydrogen and oxygen, either singly or mixed, are used to propel engines by reason of the energy they possess being under high pressure.

After having done work in this manner, and having had their temperature reduced correspondingly, the gases can be used for refrigerating purposes by being carried through the rooms to be cooled. After this the gases, by virtue of their chemical affinity toward each other, still possess sufficient energy to be utilized in the form of electricity or mechanical force for the decomposition of the water. In this manner the power of the engine in which the compressed gases expand and the refrigeration would be clearly gained. This of course is speaking theoretically. Practically there are, of course, losses of power, the extent of which I have not yet undertaken to determine. Theoretically speaking, however, I have been unable to find any principal objection to the system proposed, but am very much pleased to have had an opportunity to lay the subject before a body of men, some of whom, doubtless, would be able to point out such difficulties, if they really exist.

To caution those who are apt to see an attempt at perpetual motion in the method referred to, I will distinctly state that it involves nothing of the kind. It is a system calculated to effect the conversion of low differences of heat potential into mechanical power, but it is not an attempt to create power from nothing, which is the essential of perpetual motion as it is popularly understood. For although, theoretically speaking, such an arrangement would keep in motion forever under ordinary circumstances, after being once set in motion on the above plan, yet it would stop at once if the difference between the temperature of the expanded gases and that of the rooms or tanks to be refrigerated should fall below a certain limit, as might indeed happen in cold weather or in a cold climate.

Gas and Electric Lighting.

Editor Western Electrician — In your issue of the 21st inst., I note comments on a circular sent you from this company, and as you are disposed to question the facts and conclusions therein set forth, I beg a small space to set this company right in the matter. The replies printed were obtained during last summer, and therefore some of the figures given, as to rates, etc., are necessarily incorrect at the present time. The answers were, as has been stated, from the lighting companies in the different cities listed, and we have the originals on file. The compiler endeavored to be fair and just in his conclusions, and contends that the facts as published bear him out.

I would state, for the information of your readers, that this company was one of the first to introduce electricity as an adjunct to its gas lighting; it commenced the supply of arc lamps, both for commercial and city street lamps, in the latter part of 1884, and about one year ago commenced the supply of incandescent lamps to consumers. It has the second largest plant (building, engines, dynamos and lamps furnished) west of the Rockies, San Francisco being first. This company has pushed the lighting by electricity as zealously as by gas, and while it adheres to its position that the lighting of cities by gas lamps with best burners obtainable is for many reasons (too numerous to state in this reply) the best, safest and most effective means of illuminating street and highways, where high buildings or thickly foliaged trees abound, it still admits the position which electricity has assumed in the lighting world, and will continue to give its customers either gas, arc or incandescent lamps for the illumination of their streets, houses and stores, as they may deem best suited to their wants.

Trusting that you will correct the impression that either this company, or the compiler of its statistics, are hostile to electric lighting.

I am yours very truly,
JOHN A. BRITTON.
Secretary Oakland Gas, Light & Heat Company.
Oakland, Cal., June 25, 1890.

Some Experiments Upon Alternating Current Apparatus.[1]

By HARRIS J. RYAN.

It is well known that when the core of a transformer is heated under certain favorable conditions, the secondary will deliver electrical energy in amount considerably greater than when the core is not heated, and that this is done, too, without an increase of the energy that is supplied to the primary. In fact, we are told that on heating the core of the properly constructed transformer that there will follow

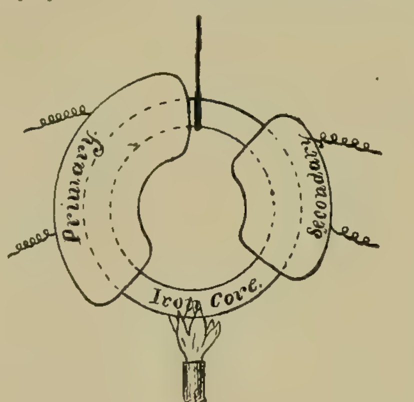


FIG. 1.

a diminution of energy taken up by the primary and a considerable increase in that given out by the secondary.

In some recent experiments made in the Physical Laboratory of Cornell University, it was not possible to obtain the above effect. L. B. Marks, a student in electrical engineering at Cornell, made an apparatus that differed materially from the forms that were first made use of in which he found this phenomenon very marked.

For two reasons do we think that the details of the performance of Mr. Marks' apparatus will be of interest to the members of the institute—first, that they indicate clearly the source of energy in the phenomenon observed with his apparatus, and second, that they show in exaggerated form certain phenomena that must be done away with

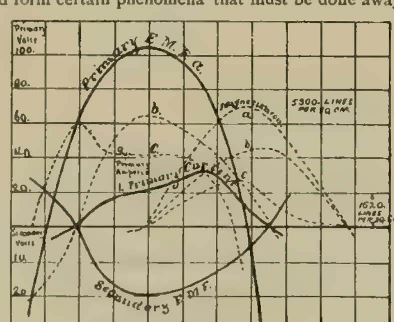


FIG. 2.

in a transformer that is to be used for incandescent lighting.

A good idea of the apparatus will be obtained by a glance at Fig. 1. The core consisted of nine well-rusted rings 1.1 cms. thick and of a mean diameter of 17 cms. each. The number of turns on the primary was 500; on the secondary 155; size of bare copper wire in each was No. 18 B. & S. guage. The wire was insulated with asbestos paper, and because of its thickness, the primary and secondary turns with their insulation occupied a space of abnormal proportions. The resistance of the primary was 1.65 ohms, and that of the secondary was 0.71 ohms.

The maximum magnetization used in the core in any of the experiments here described was not above 3,000 lines per square cms.

The diagrams, Figs. 2, 4, 5 and 6, represent graphically the observations that were made with the apparatus.

From these diagrams are deduced the following results:

Fig. 2. Secondary open; no extraneous heat applied; tem

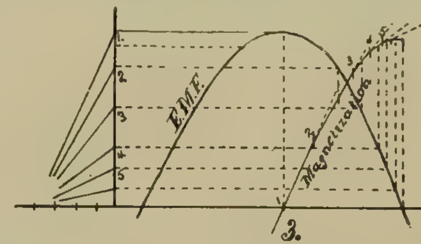


FIG. 3.

perature of the core, 97.5 C; primary e. m. f., 75.6 volts; secondary e. m. f., 16.4 volts; ratio $\frac{75.6}{16.4}$ 4.6; secondary current, 0.0.

Figs. 3 and 4. Secondary open; core heated; temperature

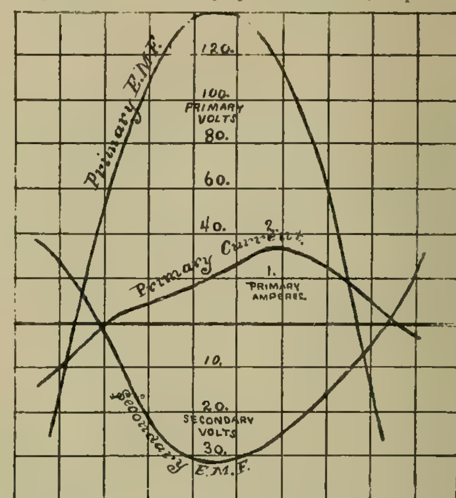


FIG. 4.

of core, 300 C; primary e. m. f., 99.4 volts; secondary e. m. f., 24.5 volts; ratio, $\frac{99.4}{24.5}=4$; secondary current, 0.0.

Fig. 5. Secondary closed; no heat applied; temperature of the core, 100.0 C; primary e. m. f., 89.3 volts; secondary e. m. f., 11.9 volts; ratio, $\frac{89.3}{11.9}=8.1$; secondary current, 2.0 amperes.

Fig. 6. Secondary closed; core heated; temperature

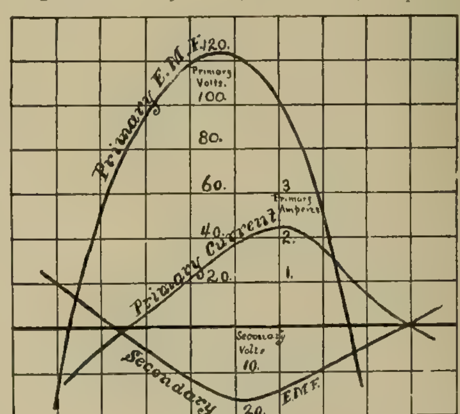


FIG. 5.

of core, 270 C; primary e. m. f., 95.7 volts; secondary e. m. f. 13.4 volts; ratio, $\frac{95.7}{13.4}=7.1$; secondary current, 2.4.

TABLE I.

	Temp.	Primary E. M. F.	Primary Watts	Secondary Watts.
2. Secondary open, no heat applied to core	97.5° C	75.6	87.	0.0
4. Secondary open, heat applied to core	300.° C	99.4	98.	0.0
5. Secondary closed, no heat applied to core	100 ° C	89.3	139.	24.
6. Secondary closed. heat applied to core	270.° C	95.7	120.	36.7

Data are presented in the latter part of this paper showing that it is correct to assume for small ranges that the loss in the core is proportional to the square of the primary e. m f.

We can, therefore, deduce from Table 1 the results that

1 Read before the American Institute of Electrical Engineers, New York, June 17th.

would have been obtained with 90 volts as the primary e. m. f. for the four experiments.

TABLE 2.

Primary, 90 volts. 120.

	Temp.	Loss in core.	Primary Watts.	Secondary Watts.
2.	97.5° C	122.	122.	0.0
4	300.° C	72.	72.	0.0
	270.° C	79. (estimated)	79	0.0
5.	99.° C	117.	131.	24. corrected for resistance of secondary
6.	270.° C	∞	116.7.	36.7 corrected for resistance of secondary

The figures in Table 2 show clearly that the loss in the core is greatly diminished when its temperature is elevated, i. e., when heat is applied, and that the loss in the core is practically independent of the output. The results indi-

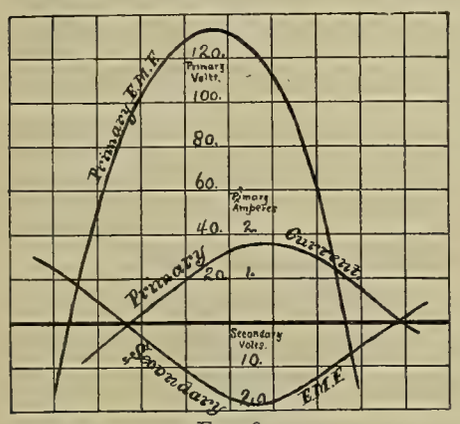


FIG. 6.

cate that with the secondary open and the primary at a difference of potential of 90 volts without heat applied, the core came to a temperature of 97° C, and dissipated 122 watts; then by the application of heat with the Bunsen burner, as indicated in Fig. 1, the temperature of the core was raised to 300 C, and was found to take up 72 watts. Now, if we assume the change in watts dissipated in the core to be approximately proportional to the changes in temperature that produced the same, then we see by estimation that 79 watts would have been dissipated by the core at 270 C, while 30 watts were found to have been dissipated by it at that temperature when the secondary was closed, and gave an output of 32 watts.

It is perfectly plain, therefore, why we can close the secondary, take from it 32 watts, elevate the temperature of the core 170° .C, and have the primary take up 5 watts less than when the secondary was open, and the core at the lower temperature.

Since the effect is due only to the fact that the core takes much less energy at higher than at lower temperatures, and since the core can dissipate energy through Foucault

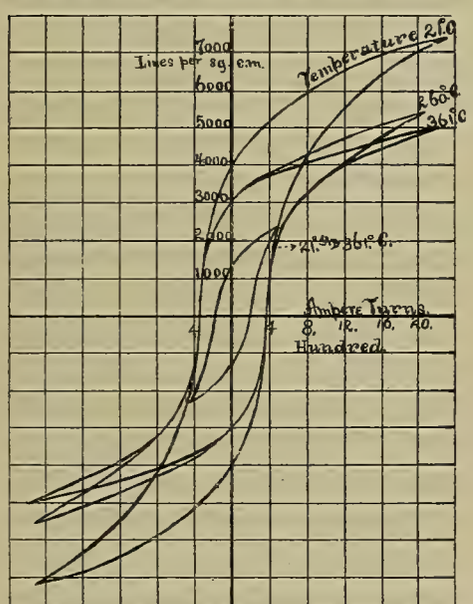


FIG. 7.

current and hysteresis phenomena only, it is due to a decrease of the total energy dissipated through changes in the above phenomena.

A rise of temperature in the core will increase its specific resistance, and therefore diminish the energy dissipated by Foucault currents. For decided decrease of magnetization it is known that the permeability of iron increases when it undergoes a rise of temperature. It was thought probable, therefore, that the energy dissipated per cycle of magnetization and demagnetization would be decreased with an increase of temperature.

Experiments were made in the Physical Laboratory of Cornell University by Arthur Herschel on the hysteresis at high temperatures of a cast iron ring, 12.3 cms. in diameter that furnished a closed magnetic circuit, the length of which is 38.5 cms. The ring was wound with 30 turns of No. 8 wire cable that had a mica insulation.

The highest temperature to which the ring was subjected was 360° C. The results of those experiments are represented graphically in Fig. 7.

One interesting thing about these results is that for degrees of magnetization below 2,000 lines per square cm. the variation of temperature below 36° C does not change

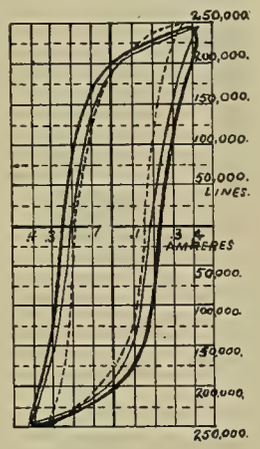


FIG. 8.

the magnetic character of the iron by an observable amount. For if wrought iron behaves in a similar manner then the decrease of energy dissipated in the apparatus of Mr. Marks was not due wholly nor in part to a diminution in the hysteresis of the iron. It was therefore due entirely to the diminution in Foucault currents, caused by the change of the resistance of the iron. A liberal estimate for the hysteresis of the core is twenty watts, whence the Foucault energy dissipated by the core at 100° C and 90

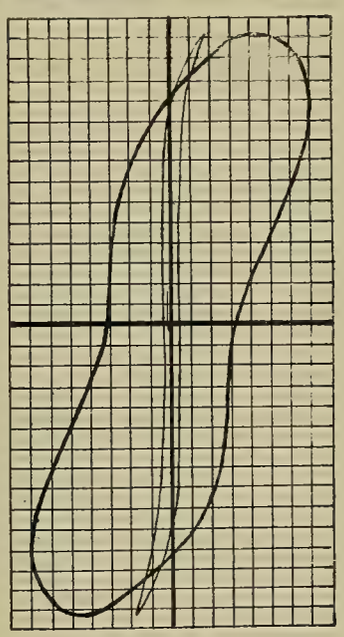


FIG. 9

volts was 102 watts, and at 270° C and 90 volts it was 60 watts.

TABLE 3.

Coil of wire B. & S. G.		Area of c il sq. cms.	Period-icity.	Magnetization per sq. cm.	Loss Watts per cu. cm.
1	12	5	169	5,300	.18
2	12	5	177	8,560	.46
3	12	5	177	11,130	.75
4	16	4.9	173	6,000	.14
5	16	4.9	175	9,430	.33
6	16	4.9	167	10,930	.43
7	16	4.9	93	7,250	.10
8	16	4.9	92	13,300	.42
9	16	4.9	45	13,000	.10
10	24	3.56	175	8,150	.19
11	24	3 56	53	8,760	.12
12	36	3.14	173	9,200	.16
13	36	"	173	14,900	.20
14	36	"	173	18,000 app.	.48
15	36	"	90	10 700	.15
16	36	"	92	17,800	.33
17	36	"	47	18,000 app.	.13
	(Cast iron diam., 3.5 x 2.54.)				
18	36	2.7	160	4,920	1.50

The range of temperature that produced this change was 170. The magnetization for each condition is the same, so that it is fair to assume that the e. m. f. setting up the Foucault currents is the same, and that, therefore, the energy dissipated by Foucault currents will diminish as the resistance of the iron is increased by the elevation of its temperature.

This gives us a rough determination for the temperature co-efficient of the iron to be .4 of one per cent. per degree centigrade, which agrees with Matthiessen's determination and furnishes a fair check upon the conclusion just arrived at.

The second interesting feature about the performance of Mr. Marks' apparatus lies in the fact that the ratio of primary to secondary turns was 3.2, while the relation of primary to secondary e. m. f.s varied from 4 to 8. In this it exhibited exceedingly bad regulation so that by examination of the diagrams 2, 4, 5 and 6, we can see in exaggerated form the trouble it is so hard to become rid of in transformers to be used for incandescent lighting. Any one of these diagrams shows that a large portion of the lines of magnetization that were set up about the primary was not set up about the secondary. That is to say, the counter e. m. f. that is produced in the primary is due to the magnetization through it that also took place through the secondary, plus the variation of magnetization that was set up in its own air space and that leaked by the secondary through the air. When the transformer furnishes current this difference becomes greater and greater, because of the increased current in the primary and the setting up of a counter magnetization by the sec-

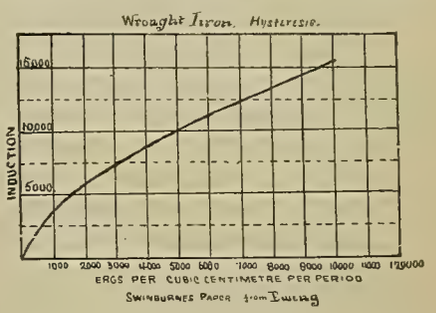


FIG. 10.

ondary current in its own air space that still further reduces the magnetization through it.

Fig. 1 shows the primary disposed on one side and the secondary on the other side of the annular core. The insulation was provided by thick asbestos paper that produced large air spaces between the turns in which magnetization was provided.

In Fig. 2, e. m. f., curve *b*, is the counter e. m. f. in the primary produced by the magnetization through it that also took place through the secondary and which is obtained by multiplying the secondary e. m. f. by 3.2, the ratio of the turns; e. m. f. *C* is the curve of counter e. m. f. in the primary that was produced by magnetization through the primary that did not take place through the secondary. This is obtained by subtracting e. m. f. *b* from e. m. f. *a*; e m. f. *c* is seen to be approximately proportional to the rate of change of the primary current, which suggests magnetization that is set up through the primary that is proportional to the primary current, or that which is set up in the air, or in a magnetic circuit compounded of iron and air.

In the same figure the curves of magnetization *a* and *b* are obtained graphically from the curves of e. m. f. *a* and *b* by the method shown in Fig. 3.

This method is found to be fully as accurate and requires much less time and is more simplified than the analytic method making use of Fourier's theorem. By subtracting *b* from *a* we obtain *c*, the curve of magnetization that was produced through the primary and not through the secondary. This curve of magnetization, *c*, is seen by the diagram to be of about the same form as the current curve, but to lag behind the latter, which indicates that it was magnetization that was produced through air and air and iron.

During the discussion at a recent meeting of the institute the question was asked whether measurements of Foucault currents and hysteresis, as separated from each other, had ever been made.

There can be no doubt but that we do have separate de-

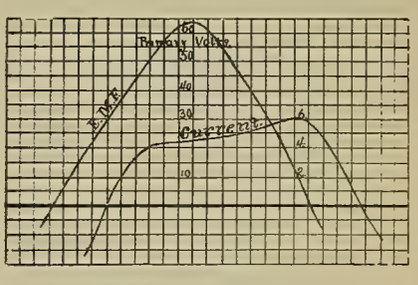


FIG. 11.

terminations of those quantities when we have determined the energy dissipated in a magnetic circuit of iron by rapid cycles of magnetization and demagnetization, and the energy dissipated by static hysteresis for the same rapidity and degree of magnetic changes as determined from a Ewing card, observed through slow magnetization and demagnetization.

Figs. 8 and 9 are two good illustrations of such determinations.

In Fig. 8, the outer card represents the card obtained from the existing current and magnetization curves taken carefully at 138 alternations from the 10-light transformer upon which the tests were made that were communicated to the institute by the writer at the last December meeting. The inner card drawn in a full line in Fig. 8, is the Ewing card of static hysteresis. This transformer on being taken

apart was found to have its disks insulated with paper so that the statement made by the writer in December in regard to the insulation of the transformer was erroneous in this particular. Foucault currents should therefore be found to be quite absent as the diagram in Fig. 8 indicates. A study of these cards does not reveal that which can be recognized as a trace of viscous hysteresis and they differ only by an amount of Foucault current energy that is represented by a small current lagging approximately an eighth of a period behind the primary impressed e. m. f.

In Fig. 9, the outer card is deducted from the current

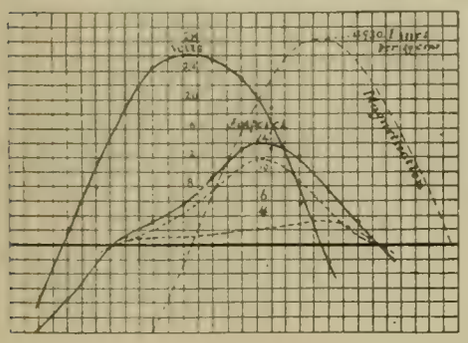


Fig. 11.

and magnetization curves that are represented in Fig. 12. These curves were obtained with 195 alternations per second from a cast iron ring 8. 6 cms in diameter, and 2. 7 sq. cms. in cross section, wound with 200 turns of wire that had a negligible resistance.

In Fig. 9, the inner card is the card of static hysteresis.

In Fig. 12, the lower broken current curve is that of the exciting current curve drawn in from the inner card of Fig. 9. By subtracting this current from the one that was observed we obtain the upper broken current curve, which is the current that exists to suppiy the Foucault current energy

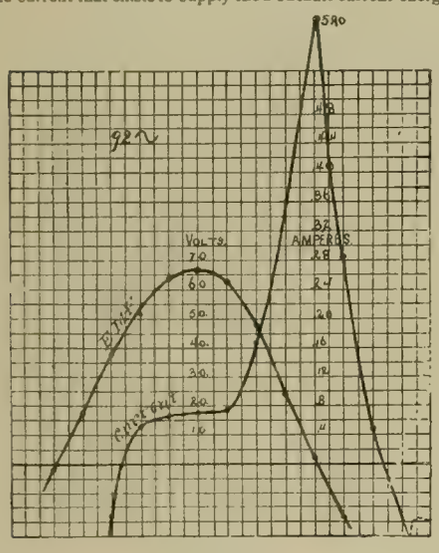


Fig. 13.

in the core. The point to be noticed from the two extreme cases here taken up is that in each case the curve of current supplying the Foucault current energy is about one eighth of a period behind the impressed e. m. f.

Messrs. Fortenbaugh and Sawyer, students in electrical engineering at Cornell University, made determinations, the results of which are given in Table 3, of the amounts of energy that are taken up per cm. in wrought iron wire cores, of different degrees of lamination, at various degrees

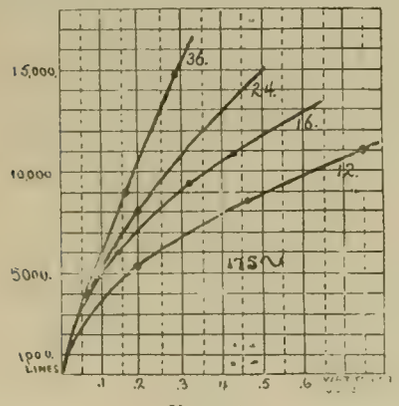


Fig. 14

of magnetization, and at different periodicities in which the oxydized surface of the iron was depended upon for insulation. They made use of four iron wire rings the mean diameter of which was 8.9 cms. and on each of which were wound 200 turns of wire that had a negligible resistance.

Fig 11. and 13, are given for illustrating the extreme variation in the character of the exciting current in going from the lowest to the highest degree of magnetization.

The results show on account of the presence of Foucault currents to a larger extent for the higher degrees of magnetization a variation in losses as the square of the periodicity and the square of the magnetization. The results obtained with the several cores at the periodicity of 175 have been plotted in Fig. 14.

The core of No. 36 wire agrees closely with Ewing's determination of static hysteresis for moderately soft wrought iron and is therefore entirely free from Foucault currents. It is interesting to note that for the cores of No. 36, No. 24 and No. 16, there is but little difference in the losses for degrees of magnetization below 4,000 lines per centimeter.

Likewise that for the higher degrees of magnetization it is seen that the loss is proportional to the magnetization as Ewing's results on static hysteresis given in Fig. 10 indicates they should be.

Diagram 13, shows the effect of compelling the magnetization to be carried above the bend of the characteristic curve of the iron.

The Association of Railway Telegraph Superintendents.

In the last number of the WESTERN ELECTRICIAN a report of the proceedings at the recent annual meeting of the Association of Railway Telegraph Superintendents at Niagara Falls was presented. At this meeting a number of interesting papers were read and abstracts of several of these were given in the report in the last issue.

The following are abstracts of other papers read before the association:

In his paper on "Train Despatching; Its Uses and Abuses," G. C. Kinsman, referring to time orders, said: "We have not only discovered that time orders are safe, but that they are absolutely necessary. We have the uniform system of rules and forms for moving trains by telegraph, adopted by the General Time convention, and endorsed by more than two-thirds of all the railway mileage of the United States, though strange to say, some who voted for this system have failed to put it into practice. * * * A time table which has been carefully checked by the proper officials before being printed, and by hundreds of employes afterwards, he considers, must be more reliable than a telegraphic order in any event, and especially so when the latter is handled in great haste and often by inexperienced operators. We must therefore assume that with every special order we incur an additional risk. It has been stated by those who have studied the records that 70 per cent of the collisions in this country happen to trains moving on special orders."

In concluding his paper Mr Kinsman stated that the train despatcher should not be considered as superior to the time table, but as subservient to it.

W. W. Nichols, superintendent of Telegraph, C. B. & Q. railroad, read a paper on "Some Details in the Manipulation of Block Signals." Speaking of the block systems of this country Mr. Nichols stated that he had had an opportunity some time ago to examine closely the workings of many block systems throughout the country, and was much interested in noting the wide differences in what appeared to him to be important details in the manipulation of the signals. Oftentimes a single movement on one road to indicate a certain condition would indicate quite the opsite on another. But what surprised him in examing the different block systems was the glaring inconsistency which appeared in one or two cases where one would hardly expect to find it, an inconsistency which in one instance held a man responsible for a condition and yet took away from him the knowledge upon which his responsibility depended. After giving his views as to the details in the manipulation of block signals, Mr. Nichols stated that he considered the best arrangement of all, and the one for the model system, is to place the two signals at each station upon one post, the "Home," a red semaphore board at the top, the "Distance," a forked green one below the "Home;" the green board to be the distance signal to the "Home" of the block ahead. Under this arrangement, he thought, the system for obvious reasons should be an absolute block. Running under such a system an engineer can so graduate his speed as to secure the best, as well as the most economical results.

"Correct Time—How Shall we Maintain It," was the title of an able paper by H. S. Pritchett, superintendent of Time Service and Watch Inspection, Wabash railroad. In his introduction Mr. Pritchett stated that he thought the problem of furnishing and maintaining correct time has become within the past ten years relatively much more important than it was during the earlier history of railroading in the United States. Under the present system of train dispatching requiring the movement of numerous trains of different classes over a single line of track, as is generally the case on our American roads, an exact and uniform time system is a necessary part of the safe and efficient operation of any railway. A long step, he thinks, in the right direction, was taken when the plan of uniform time over large areas, now in use, was adopted. His experience, he said, had been sufficient to establish without question the following points in the matter of practical railway time service:

"1. The time signals should be automatic clock beats from some source whose accuracy is guaranteed, and all repeating should be automatic and not by hand. By such a plan only can the confidence of employes in the service be secured.

"2. The clock signals themselves should be preceded by some warning, as the word 'Time' called on the wire.

"3. The programme of signals should be short, preferably not more than two minutes of automatic signals; and it should be of the simplest character, yet should afford several opportunities to identify the minute and second. It is to be remembered in any system of time signals for practical use in railroad work that the operator who is to receive them is not a trained astronomer, equipped with a chronometer for identifying clock beats; but on the other hand the signals must be made so plain that they cannot be mistaken if the wires are working badly and only a part of one minute is received. For this reason the use of the double beats one minute and of single beats the other is a matter of considerable practical importance.

"4. The plan of requiring an acknowledgment of the receipt of time from each operator goes far toward creating a careful attention to the time and indirectly helps the discipline of the service."

Lightning Conductors from a Modern Point of View.[1]

By Prof. Oliver J. Lodge.

A lightning conductor used to be regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea was that a certain quantity of electricity had to get to the ground somehow; that if an easy channel were opened for it the journey could be taken quietly and safely, but that if obstruction were opposed to it violence and damage would result. This being the notion of what was required, a stout copper rod, a wide-branching and deep reaching system of roots to disperse the charge as fast as the rod conveyed it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, were the natural guarantees of complete security for everything overshadowed by it. Carrying out the rainwater-pipe analogy, it was natural also to urge that all masses of metal about the building should be connected to the conductor, so as to be electrically drained to earth by it, and it was also natural to insist on very carefully executed joints, and on a system of testing resistance of conductor and "earth" so as to keep it as low as possible. If ever the resistance rose to 100 ohms it was to be considered dangerous.

The problem thus seemed an easy one, needing nothing but good workmanship and common sense to make accidents impossible. Accordingly, when, in spite of all precautions, accidents still occurred, when it was found that from the best constructed conductors flashes were apt to spit off in a senseless manner to gun barrels and bell ropes and wire fences and water butts, it was the custom to more or less ridicule and condemn either the proprietor of the conductor, or its erector, or both; and to hint that if only something different had been done—say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall, or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earthplate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet, or etc., etc.,—then the damage would not have happened. Every one of these excuses has been appealed to as an explanation of a failure; but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

All this is now changing or changed. Attention is now directed, not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between. It is recognized that all this volume of energy has somehow to be dissipated, and that to do it suddenly may be by no means the safest way. Given a store of chemical energy in an illicit nitro-glycerine factory, it could be dissipated in an instant by the blow of a hammer, but a sane person would prefer to cart it away piecemeal and set it on fire in a more leisurely and less impulsive manner. So also with the electrical energy beneath a thundercloud. A rod of copper an inch or a foot thick may be too heroic a method of dealing with it; for we must remember that an electric discharge, like the recoil of a spring or the swing of a pendulum, is very apt to overshoot itself, and is by no means likely to exhaust itself in a single swing. The hastily discharged cloud, at first, suppose, positive, over-discharges itself and becomes negative; this again discharges and over-discharges till it is positive as at first, and so on, with gradually diminishing amplitude of swing, all executed in an extraordinarily minute fraction of a second, but with a vigor and wave-producing energy which are astonishing. For these great electrical surgings, occurring in a medium endowed with the properties of the ether, are not limited to the rod or ostensible conduit; the disturbance spreads in all directions with the speed of light, and every conducting body in the neighborhood, whether joined to the conductor or not, experiences induced electrical surgings to what may easily be a dangerous extent. For not only is there imminent danger of flashes spitting off from such bodies for no obvious reason—splashes which, on the drain-pipe theory, are absolutely incredible—flashes sometimes from a perfectly insulated, sometimes from a perfectly earthed, piece of metal; but, besides this, remember that near any considerable assemblage of modern dwellings there exists an extensive metallic ramification in the gas-pipes, that these are in places eminently fusible, and that the substance they contain is readily combustible.

On the drain-pipe theory, the gas-pipes, being perfectly earthed, would be regarded as entirely safe so long as they were able to convey the current flowing along them without melting; but, on the modern theory, gas-pipes constitute a widely spreading system of conductors able to propagate disturbance underground to considerable distances, and very liable to have some weak and inflammable spot at places where they are crossed by bell wires or water-pipes or any other metallic ramification.

Above ground we have electrical waves transmitted by the other, and exciting surgings throughout a neighborhood by inductive resonance. Below ground we have electrical pulses conveyed along conductors, leaking to earth as they go, but retaining energy sufficient to ignite

1 Industries.

gas whenever conditions are favorable at considerable distances.

The problem of protection, therefore, ceases to be an easy one, and violent flashes are to be dreaded, no matter how good the conducting path open to them. In fact, the very ease of the conducting path, by prolonging the period of dissipation of energy, tends to assist the violence of the dangerous oscillations. The drain pipe theory, and the practical aphorisms to which it has given rise, would serve well enough if lightning were a fairly long-continued current of millions of amperes urged by a few hundred volts, or if there were no such thing as electro-magnetic inertia; but, seeing that the inverse proportion between amperes and volts better corresponds to fact and seeing that the existence of electro-magnetic inertia is emphasized by multitudes of familiar experiments, the drainpipe theory breaks down hopelessly, and only a few of its aphorisms manage to survive it.

What, then, are we to set up in place of this shattered idol? First of all we can recognize, what was virtually suggested by Clerk Maxwell, that the inside of any given inclosure, such as powder magazine or dynamite factory, can, if desired, be absolutely protected from internal sparking by inclosing it in a metallic cage or sheath, through which no conductor of any kind is allowed to pass without being thoroughly connected to it. The clear recognition of the exact, and not approximate, truth of this statement is a decided step in advance, and ought to be satisfactory to those who have to superintend the practical protection of places sufficiently dangerous or otherwise important to make the aiming at absolute security worth while. Similarly, for wire-covered ocean cables absolute protection is possible. But not for ordinary buildings, any more than for ordinary land telegraph offices, is such a plan likely to be adopted in its entirety. Some approximation to the cage system can be applied to ordinary buildings in the form of wires along all its prominent portions; and such a plan I have suggested, and I understand it is being carried out, for the entrance towers and part of the main body of the present Edinburgh Electrical Exhibition, A. R. Bennett having asked me to recommend a plan to the committee as a sort of exhibit. For chimneys a set of four galvanized iron wires, joined by hoops at occasional intervals, and each provided with a fair earth, seems a satisfactory method; but it is to be noted that a column of hot air constitutes a surprisingly easy path, and that it is well to intercept a flash on its way down the gases of a chimney by a copper hoop or pair of hoops over its mouth. Mr. Goolden tells me that he has just applied this method to a new chimney at his works in the Harrow Road. For ordinary houses, a wire down each corner and along the gables is as much as can be expected. At many places even this will not be done; a couple of vertical wires from the highest chimney stacks on opposite sides must be held better than nothing or than only one.

Earths will be made, but probably they will be simple ones, entailing no great expense. A deep damp hole for each conductor, with the wire led into it and twisted round an old harrow or a load of coke, may be held sufficient. And as to terminals; rudely sharpened projections, as numerous as is liked, may be arranged along ridges and chimney stacks; but I have at present no great faith in the effective discharging power of a few points, and should not be disposed to urge any considerable expense in erecting or maintaining them. Crowns of points on chimneys and steeples are certainly desirable, but a multitude of rude iron ones will be more effective than a few highly sharpened platinum cones. I find that points do not discharge much till they begin to fizz and audibly spit; and when the tension is high enough for this, blunt and rough terminals are nearly as efficient as the finest needle points. The latter, indeed, begin to act at comparatively low potentials, but the amount of electricity they can get rid of at such potentials is surprisingly trivial, and of no moment whatever when dealing with a thundercloud.

But the main change I look for in the direction of cheapness and greater universality of protection is in the size and material of the conducting rod itself. No longer will it be thought necessary to use a great thick conductor of inappreciable resistance; it will be perceived that very moderate thickness suffices to prevent fusion by simple current strength, and that excessive conducting power is useless.

In the days when the laws of common "divided circuits" were supposed to govern these matters, the lightning rod had to be of highly conducting copper, and of such dimensions that no other path to earth could hope to compete against it. But now it is known that low resistance is no particular advantage; it is not a question of resistance. The path of a flash is a question of impedance, and the impedance of a conductor to these sudden rushes depends very little on cross-section and scarcely at all on material. A thin iron wire is nearly as good as a thick copper rod, and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy, and tends to damp out the vibrations sooner. Owing to this cause a side flash from a thin iron wire is actually less likely to occur than from a stout copper rod.

The only limit is reached when the heat generated by the current fuses the wire, or runs the risk of fusing it. But in so far as oscillations are prevented, the mean square of current strength on which its heating power depends is diminished. Accordingly, a fairly thick iron wire runs no risk of being melted. Its outer skin may, indeed, be considerably heated, for these sudden currents keep entirely to the outer skin, penetrating only a fraction of a millimeter into iron, and they make this skin intensely hot. But the central core keeps cool until conduction has time to act; and, consequently, unless the wire is so thin as to be bodily deflagrated by the discharge, its continuity is not likely to be interrupted. Thickness of wire is thus more needed in order to resist ordinary deterioration by chemical processes of the atmosphere than for any other reason.

But the liability to intense heating of the outer skin should not be forgotten, and care should be taken not to take the wire past readily inflammable substances for that reason. For instance, it would be madness to depend on Harris' notion that a lightning conductor through a barrel of gunpowder was perfectly safe, especially if said conductor were an iron wire or rod.

In the old days a lightning conductor of one or two hundred ohms resistance was considered dangerously obstructive, but the impedance really offered by the best conductor that ever was made to these sudden currents is much more like 1,000 ohms. A column of copper a foot thick may easily offer this obstruction, and the resistance of any reasonably good earth connection becomes negligible by comparison. A mere wire of copper or iron has an impedance not greatly more than a thick rod, and the difference between the impedance of copper and iron is not worth noticing.

But although, in respect of obstructing a flash, copper and iron and all other metals are on an approximate equality, it is far otherwise with their resistances, on which their powers of dissipating energy into heat depend. It is generally supposed that iron resists seven times more than copper of equal section, and so it does steady currents, but to these sudden flashes its resistance is often 100 times as great as copper, by reason of its magnetic properties. This statement is quite reconcilable with the previous statement, that in the matter of total obstruction there is very little to choose between them; the apparent paradox is explicable by the knowledge that rapidly varying currents are conveyed by the outer skin only of their conductor, and that the outer skin available in the case of magnetic metals is much thinner than in the case of non-magnetic.

Questions about shape of cross-section are rather barren. Thin tape is electrically better than round rod, but better than either is a bundle of detached and well-separated wires—for instance, a set of four, one down each cardinal point of a chimney; but it is easy to over-estimate the advantage of large surface as opposed to solid contents of a conductor. The problem is not a purely electrical one—it is rather mixed. The central portion or core of a solid rod is electrically neutral, but chemically and thermally and mechanically it may be very efficient. It confers permanence and strength; and the more electrically neutral it is, the less likely is it to be melted. Its skin may be gradually rusted and dissolved off, or it may be suddenly blistered off by a flash; but the tenacity of the cool and solid interior holds the thing together, and enables it to withstand many flashes more. Very thin ribbon or multiple wire, though electrically meritorious, is deficient in these commonplace advantages.

There were two functions attributed to high conducting power in the old days—first, the overpowering of all other paths to earth; second, the avoidance of destruction by heat. The first we have seen to be fallacious; on the second a few more explanations can be made. In so far as fusion by simple current strength is the thing dreaded, it must be noticed that a good conductor has no great advantage over a bad conductor. It is a thing known to junior classes that when a given current has to be conveyed less heat is developed in a good conductor, but that when an electromotive force is the given magnitude less heat is developed in a bad conductor. The lightning problem is neither of these, but it has quite as much relationship to the second as to the first. There is a given store of energy to be got rid of, and accordingly the heat ultimately generated is a fixed quantity. But the rise of temperature caused by that heat will be less in proportion as the production of it is slow; and though by sudden discharge a quantity of the energy can be made to take the radiant form, and spread itself a great distance before final conversion into heat, instead of concentrating itself on the conductor, yet this cannot be thought an advantage. For, just as in the old days a lightning rod was expected to protect the neighborhood at its own expense by conveying the whole of a given charge to earth, so now it must be expected to concentrate energy as far as possible on itself, and reduce it to a quiet thermal form at once, instead of, by defect of resistance and over-violent radiation, insisting on every other metallic mass in its neighborhood taking part in the dissipation of energy,

The fact that an iron wire, such as No. 5 or even No. 8 B. W. G., is electrically sufficient for all ordinary flashes, and that resistance is not a thing to be objected to, renders a reasonable amount of protection for a dwelling-house much cheaper than it was when a half-inch copper rod or tape was thought necessary.

A recognition of all the dangers to which a struck neighborhood is liable doubtless prevents our feeling of confidence from being absolute in any simple system of dwelling-house protection; but at the same time an amount of protection superior to what has been in reality supplied in the past is attainable now at a far less outlay; while, for an expenditure comparable in amount to that at present bestowed, but quite otherwise distributed, a very adequate system of conductors can be erected.

Only one difficulty do I see. In coal-burning towns galvanized iron wire is, I fear, not very durable, and renewal expenditure is always unpleasant. It is quite possible that some alloy or coating able to avoid this objection will be forthcoming, now that inventors may know that the problem is a chemical one and that high conductivity is unnecessary.

Improvements in the St. Paul Telephone Exchange.

The Northwestern Telephone company took possession of its new exchange at St. Paul recently and since that time the service has materially improved. The exchange has 1,350 subscribers. A new switch-board was installed when the change was made. Its capacity is 4,000 subscribers. The operating room is well lighted and ventilated and everything possible has been done to make the operators comfortable. There are several other rooms devoted to the young ladies. One of these is a lunch room, nicely fitted up; cloak room, etc. The employes evidently appreciate the fact that Manager Joyce has shown so much concern for their comfort for they perform their duties in a most satisfactory manner. Very few complaints are made. In July, 1889, Manager Joyce desired an expression of opinion from subscribers as to the service of the company. He furnished blanks for this purpose and when the subscribers returned them they were placed on file. These forms are now in the possession of the company and they form the best possible evidence of the efficiency of the service. Of 1,140 replies received only 84 contained criticisms or complaints of any kind. Twenty-two of them were due to line crosses, one to the instrument, seven to induction from electric light wires, twelve, operators, and thirty-nine, combination lines. On examination some of the complaints were found to be groundless. The service has been generally praised by subscribers. With improved facilities Supt. Joyce hopes to bring it to an even higher efficiency. Some trouble has been caused by induction from street railway lines, but it is hoped that an arrangement will be reached whereby the trouble may be obviated. The telephone company has decided to bury its wires at once.

The Book Table.

THE ELECTRIC RAILWAY OF TO-DAY. By H. B. Prindle; 55 pp. Published by E. B. Stillings & Co., Boston. Price fifty cents.

The method of operating electric railways is explained in this little book for the benefit of readers who are unacquainted with electrical terms. The apparatus used is described in simple terms and a number of diagrams make clear the matter of line construction. The book is profusely illustrated, though those who peruse electrical journals have seen most of the cuts. This little work is clearly written and one who is unfamiliar with technical terms can gain from it a general idea of the operation of the electric railways.

BROWN'S DIRECTORY OF AMERICAN GAS COMPANIES. Compiled by E C. Brown. Published by *Progressive Age*, New York. Price $5.

This is the third edition of this very complete and accurate work. For those seeking information in regard to the gas industry of the country the book will prove invaluable. A full list of American gas companies is presented, and names of officers, and figures in regard to the business in each case are given. General statistics relating to the gas companies are presented. It appears in one of the tables that 304 gas companies are operating electric light plants, with a capacity of 31,558 arc lamps and 132,771 incandescent lights.

ELECTRICAL ENGINEERING. By W. Slingo and A. Brooke; 622 pp, 307 illustrations. Longmans, Green & Co., London and New York. Price $3.50.

The authors in their preface state that they were prompted to prepare the work by their inability to recommend any single work covering the whole field of electric lighting. It was intended that the book should embrace the requirements, not only of those actually employed in the electric lighting industry, but also of those who, while having little or no electrical knowledge, have under their supervision various kinds of electrical machinery. The authors have performed their task admirably. They have exercised excellent judgment in their selection of material and they have presented it in clear, simple style, which should always be a characteristic of a work of this kind. A hasty examination of the book convinces one that it is a volume to be heartily recommended to that constantly growing class of persons who desire a thoroughly scientific work, more satisfactory, more exact and more technical than popular books on electrical subjects, yet not so technical as to discourage a student. "Electrical Engineering" should reach a large class of readers.

LIVE QUESTIONS, by John P. Altgeld. Published by Donohue & Henneberry, Chicago.

This is the third edition of Judge Altgeld's series of essays on economical topics. A new essay is incorporated in the volume, "Our Penal Machinery and Its Victims."

Telegraph and Cable Lines.

At the banquet given recently to the members of the International Telegraph conference at Paris, Sir John Pender gave the following figures: "There are 2,000,000 miles of land lines worked by 650,000 miles of wire. The cables belonging to the governments at present amount to 13,178 miles, valued at £4,000,000. The cable companies have 107,000 miles of cable, costing £36,000,000, or a total capital of £40,000,000. The total expenditure on land lines and cables has been £100,000,000. The cable ships employed in keeping these cables in repair number thirty-six, with a tonnage of 53,780 tons. I may say that all this has been done within the last fifty years, and the greater portion of the submarine system has been accomplished within the last quarter of a century, it has scarcely yet attained its maturity."

CORRESPONDENCE.

New York Notes.

NEW YORK, June 26.—There have been no explosions in Broadway for two days. The crowds which gathered daily to see the blow-up which the experience of the last couple of weeks has justified them in regarding as likely to occur at any moment, are growing less. The notorious corner of Broadway and Fulton is now called "Mount Vesuvius Place." The Steam Heating company is just now in no enviable position. It has appealed to its patrons for a mollified judgment on its recent unfortunate record, because in eight years its subways have not killed any one. This does not make it less of a menace, nor does it alter the fact that it has become a public nuisance. Possibly the extreme remedy of revoking its charter may not be necessary, but a little legislation requiring it to build subways which shall not interfere with and be a danger to everything near them is desirable. A little healthy competition would also have a most wholesome effect on the company. In Mayor Grant's letter to President Wilson of the Board of Health on the subject, with which was enclosed the report recently made by Commissioner Gilroy, the mayor says: "As the report states there is grave reason to believe that the existence of these pipes in their present condition constitutes a menace to public health, and they are therefore to be regarded as common nuisances. I submit the report for such action as you may deem proper to take." The latest phase of this question is that the commissioner of public works and his experts went before the grand jury yesterday to testify concerning the Broadway explosions, and it is rumored that the grand jury will indict the Steam Heating company.

The Order of Railway Telegraphers has been holding its fifth annual convention during the week. Representatives of about seventy divisions were present. The order is essentially benevolent, and while it seeks to promote the general welfare of its 8,000 members, its constitution declares that a forfeiture of membership shall be incurred by any member who shall instigate a strike.

An important decision was handed down on the 24th inst. by Judge Brown of the United States District Court, which concerns especially the Western Union Telegraph company, and incidentally other companies having cables on the beds of the North or East rivers. On August 9, 1887, the propeller of the steamship City of Richmond caught in the cables of the Western Union Telegraph company which cross from the foot of Cortlandt street to Jersey City. The steamship was using her propeller at the time to get into her dock through the bed of mud on which the cables rested. The result of the encounter between cable and propeller was disastrous to both. Twelve of the cables were broken, and the wires became so entangled around the propeller that the City of Richmond had to go into dry dock to get her machinery in running order again. The Inman & International Steamship company sued the Western Union company for $2,000 damages. The Western Union brought a cross suit for $10,789, the alleged cost of repairing the damage to its cables and for $50,000 for the loss of the use of the cables. Judge Brown dismissed the complaint of the Western Union company and gave judgment for the Inman & International Steamship company, holding that although telegraph companies have received the right to lay their cables across navigable streams they must not obstruct navigation, and that cables lying in mud through which steamships have to plow to get to their docks are obstructions to navigation.

One of the points made by the Third Avenue Railroad company in its programme for the substitution of cable for horse traction on Third avenue is the establishment of varying rates of speed on the different parts of the road. Owing to the constant interruptions to traffic on the lower end of the road—through the Bowery and Old Chatham street—the cable in that section will be run at a comparatively slow rate of speed. In the next section above the cable will be run somewhat faster, and in the up-town section where the road is generally clear, the maximum rate of speed will be reached. It is proposed to have the whole road in running order under the new system early in the Fall.

The work of the Rapid Transit committee is finished, but whether any practical results will ensue is at present very much a matter of uncertainty.

Articles of incorporation were filed in the Union County Clerk's office at Elizabeth yesterday by the Rahway Electric Light & Power company, whose capital is $50,000. The company's plant will be located at Rahway, where it will compete for lighting the city by electricity.

New York does not seem to have got through with its lighting troubles, although most smaller cities have the advantage in this respect. The Gas Commission to-day rejected the bids of the electric light companies. Other bids will be advertised for, and if the estimates exceed last year's price the lamps will be replaced by gas.

The American Rapid Telegraph company brought suit for damages against the city because some of its wires were pulled down in the crusade against the electric lighting companies last year. Judge Beach has given a decision in favor of the city.

A seashore street railway company for Asbury Park has been incorporated at Trenton. New York capitalists are among the directors and stockholders. The road is to be between Asbury Park and Avon-by the-Sea, and the cars will be run by electricity.

The trustees of the New York Phonograph company and the trustees of the Metropolitan Phonograph company have ratified the agreement entered into by the trustees of each company for the consolidation of the two companies. The name of the consolidated company is the New York Phonograph company, and the trustees elected for the first year are. John P. Haines, John D. Cheever, Richard Tounley Harris, Noah Davis, W. Seward Webb, William Fahnestock and John L. Martin. The office of the new company will be located in this city. W. H. T.

Springfield, Mo.

SPRINGFIELD, June 28.—Workmen began setting posts for the electric motor last week on St. Louis street. Work was also begun on the power house at the corner of Main street and Phelps avenue. The building is to be 70 by 156 feet, two stories high, and will be completed about the first of August. It is the intention of the company to have the motor line in operation before the Springfield fair opens.

The well which is being drilled at the southeast corner of Main street and Phelps avenue for a water supply for the electric motor plant has reached a depth of 230 feet, and water strongly impregnated with mineral has been reached, which is believed by some to have health giving properties.

The city council of Odessa, Mo., granted an electric light franchise to a home company at a special meeting last week for a duration of twenty years. The plant will be of the Thomson-Houston make and thirty lights will be brought into use at once.

Prof. L I. Blake of the Kansas State University, at Lawrence, Kan., left last week for Boston, Mass., where he will conduct a series of experiments off the Atlantic coast with an electric fog signal. The secretary of the navy placed at his disposal any coast line ship in the United States service that he may find suitable for his purpose. The method of signaling consists in telegraphing between ships from five to ten miles distant, the water serving as a conductor. P.

Pittsburg, Pa.

PITTSBURG, June 27.—The citizens of Allegheny are making the grandest preparations for a semi-centennial celebration, which is to be held on the 18th of July. Electricity is to play a very important part in the programme.

Mention has already been made in this correspondence in last week's WESTERN ELECTRICIAN, stating that the electric plant established by the city is now about completed. At a meeting of city councils held a few nights since, it was decided to defer putting the plant into practical operation until the evening of July 18. In order to make the illumination of all the lights in the city more effective in its brilliancy, the lamps are to be covered with colored globes of red, blue, green, etc. Around the parks especially, as well as around the lakes, it is expected that this arrangement will render the general scene unusually striking.

In accordance with an ordinance passed by the councils of Allegheny City, the transformation from horse to electric power of all the street car lines controlled by the Pittsburg, Allegheny & Manchester Passenger Railway company was to commence not later than during the last week of June. To conform with this ordinance, a number of workmen started tearing up the tracks of the company's line last Monday. The work is to be rapidly pushed, and it is expected that the new tracks on all the lines will be laid by next November. The Pittsburg, Allegheny & Manchester Railway company controls the Western avenue line, the Union line, the Rebecca street line, the Troy Hill line and the Allegheny Transverse line with a total number of 100 cars. It has been definitely settled that an electric motor system is to be used on all these roads, though which one has not been decided.

The Grafton Electric Light company of Grafton, W. Va., is rushing things to get its plant in operation before August 1. The poles are set, the wires are strung, and the power house is also well under way. The Fairmount, W. Va., Electric Light company has promised the people of that town to turn on the lights July 4 in celebration of the day. The company will light the streets of Fairmount and several suburban towns, and already a number of buildings have been wired.

The first application of electricity in newspaper work in the state of West Virginia took place last week in Lewis county. The *Western Democrat* published there appeared the other morning, the entire issue being printed by the aid of electric power.

At Harrisburg, Pa., charters were granted a few days ago to the Wilkins & Braddock Street Railway company and the Pittsburg, Braddock & Tuttle Creek Street Railway company; capital, $36 000. E. H. H.

Nashville, Tenn.

NASHVILLE, June 28.—It has been not quite a year since the first electric street car was started in this city. New deals and combinations have been of weekly occurrence until we have finally the largest and best equipped system, it is claimed, in America, under one management. The entire system is absolutely controlled by the United Electric Railway company. The officers are: T. W. Wrenne, president; I. T. Rhea, vice president; Frank Morrow, secretary; G. W. Cunningham, treasurer and manager, and E. G. Cannette, superintendent. The plant consists of one power house equipped with a system of steam boilers arranged in batteries, and eight engines aggregating 1,000-horse power of improved automatic construction. The Thomson-Houston and the Sprague systems are in use. There are now in operation, according to the statement of Mr Wills, the electrician of the company, a fraction more than fifty five miles of roadway, and a few additional miles are to be laid. Fifty-three cars are now in use and eight more will arrive in a few days. The entire system is operated by the single trolley system with feed wires and ground return.

The present power house and plant have become inadequate and ground has been secured and work has been begun on a new and larger plant. The details of the new plant have not yet been made public. At present one fare entitles a person to ride to any part of the city by a system of transfer tickets, but arrangements will soon be completed whereby through cars will be run from one end of the city to all others. A large covered arcade extending from the public square to Cherry street in the heart of the city is under construction. Through this building all the cars of the company will pass. The arcade will also contain the offices of the company. The new power house will be in the immediate vicinity. When these improvements are completed the city will have a most perfect system of street car lines.

The Citizen's Rapid Transit company has not yet secured all its rights of way, but it is probable that all troubles will soon be settled and the work pushed forward. The United Electric Railway company is its principal opponent.

The bill of the Nashville Electric Railway & Power company is still pending on third reading in the city council. It will doubtless pass in a form satisfactory to all concerned.

The petition of the Rock City Electric Railway company is still pending with favorable prospects for a final satisfactory grant.

The extension of the Fairfield line to Mt. Olivet and Mt. Calvary cemeteries was completed and tested last Saturday, and Sunday was opened to the public. This extension was projected by T. W. Wrenne, Isaac T. Rhea and others, and was built by the United Electric Railway company, not as a profitable investment, but they say, merely as a matter of public enterprise, and to accommodate those who wish to visit the cemeteries. Cars were run every thirty minutes from 1 to 7 o'clock, and the programme will be repeated every succeeding Sunday.

Last Saturday evening a fire occured that may result in the temporary stoppage of every street car and electric light in the city. It destroyed the original pumping station of the water works and a water famine is imminent. This plant and its accompanying reservoir was built fifty-eight years ago and had a capacity of 10,000,000 gallons per day. A new station and reservoir of very much greater

capacity has recently been completed, but owing to accidents to the machinery only a part of it is available until repairs can be made. Meantime it is feared the large steam plants may be deprived of water and be forced to suspend operations. The electric light plant is near enough to the river to obtain its supply by putting in a pump of its own, but the electric car plant must depend solely on the water works supply. B.

Louisville, Ky.

LOUISVILLE, June 28.—The steel rails for the Winchester, Ky., electric street railway were shipped some time ago and the work was begun yesterday. The Winchester city council has granted an extension of time until September 10 to complete the line.

At Harriman, Tenn., there has just been completed a first-class electric light plant. The Westinghouse system is used and 65 arc lamps of 2,000 candle power each are used for street lighting, etc. The rails for the electric belt-line road have been put down and the line will be finished in the next thirty days.

At Cardiff, Tenn., an electric light station has just been completed. L.

Joplin, Mo.

JOPLIN, Mo., June 21.—The mayor and several councilmen will go to St. Louis next week on the invitation of the Joplin Rapid Transit company, to examine into the workings of the electric street railways of that city. The company has been granted a franchise for the construction of a single track electric line, and it is now endeavoring to secure the right to build a double track on Main street. The company will build two miles of track this summer and will invest about $100,000. The Thomson-Houston motors will be used. The council fears that the system will prove an obstruction to traffic, and the company therefore proposes to send the members to St. Louis to have their eyes opened.

The Southwestern Electric Light and Power company has commenced to improve its Grand Falls property, recently purchased for $55,000. A survey for a new pole line has been made between the falls and Joplin, and the work of building the line will be commenced soon. The company has received three additional dynamos from the Thomson Houston works. All the machinery of the miners' plant which will be erected near the falls will be driven by electric motors. The company will demonstrate that electricity will do all that steam can do in driving machinery. R.

THE ELECTRIC LIGHT.

Two large electric light plants are to be installed by hotels, to be built in Corpus Christi, Tex., by W. W. Dunn and Col. Ropes.

The People's Gas & Electric company was incorporated in St. Louis last week; capital $50,000. The stockholders, John Maguire, R. D. Walsh of St. Louis, and Rolla Wells.

Economy Light & Power company, to furnish light, heat and power, was incorporated at Springfield, Ill., last week; capital stock, $400,000; incorporators, W. A. McSurely, C. H. Briat and George C. Helmer.

The streets of Rockville, Ind., are to be lighted by Westinghouse alternate current arc lights. A plant of 50 lights has already been contracted for, and the installation of the machinery is to be immediately commenced.

According to a despatch from Seattle, Wash. an electric light plant has been shipped to Blaine and it is expected the latter town will be lighted by electricity August 1st. Seventy arcs and 600 incandescents will be supplied.

An electric light company has lately been organized in Ogden, Utah. The Westinghouse Electric company has received from it an order for alternate current apparatus for a central station plant of 1,500 incandescent and 80 arc lights.

The Merchants' Electric Light & Power company of Frankfort avenue, Philadelphia, Pa., has recently been established. The company has given a contract to the Westinghouse Electric company for a 750-light alternate current apparatus.

The electrical fraternity of St. Paul and Minneapolis contemplate the formation of an electric club. The activity in electrical circles in the Twin cities lead those interested in the project to believe that such an organization would find many ardent supporters.

"There is no city in the country better lighted than Salt Lake City," says an exchange. At each street crossing in the business and resident portions is a 2,000 candle power arc light 20 feet above the street. Business houses, public buildings and residences are lighted by arc and incandescent electric lights.

The Economy Steam Heat company of St. Paul has decided to overhaul its plant and enlarge it. This company has a valuable franchise for electric lighting and will soon extend its plant. Alex Thompson, well known in Chicago, will have charge of the electrical department. He was appointed superintendent July 1st.

The contract for the East Seattle (Wash.) Electric Light and Power company's station, on Mercer Island, has been awarded and the structure will be completed August 10. The station will be 40x60 feet, with a tower ten feet square and fifty feet high. The Thomson-Houston system of arc and incandescent lighting will be used, and an Edison generator for the motor line of railway The building and machinery will cost when completed about $12,000.

A despatch from Milwaukee says, a deal involving upwards of $5,000,000 and including a transfer of a controlling interest in the Badger Electric Light company, the Edison Light Company, and the Cream City and Milwaukee Street Car Companies has practically been consummated. The purchaser is the so-called Villard syndicate, including Henry Villard and Ryan, the Pittsburg capitalist, but Milwaukee capitalists will still retain an interest in each of the corporations, although there is a complete change of owners in the Badger Electric Light plant, which was sold Monday. The sale was made by John A. Hinsey, S. S. Badger, E. C. Wall, and Winfield Smith. The purchasers outside of the Villard syndicate are the same Milwaukeeans who are interested in the Edison Electric Light plant now being built. So instead of competition the Villard syndicate for the present at least will have a monopoly of electric lighting in Milwaukee, the Badger Company to continue to furnish the arc light and the new Edison plant the incandescent. By also securing controlling interest in both the Cream City and Milwaukee City street-car lines the Villard syndicate will have two of the best paying companies in the city. Both lines will be transferred into an electric system.

THE ELECTRIC MOTOR.

The new cars for the Minneapolis electric railway will all be on hand in September when the lines will be started. Some of the cars have already arrived.

The power station of the electric railway company at St. Paul is now in course of construction. The Northwest Thomson-Houston company will install the electrical apparatus.

The Adams company has been incorporated at Chicago to purchase or control patents for or build or construct electric and elevated railroads; capital stock, $200,000; incorporators, J. W. Adams, C. W. Griggs, and G. M. Harris.

The new electric railway system of Paducah, Ky., comprising 8 miles of track, was started last week and is operating successfully throughout City officials and prominent citizens assisted in the opening and the jollification that followed.

An English electrical journal says: We understand that a company will shortly come before the public for a large capital to carry out certain contracts which have been made with tramway lines to work them with electric traction. Contracts have already been made to the extent of £300,000, and the company will need at least a million and half of capital. The systems of traction to be used are those of Thomson-Houston and the series system. Undoubtedly tramway companies are earnestly watching the developments being made, and it only needs a few successful installations to ensure a very large business. The great success of electric traction in America must have its influence in England, although the conditions holding there are generally somewhat more favorable to such a system than those existing here. It is absolutely certain that tramway lines can be satisfactorily worked by electricity, and it is high time that the so-called experimental lines, which are neither fish, flesh, nor fowl, were relegated to the archæological museum They are never satisfactory and never can be. What is required is a responsible company to undertake electric tramway and railway work upon a large scale, and this is just what the company referred to intends to do.

The Pumpelly storage battery car designed by the Detroit Electrical Works recently made a trial trip in Detroit. The car was equipped with a 15-horse power motor designed by Frank B. Rae. The motor was wound to suit the voltage of the battery, which was 196 volts. The arrangement for regulation was such that in starting the car the batteries were placed in multiple arc in four banks giving a voltage of about 48 volts. When speed was obtained with this voltage a second movement of the switch connected the battery in two banks making the potential at the motor 96 volts. Under these conditions the car had a speed of about six miles per hour. The final position of the switch placed all the batteries in series and caused the speed of the car to increase to 12 or 15 miles per hour, depending on the grade and load. In the trial trip of the car the required power and speed were realized. No difficulty was experienced mounting a grade of between five and six per cent. with full loaded car. The truck arrangement was the same as that in the standard cars designed by this company for overhead work in which a single motor geared to both axles is employed. The car body was the same as that designed by the John Stephenson company of New York for the Fourth avenue line in that city. The batteries are placed under the seats and are accessible for removal from the outside of the car. The connections on the top of the cells can be reached by raising the seats of the car, which are conveniently arranged with hinges for this purpose. The estimated weight of the car body is about 600 pounds and the total weight of the car, batteries and motor truck is about 15,000 pounds.

The following from the Rochester *Sunday Herald* states the progress of electric railway construction in that city. The street car company is making extraordinary exertions to effect the change from horse power to electric motors before the best part of the summer is over, and is accomplishing all that energy, pluck and a liberal outlay of money can attain to that end, but insurmountable obstacles seem to meet the energetic directors of the new company at every turn. It was hoped that the route from the four corners to the junction with the electric road to the lake could be put in operation by July 10 and contracts were let with that end in view, but this result it now seems impossible to accomplish. In fact, if electric motors are in operation on any of the routes by the first of August the directors will consider themselves fortunate. The progress of the work has been delayed in several directions by the service of injunctions and in several instances the necessary rights will have to be acquired through the aggravating, slow process of condemnatory commissions. Much public interest has been attracted by the groups of men all over the city in substituting the rail for the running of electric cars in place of old street car rails Besides the drivers, barn men, hill boys and others employed in the regular work of operating the road under the old system of horse power, the company now has in its employ between 700 and 800 men in the construction of the new road bed. The men are divided off into relays and the work is in progress night and day. In all matters connected with the amount for which contracts are let and in matters connected with the finance in general, the directors of the road are extremely reticent. It is, however, understood that the cost of the transfer from the old track to the new will not be less than $350,000 and will probably be considerably in excess of that sum. A further cause of delay and one which the directors could not well avoid, was the selection of the location for the electrical power house. This was a matter which could not be decided in haste and it was a long time before a satisfactory conclusion was reached. The spot finally selected is just below the Central tracks on the east side of Mill street and work upon the construction of the power house has been in progress for several days. It is being pushed with all the rapidity possible. As the power house is to be the mainspring of the entire street car system great care must be used in its construction, and unnecessary haste now may result in annoying delays later on. The company has exhibited a most liberal policy in all its movements thus far, and though the directors, of course, expect to make a good thing of it, they do not seem unwilling to share their prospective profits, to a small extent at least with the public.

Personal Mention.

William H. Bryan, secretary of the Heisler Electric Light company, of St. Louis, was in Chicago last week.

C. B. Hopkins of the Spokane Falls Edison Illuminating company, who is a World's Fair commissioner, is in Chicago wrestling with the problems connected with the great exposition of 1893.

S. E. Barton, Boston, W. D. MacQuesten, L. Stieninger, W J. Jenkins and E. A. Davies, New York, were entertained at Ashville, N. C, by the Electric Street Railway company last week. They are on a hunting and fishing trip and at present are at Hogback mountains.

Business Mention.

The Wm. Powell company of Cincinnati, O., has issued a circular illustrating numerous devices for oiling electrical apparatus. This company manufactures engine builders and steam fitters' brass work sight feed lubricators and star regrinding valves.

F. W Cushing of the Central Electric company, Chicago, made a flying trip through the Northwest last week and came back with a number of excellent orders. He reports excellent business throughout the territory and says the outlook is favorable.

W. R. Molinard of the Baxter Motor company was in St. Paul and Minneapolis last week, looking after the interests of his company. Mr. Molinard is establishing agencies throughout the Northwest and the improved Baxter motor is once more looming up in the market as a formidable rival to other favorite types.

The Excelsior Electric company is doing a very handsome business from its new headquarters, 425 Rookery Building, Chicago. Manager Wadsworth has reorganized the entire western business of the company since taking charge and the results are apparent in largely increased sales and a general spreading out of the field of operations.

Ames, Wright & Co., St. Paul, are exploiting a novel device in the form of an electric door opener. The device is adapted to use in large offices when private rooms are desired by officers. This firm represents the Western Electric company in the Northwest and has the agency for numerous special devices. It reports excellent business and shows signs of prosperity.

The Elektron Manufacturing company of 79-81 Washington street, Brooklyn, has recently issued a little pamphlet containing considerable information in regard to small electric motors and batteries, and their applications. The pamphlet is well written and presents the points in regard to small motors in such a way that they can readily be understood by persons having no knowledge of electrical apparatus.

The Northwest Thomson-Houston company, St. Paul, is refitting its building, and in a couple of weeks will be settled in its new quarters. The company will occupy the same building and will have more floor space than at present. The offices will be removed to the fourth floor and the ground floor will be devoted exclusively to displaying the specialties handled by this company. The intermediate floors will be filled with supplies.

The Great Western Electric Supply company is progressing rapidly with the work of classifying and arranging the large shipments of goods daily arriving at 190–192 Fifth ave. The organization of a business of the magnitude of this is a tremendous task, calling for a high order of administrative ability. Manager George Cutter is, however,

equal to the emergency, and one of the handsomest stores in Chicago can be seen at the above-mentioned numbers.

Queen & Co. of Philadelphia, report that in consequence of the great demand for Ayrton & Perry's magnifying spring ammeters and voltmeters, they have much increased their already large stock of these instruments, and can fill orders for all the regular ranges without delay. The cardinal points in these instruments are portability, freedom from magnets, hence they are not affected by dynamos, and direct reading scales which are at the same time proportional throughout. That the Ayrton & Perry meters are appreciated is shown from the great demand for them during the last few years. They have been and are now used very extensively on electric railroads.

The Central Electric company has in its Chicago warehouse a complete stock of all sizes of the improved Candee weatherproof wire ranging from No. 00 to No. 18. The number of large orders placed for this wire in the past few months are sufficient proofs of its merits The company has recently received a very large consignment of a high grade of soft rubber tubing, ranging in sizes from ⅛ to 1 inch in diameter. The expanding brass wire guards introduced by the Central Electric company, and adaptable to the Sawyer-Man, Edison, Westinghouse, Thomson-Houston, and Schaefer sockets, without the use of a shadeholder, are a great protection to the lamp, especially while exposed, as in factories, warehouses, etc.

The Crocker-Wheeler Motor company, corner of Fourteenth, Washington and Thirteenth streets, New York, are doing a rushing business. Among the orders for 1-6 to ⅓ horse power motors which they have received within the last two days are the following: 33 from Cincinnati, 62 from Chicago, and 3 from Kansas City. They have unfilled orders for 50 motors for the Sprague company, and over 40 for the United Edison Manufacturing company. They are manufacturing a new motor fan guard, which is remarkable for its simplicity and strength. They now manufacture motors from 1-horse power down; but they are making preparations to manufacture larger kinds Mr. McCoubray, formerly secretary of the National Electric Light company and of the Baxter Motor company, is the efficient manager of the company.

The Interior Conduit & Insulation company of New York is now making carload shipments daily of tube throughout the country. The new underground tube seems to have met with a great deal of satisfaction. This company has a contract for furnishing the underground conduits for St. Paul and Minneapolis, and has also sold several thousand feet to the Pennsylvania Railroad company for underground work. Quite a shipment to Japan has been made, and a shipment will probably be made to Germany during the coming week. The company's new and commodious quarters now enables it to turn out tubes in large quantities, although it has not as yet succeeded in catching up with the orders, but it is probable that this will be done before the middle of the coming month, as the output has been increased tenfold. The initial job of this company, the Shorham apartment house, Washington, D. C., owned by the Hon. L. P. Morton, has now been in operation about eight months, and never has given any trouble since the plant was turned over to the purchaser. That it is an unqualified success is evidenced by the fact that Mr. Morton is now preparing to build an extension of the Shorham House, and it is specified by the architects throughout the entire new building. As this company is not doing any construction work, the architects desire, as a special favor, that it shall be put in under its supervision.

On the treatment of ores by the electrolytic method, a well-known writer states in his work on metallurgy.

"During the past forty years many attempts have been made to extract metals from their ores by electrolysis, and many ingenious processes have been devised, but few of these, so far as we are aware, have proved successful. Some of the earlier investigations of Bunsen, Saint Claire, Deville and Becquerel are of special importance as indicating the general principles upon which such electrolytic operations may be conducted; there is little doubt, however, that much has yet to be done before the separation of metals from their ores will attain the position of a really practical branch of electro-chemistry. We have noticed in the cases of copper refining by the wet way, that many attempts were made in this direction long before a commercially successful application of the electrolytic method was arrived at, and we still hope and believe that electricity will yet be practically employed in extracting metals from their ores; indeed, some trials which we have recently made in this connection are at least of a very hopeful character." This paragraph could now well be eliminated from his work. Electrical engineering firms for the past three years have given this branch of the profession great attention, and with the result that their efforts in constructing dynamos especially adapted for this work have been successful. The United Edison Company, with their unusual facilities for the manufacturing of generators, promptly exploited this field, and are now turning out dynamos to develop any amount of current requisite for the capacity of the works treating the ores. Many mine owners and operators of existing plants treating ores in the old method have, from time to time, been considerably exercised in their minds in reading and hearing reports of the marvelous statements that have appeared, about the output of the establishments already provided with plants for treating copper ore electrolytically namely: 1. The pureness of copper deposited. 2. The recovery of the gold and silver, obtained by no other method. 3. The cheapness of production. 4. The ready sale of the product. These statements are so far true, but the owners, on investigating the matter have had great obstacles thrown in their way, as they could get no information as to the construction of plants, being told that the method is altogether conducted in a secret manner. This consequently has damped their ardor and they have returned to their old system of conducting operations. But it may be at once stated that there is no real secret process. Owners of electrolytic plants have, however, only adopted the ordinary wise and business caution of when they have a good thing, keeping it as far as possible, to themselves. The United Edison Company, with a thorough knowledge of the whole system, can now contract with parties to furnish them with a complete plant, including motive power and generators, baths, pumps, and with all the necessary information for conducting, with financial success, the operations of treating ores by the electrolytic method

Electrical Patents.

Issued June 24, 1890.

430,606. Magnetic Power Equalizer. William W. Alexander, Kansas City, Mo

430,607. Electro-Mechanical Combination Lock. William W. Alexander, Kansas City, Mo.

430,608 Electro-Mechanical Combination Lock. William W Alexander, Kansas City, Mo.

430,622. Electric Lamp Support. James Chase, Rochester, N. Y.

Of the nine claims the third is given:

"In an electric lamp, the combination, with a lamp-post having an extended arm, of a suspended rising and falling lamp, an oscillatory contact or switch lever, and a rock-shaft having at its outer end an operating lever and at its inner end a tripping-arm rocking with the shaft and connected with the contact or switch lever."

430,633. Electric Temperature Regulator. Lucien F. Easton, La Crosse, Wis.

430,634 Regulator for Dynamos. William H Elkins, Boston, Mass

430,636. Electric Circuit Controlling Apparatus. Edwin R. Gill, Jr , Pleasant Hill, Mo.

430,637. Automatic Signal and Switch Controlling Apparatus and Verifying Mechanism. Edwin R Gill, Jr , Pleasant Hill, Mo.

430,645. Incandescent Lamp Hood. John Heath, Plymouth, Mass.

430,675. Trolley Carrier. David C. Nelson, Quincy, and Walter R. Eaton, Cambridge, Mass.

The invention comprises two features. One consists in a double arm trolley carrier and in an arrangement of parts whereby the pressure of the trolley arms—the two being oppositely disposed—can be adjusted and controlled to suit varying conditions of the wire. The second feature of the invention is embodied in a pivotal extension in which is journaled the trolley wheel, and further provided with spreading prongs or automatic "finders."

430,686. Switch for Electric Locomotives. Frank B. Rae, Detroit, Mich.

430,688. Commutator for Induction Generators for Telegraph Lines. Walter S. Richards, Boston, Mass.

430,690. Electric Railway. William Robinson, Boston, Mass

The invention consists in the combination of the contact or working conductor, and a damper arranged to prevent or absorb the vibrations of said conductor.

430,696. Insulator. William H. Seamon, Rolla, Mo.

The first claim reads:

"A cylindrical insulator for electrical conductors, adapted to be bodily located in a cross-arm or support and having a longitudinal passage or bore extending from terminal to terminal for reception of the conductor, and having an additional parallel passage similarly formed and located, and a tie wire located in said additional passage."

430,722. Arc Lamp. James J. Wood, Brooklyn, N. Y.

The sixth claim is given:

'In an arc lamp, the combination of main and shunt magnets, an armature and armature lever, connected by a loose connection adapted to permit the armature to move independently of the lever when abnormally attracted by the shunt magnet, and cut-out contacts carried by the armature and lever, respectively, to be brought into contact upon such abnormal attraction and arranged in two pairs upon opposite sides of the lever, whereby normally a double contact is assured, or in case of the lateral tilting of the armature one pair of contacts at least is caused to act.

430,747. Telephone Exchange Apparatus. Joseph J. O Connell, Chicago, Ill.

The invention consists, first, in a double thimble socket, with the different portions of which the different sides of the limbs of the metallic telephone line circuits are connected, one of said double thimble sockets being provided, when multiple switch-boards are employed, on each board for each line; second, in the pair of loop plugs, one being adapted to be inserted in the answering springjack of a calling subscribers line, and the other being adapted to be used as a test plug and to be inserted in the double thimble socket of the line called for; third, in providing a high resistance individual annunciator in each metallic circuit, so that when an instrument, as a telephone or annunciator, shunts this high resistance annunciator it will be prevented from being operated by any of the currents liable to be thrown upon the line; fourth, in providing a condenser of considerable capacity in a shunt around the grounded test battery, to prevent disturbances which might otherwise be caused by induced currents from the circuit containing the battery; fifth, in the key-board apparatus and circuits therefor; sixth, in a special shelf provided at the rear of the switch-board for supporting the different sets of key board apparatus.

430,748. Telephone Exchange Key-Board Apparatus. Joseph J. O'Connell, Chicago, Ill.

The third claim is:

"The test battery branched to different contacts, one near the special test-circuit-closing spring of each of several answering springjack switches of different telephone lines connected each with two or more switch-boards, and an annunciator in each of said lines, and connections from between the coils thereof, respectively, to the different test-circuit springs."

430,758. Magnetic Ore Separator. Harris B. Smith, Bridgeport, Conn.

430,764. Electric Lock. Charles B. Beers and William B. Tuttle, Bridgeport, Conn.

430,804. Electrical Calculating System. Herman Hollereith, St. Louis, Mo.

The last claim follows:

"20. In a system the combination, with the register circuits, the switch to which they are connected, the series of wires leading to the integrator and connected to the switch, and means for operating the switch to connect any of the last-named wires with any of the register circuits, of the carrying switch and the integrating device."

430,838. Method of Electric Welding or Metal Working. Mark W. Dewey, Syracuse, N. Y.

The invention consists in exposing or subjecting the said part or parts to be operated upon to the heat of a continuous electrically heated conductor in proximity thereto, thereby heating the said part or parts to the required welding, working or treating temperature.

430,839. Apparatus for Working Metals by Electricity. Mark W. Dewey, Syracuse, N. Y.

Claim twelve is:

"In an apparatus for electric welding and metal working, a continuous electric heating conductor adapted to inclose the work and provided with a lining of powdered or granulated semi-conducting material."

430,846. Insulating Joint. Emil F. Gennert, New York, N. Y.

430,865. Electrical Indicator. Harry W. Leonard, New York, N. Y.

430,868. Regulation System for Electric Circuits. Cyprien O. Mailloux, Brooklyn, N. Y.

The fourth claim reads as follows:

"The combination, with the storage-battery, of a re-enforcing dynamo in the circuit thereof, and a regulating coil in the main circuit for determining the re enforcing power of the dynamo."

430,913. Telephone Mouth-Piece and Holder. Elizabeth B. Bell, Washington, D. C.

"Claim 2: A holder for mouth-pieces, formed of resilient material, having spring arms and prongs extending in line with the holder at the end opposite the spring arms."

430,926. Suspending Device for Electric Conducting Wires. William M. Davis, East Weymouth, Mass.

430,932. Manufacture of Incandescent Lamps. Thomas A. Edison, Menlo Park, N. J.

The process consists in filling the globe with oil of turpentine, inverting the globe, heating said globe, and expelling all of the oil by the tension of its vapor and again heating said globe to expel said vapor.

430,933. Filament for Incandescent Lamps. Thomas A. Edison, Menlo Park, N. J.

The fifth claim is given:

"A filament for incandescent electric lamps the entire incandescing portion of which is in the form of a tube"

430,934. Electric Lighting System. Thomas A. Edison, Menlo Park, N. J.

430,960. Telephone System. Isidor Kitsee, Cincinnati, Ohio.

One of the especial features of the invention is that no interruption occurs to talking lines, while others are being cut in and out at the central station, and this by reason of the fact that each subscriber works with an independent current of electricity.

430,967. Fusible Cut-Out. Isaac N. Miller, Cincinnati, Ohio.

430,974. Electric Connection. Hercules Sanche, Detroit, Mich.

430,979. Burglar Alarm. James Winegarden, Grand Rapids, Mich.

430,990. Galvanic Battery. John H. Davis, Findlay, O.

430,991. Carbon for Electrical Purposes and the Process of Making it. John H. Davis, Findlay, Ohio.

The second claim reads:

"The within-described carbon, composed of calcined and ground shale and adhesive substance."

430,992. District Police and Fire Telegraph. Charles C. Drake, Trenton, N. J.

431,011. Electric Railway Signal. William J. Smith, Charlottesville, and James W. Fox, Lexington, Va

431,017. Block Signaling System for Railroads. Mahlon S. Conly, Hyde Park, Ill.

431,018. Dynamo or Magneto Electric Machine. Thomas A. Edison, Menlo Park, N. J.

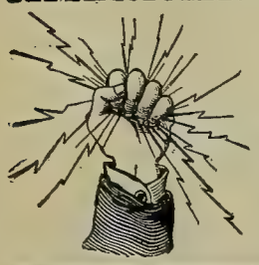
The first claim is given:

"The combination, with the commutator, of an armature end composed of disks having tongues integral therewith for electrical union with the commutator."

431,020. Dental Engine Motive Gear. Peter Brown, Montreal, Quebec, Canada.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

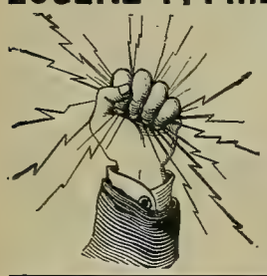
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS: W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

FRANCIS W. PARKER,

Patent Lawyer and Solicitor.

SPECIALTY, ELECTRICITY.

1001-3-5-7 OPERA HOUSE BLOCK.

CHICAGO, ILL.

FRANK T. BROWN, Late

PRINCIPAL EXAMINER ELECTRICITY,

U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

THE TURNER BRASS WORKS
4 LASALLE AVE
CHICAGO.
MAKE ANYTHING IN BRASS

NOTICE TO CONTRACTORS.

Electric Light Plant and Gas Works.

The council of the city of Clinton, in Henry county, Missouri, will receive sealed proposals until July 15, 1890, for lighting the streets of the city, upon one or all of the following plans, viz.:

1st. FOUR ELECTRIC ARC LIGHTS, of 2,000-candle power each, and eighty Electric Incandescent Lights of 32 candle power each.

2d. EIGHT ELECTRIC INCANDESCENT LIGHTS of 100-candle power each, and eighty Electric Incandescent Lights of 32-candle power each.

3d SEVENTEEN ELECTIC ARC LIGHTS of 2,000-candle power each.

4th. TWELVE GAS LIGHTS of 100 candle power each, and eighty Gas Lights of 32-candle power each.

Said lights to be distributed and located according to plans and specifications on file in the City Clerk's office.

Such proposals will be made upon each of said systems separately, and separately for an all-night or moonlight and a midnight light, and for a term of five years, with an option to the city to renew the same for another term of five years.

The council reserves the right to accept any one, or reject all of said proposals. Address

A. HAYNIE, City Clerk,
Clinton, Mo.

Dated CLINTON, Mo., June 23, 1890.

WILLIAM S. BATES,
PATENT LAWYER,
204 Dearborn Street, CHICAGO.
17 YEARS EXPERIENCE IN THE PATENT OFFICE AND THE COURTS.

NOW IS THE TIME TO BUY

AYRTON & PERRY'S

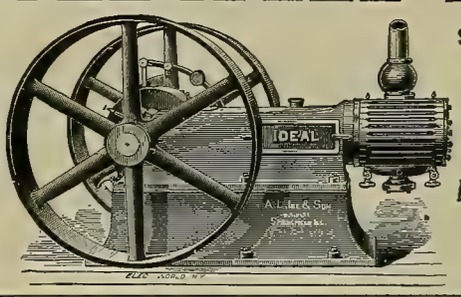
Celebrated Spring Ammeters & Voltmeters.

No permanent magnets. Scale divisions equal throughout. Portable. Direct Reading.

We have received large consignments from the makers, and are prepared to fill orders for all ranges AT ONCE.

QUEEN & CO, PHILADELPHIA.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers

SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

OKONITE
TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

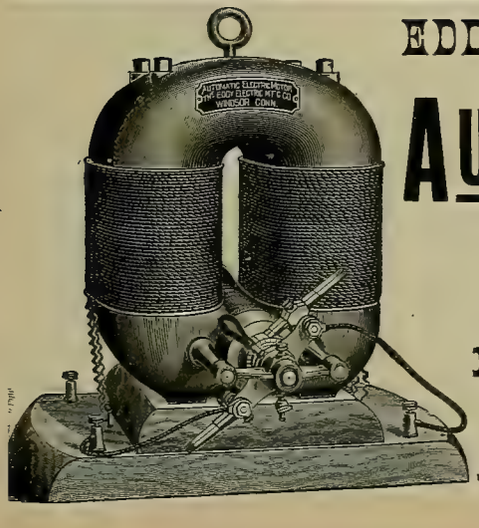
For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.



EDDY ELECTRIC MANUFACTURING COMPANY,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS

In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: *NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.*

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

C., M. & ST. P. R. R.

The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

THE MONON ROUTE

Affords choice of Four (4) Fast Trains each way, commencing June 1, 1890.

EVERY DAY AND SUNDAY, TOO

In Pullman's Patent Perfected Safety Vestibuled Buffet Sleepers and Chair Cars between

CHICAGO and the OHIO RIVER.

These are all solid Pullman trains of latest design and improvements, consisting of Elegant Day Coaches, Chair Cars, Composite Cars, Dining Cars and the very finest of Buffet Sleeping Cars, equipped with Pullman's Perfected Safety Vestibules.

Trains from Cincinnati and the Southeast, and from Louisville and the South, arrive at Chicago in ample time to connect with the morning and evening fast trains for Milwaukee, Minneapolis, St. Paul, Omaha and all points in the Northwest.

Morning and evening connections made both at Louisville and Cincinnati with the Fast Express Trains of connecting lines for Memphis, Knoxville, New Orleans, Jacksonville and all points South.

At Indianapolis connections are made with all diverging lines.

Special Features: Steam Heat, Electric Light, Perfected Safety Vestibules.

For rates, through and local schedules, address any Ticket Agent of the Monon Route.

Wm. F. Black, General Manager.
W. H. McDoel, Traffic Manager.
James Barker, General Passenger Agent.

ELECTRICAL BOOKS.

Send For New and Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

C., B. & Q. R. R.

—IS THE—

Best Appointed Line

—FOR REACHING THE—

West, Northwest and Southwest.

POND ENGINEERING CO.

707 and 709 Market St., St. Louis.
427 "The Rookery" Chicago.
31 Waterworks Building, Kansas City.
319 Ramge Building, Omaha.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

Erected Ready for Service.

SPECIALTIES:—The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, etc.

SEND FOR LATEST CATALOGUES.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. Correspondence Solicited.

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

The Rae "Horn" Ammeter

A New Measuring Instrument.

Send for Circular and Price List.

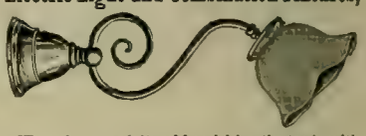
LOCKWOOD INSTRUMENT CO.,

91 Griswold St., · DETROIT, MICH.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

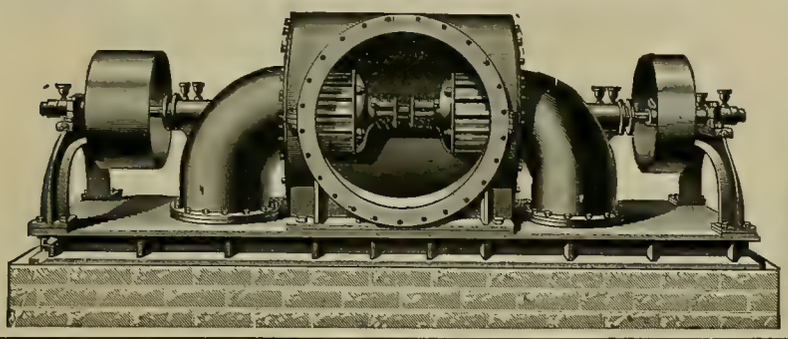
FITCHBURG, MASS.

FAIRBANKS, MORSE & CO.,

St Louis, Chicago, Kansas City, Denver, Omaha, St. Paul.

SELLING AGENTS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE

Free from gum or acide. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO.

1221-1223 Union Ave.

KANSAS CITY, MO.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

ROSE POLYTECHNIC INSTITUTE,

TERRE HAUTE, IND.—A SCHOOL OF ENGINEERING.

Well endowed, well equipped departments of Mechanical and Civil Engineering, Electricity, Chemistry, Drawing. Extensive Shops & Laboratories. Expenses low. For catalogue address C. A. Waldo, Lib'n.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

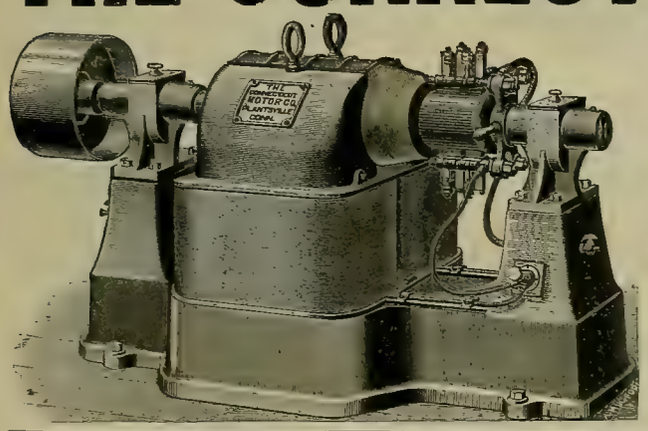
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 N. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

THE SPERRY ELECTRIC CO.,

D. P. PERRY, Vice-President and General Manager,

—MANUFACTURERS OF THE—

SPERRY IMPROVED SYSTEM

—OF—

ARC LIGHTING,

HIGH OR LOW TENSION.

WE GUARANTEE:

1. The new Sperry apparatus free from repairs for twelve months.
2. That the new Sperry improved Dynamos can be coupled in series with perfect safety.
3. That any number of lamps from one to capacity of dynamo can be cut in or out of circuit, singly or in groups, with perfect safety, and without sparking at the brushes.
4. To absorb power in exact proportion to number of lights burning.

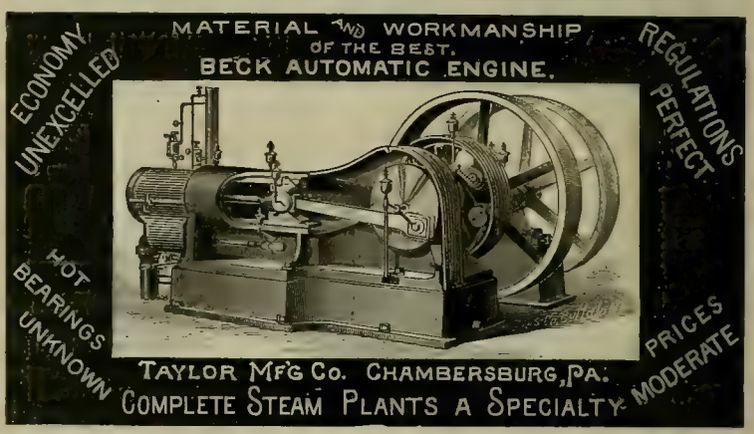
WE BELIEVE:

1. The new Automatic Sperry Dynamos and Lamps surpass in efficiency those of any other make.
2. That there is greater economy in operating the new Sperry System than any other.
3. That our automatic regulation has no equal; no rheostat, no wall boxes, no solenoid or dash-pot.
4. That if you will visit our factory we can show you the best arc lighting apparatus in existence.

We invite correspondence with electrical engineers, Intending buyers, and Interested people everywhere.

THE SPERRY ELECTRIC CO., 195 to 207 South Canal Street, CHICAGO ILL,

---



SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

The Detroit Electrical Works

ELECTRIC RAILWAY SYSTEM.

— RAE PATENTS. —

CHEAPEST.

SIMPLEST. BEST.

The Detroit Electrical Works, Detroit, Mich.

THE EVANS FRICTION CONE CO.

Have had their System of Transmission of Power in use for four years, driving all classes of machinery.

THE FIRST APPLICATION OF THE SYSTEM TO THE RUNNING OF

DYNAMOS

WAS MADE JUST ONE YEAR AGO.

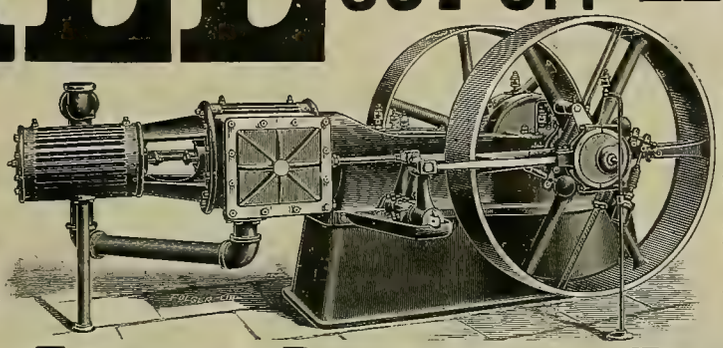
There are now 50 Dynamos and Railroad Generators running by the system, varying from 10 to 80 H. P. in twenty-three different stations, all giving perfect satisfaction, and there are in process of erection plants for the use of the system, aggregation 1,200 H.P., and at the present rate of increase this amount will be over 5,000 H. P. by July 1.

Illustrations of Plants using the System, with testimonials, will be shown in this space from week to week.

Send for Catalogue and General Information to **EVANS FRICTION CONE CO., 85 Water St., BOSTON, MASS.**

BALL AUTOMATIC CUT OFF ENGINE

Standard.
Cross Compound.
Triple Expansion.
Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO., 15 Cortlandt Street, NEW YORK.

J. W. PARKER, 38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER, 224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON, Room 403 Home Insurance Build'g, CHICAGO, ILL.

OMAHA ENGINEERING COMPANY, Sheeley Building, OMAHA, NEB.

KANSAS CITY ENGINEERING CO. KANSAS CITY, MO.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS M. WILKINS. E. WARD W LKINS

TRADING AS

PARTRICK & CARTER,

Manufacturers of and Dealers In Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

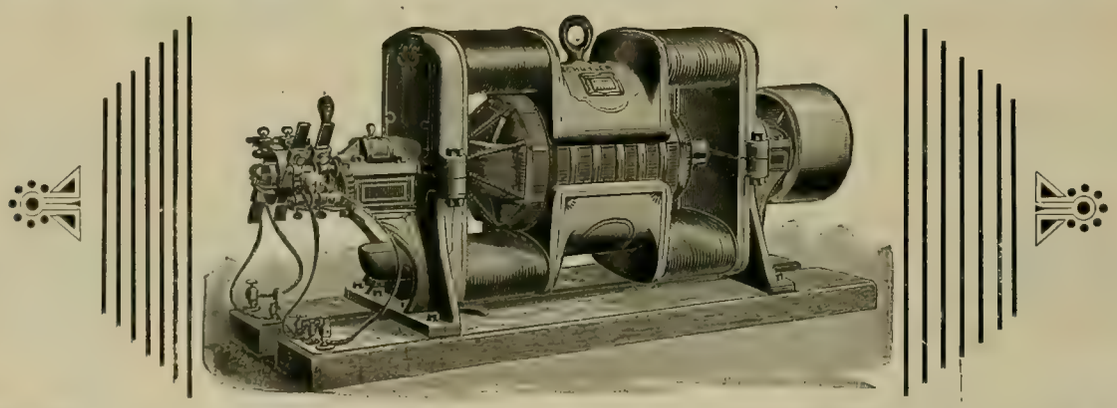
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.

THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S

Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders, Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

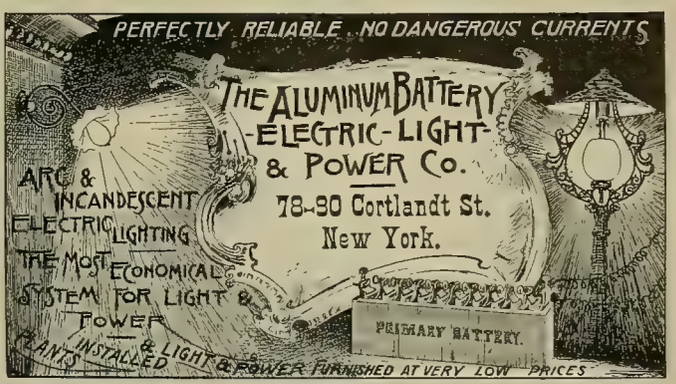
OK-ONITE
TRADE MARK.
WIRES, CABLES, TAPE and CORD
FOR
PROMPT SHIPMENT.

HOGGSON'S
IMPROVED
Door Spring.

Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

WHEN YOU BUY A MOTOR

From ANY Manufacturer or Dealer,
State that you WANT IT SUPPLIED WITH the
Whittingham Automatic Switch.
Send for Catalogue.
Automatic Switch Co.,
No. 8 Keyser Building,
BALTIMORE, MD.



GONDA

The Standard Open Circuit Batteries of the World.

AXO

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

TRADE
GONDA
MARK.

THE ONLY
Genuine Leclanche Batteries
Made or Sold in America.

LECLANCHÉ BATTERY CO., 149 West 18th St., NEW YORK.

WESTERN ELECTRIC CO.,

We are the Exclusive Western Agents for the sale of
Washburn & Moen's
Galvanized Iron Wire,
Galvanized Steel Wire, and
Hard Drawn Copper Wire.
Prices on Application.

CHICAGO. NEW YORK.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
FOR
ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2,000	"
" " " "	3d " (Just ready.)	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition (Just ready.)	2,500	Cop'es.
Bell Hangers' "	1st "	2,500	"
" " " "	2d "	1,000	"
Total within Eighteen months		15,000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B BADT.

PRICE $1.00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

W. D. Sargent, President. John A. Barrett, Vice-President and Cons. Electrician.
E. H. Cutler, Treasurer and Manager. Frank A. Perret, Electrician.

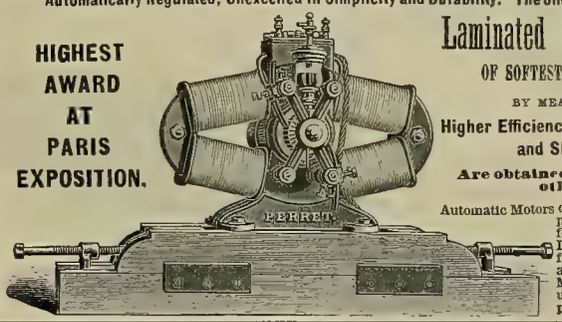
THE ELEKTRON MFG. CO.,
79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting, Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

ST. LOUIS ELECTRICAL SUPPLY CO.,

High Grade Wires, Weatherproof Wires, Pins, Brackets, Cross Arms, C. & W. Mica Railway Insulators, Cut Mica, Sheet Mica, Fuse Wire, Soldering Salts, Tapes, Tubing, Glass and Porcelain Insulators, Sleet Proof Pulleys and Arc Light Windlasses, Incandescent Lamps, Porcelain Cut-outs and Switches, Everything Electrical Required for Electric Light, Power and Railway Companies. Agents for Novelty Electric Supply Co.'s Specialties, and Gould & Watson Co. Write for Quotations.

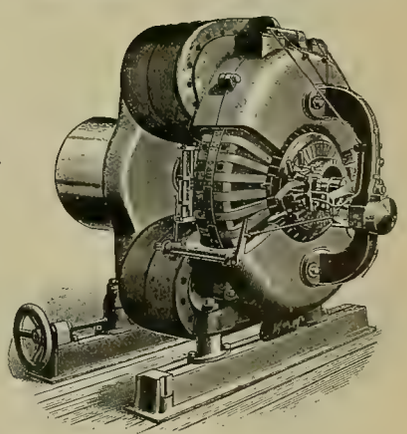
Favor Us with Your Orders.

403 North 8th Street, ST. LOUIS, MO.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

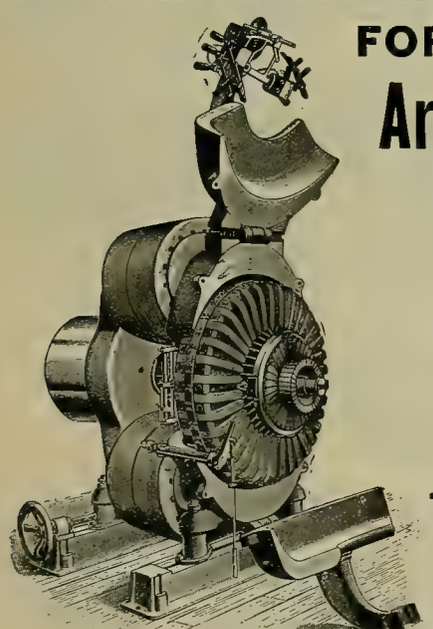
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features:

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

THE CONSOLIDATED ELECTRIC STORAGE COMPANY,

MANUFACTURERS OF

THE JULIEN

ELECTRIC STORAGE BATTERY.

Exclusive licensees for the whole of the United States of the Storage Battery Patents of Charles F. Brush (lately owned by the Brush Electric Company), and sustained by the Circuit Court of the United States.

Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

BATTERIES FOR LIGHT AND POWER,

SOLD AT PRICES SO LOW AS TO DEFY COMPETITION.

For Agencies and Licenses apply to the Company's Office at

120 BROADWAY, NEW YORK CITY.

All other inquiries, more especially those in relation to Purchase of Batteries, should be addressed to the Philadelphia Office of the Company.

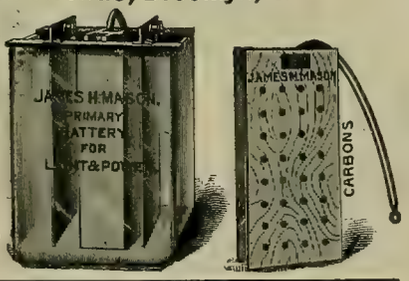
926 Drexel Building, PHILADELPHIA, PA.

PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.
These Batteries are in practical use, and giving perfect satisfaction.



BARNES' NEW SENSITIVE DRILL
Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

WESTERN AGENT
L. W. COLBURN'S
DYNAMOS AND MOTORS.

WESTERN AGENT
ELECTRICAL DEPARTMENT
NEW HAVEN CLOCK CO.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.

WESTERN AGENT FOR
ALFRED F. MOORE'S
ESTABLISHED 1820.
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

SPRAGUE
ELECTRIC RAILWAY SYSTEM.

More than one hundred different street railways in operation or in course of construction.

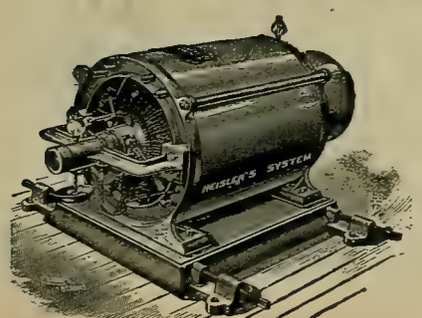
MORE THAN 175
SEPARATE ORDERS
From Street Railways for Electrical Equipments.

The Sprague Electric Railway System has been proved to be the most

DURABLE, RELIABLE, ECONOMICAL, CONVENIENT.

Sprague
ELECTRIC RAILWAY & MOTOR COMPANY,
16 and 18 Broad St., NEW YORK.

THE HEISLER PATENT LONG DISTANCE
INCANDESCENT ELECTRIC LIGHT SYSTEM.
UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,
809-817 South 7th Street, - - - ST. LOUIS, MO.

THE

THOMSON-HOUSTON

ELECTRIC RAILWAY SYSTEM

BY THE VERDICT OF OVER FIFTY RAILWAY COMPANIES HAS BEEN DECLARED

A PRACTICAL AND COMMERCIAL SUCCESS.

Schedule Time Regularly Maintained,
No Destruction of Apparatus,
Slight Cost for Repairs,

—ARE THE DISTINCTIVE FEATURES OF THE—

Thomson-Houston Railway System.

FIFTY ROADS IN OPERATION.
THIRTY ROADS UNDER CONSTRUCTION.
TWENTY CONTRACTS JUST CLOSED,

—MAKING A GRAND TOTAL OF—

ONE HUNDRED ELECTRIC RAILWAY COMPANIES

USING THE THOMSON-HOUSTON SYSTEM.

Illustrated and Descriptive Pamphlets Furnished to Prospective Purchasers.

THOMSON-HOUSTON ELECTRIC CO.,

MAIN OFFICE: 620 ATLANTIC AVE., BOSTON, MASS.

BRANCHES:

148 Michigan Ave., Chicago, Ill. Wall and Lloyd Sts., Atlanta, Ga. 403 and 405 Sibley St., St. Paul, Minn.

THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

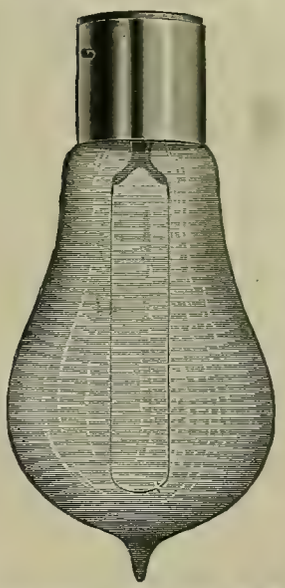
PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,

ALL CANDLE POWERS,

ANY VOLTAGE,

ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT CO., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER CO, Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

GRIMSHAW WHITE CORE

WIRES AND CABLES.

—FOR—

TELEGRAPH,

TELEPHONE,

ELECTRIC LIGHT.

Switch-Board Cables,

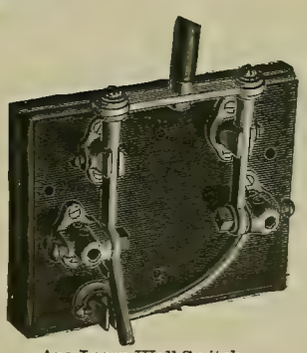
Grimshaw White Tape,

Grimshaw Black Tape,

GRIMSHAW SPLICING COMPOUND.

McLennan Switch.

Paiste Switch.



Arc Lamp Wall Switch.

Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.,* CHICAGO, ILL.

THE Electrical Supply Co.,

171 RANDOLPH ST.,

C-H-I-C-A-G-O.

MANUFACTURERS OF

BARE AND INSULATED

WIRES AND CABLES

AND

GENERAL ELECTRICAL GOODS.

Catalogues or Quotations upon Application.

NO CHARGE MADE CUSTOMERS FOR EXPERT ADVICE.

A large and well assorted stock of Shield Brand and Habirshaw Wires constantly on hand.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219,208, and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219,208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC Co.,

FORT WAYNE, IND.,

Manufacturers of the

SLATTERY INDUCTION SYSTEM

—OF—

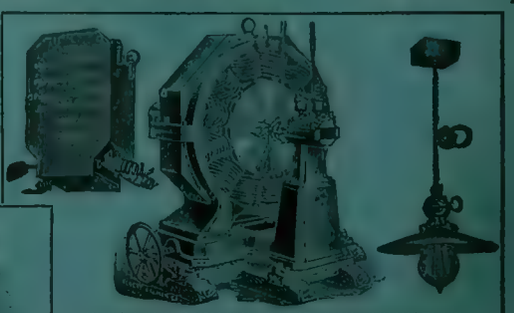
Incandescent Lighting,

—AND THE—

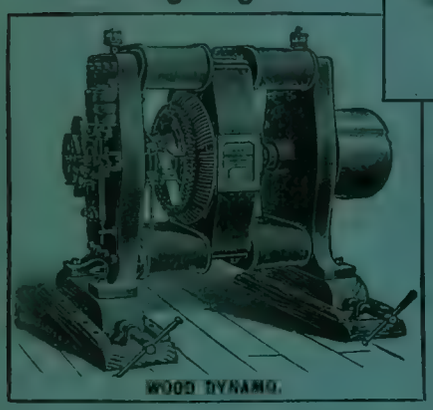
WOOD SYSTEM

—OF—

Arc Lighting.



SLATTERY DYNAMO, LAMP AND CONVERTER.



WOOD DYNAMO.

The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12-16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.

CORRESPONDENCE SOLICITED.

MAIN OFFICE AND WORKS, FORT WAYNE, IND.

NEW YORK OFFICE,
115 Broadway, Boreel Bldg.

SAN FRANCISCO OFFICE,
217 Sansome Street.

CHICAGO OFFICE,
185 Dearborn Street, First Floor,
W. J. BUCKLEY, Manager.

PHILADELPHIA OFFICE,
907 Filbert Street,
C. A. WILBUR, Manager.

PITTSBURGH, PA., 533 Wood Street.

CITY OF MEXICO OFFICE, F. ADAMS, Successor.

BERGMANN & CO.,

ELECTRIC LIGHT, COMBINATION

AND

GAS FIXTURES,

ADAPTED TO ANY SYSTEM OF INCANDESCENT LIGHTING.

ALL APPLIANCES FOR THE EDISON ELECTRIC LIGHT.

Illustrated Catalogues, Designs and Estimates Furnished on Application. Correspondence Solicited.

Office and Works, 292-298 Avenue B, } **NEW YORK** { Show Rooms, 65 Fifth Avenue.

T. W. WILMARTH & CO., 227 State Street, CHICAGO, ILL.

AGENTS FOR OUR FIXTURES IN THE NORTHWEST.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, JULY 12, 1890. No. 2.

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE.

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { BAKER, BALCH & CO., Seattle, Wash. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufactures can be found at our Agencies.

THE ACME OF FINE CONSTRUCTION.

OUR WIRES

OUR CABLES

STANDARD UNDERGROUND CABLE CO.,

Westinghouse Building, PITTSBURGH, PA.

G. L. WILEY, Manager, New York. F. E. DEGENHARDT, Manager, Chicago.

ROOT'S WATER-TUBE BOILER.

ROOT SECTIONAL SAFETY BOILER.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

ELECTRIC PLANT BOILER.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff Street, New York.

BRANCHES: BOSTON, PHILADELPHIA, NEW ORLEANS, DALLAS and CHICAGO.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

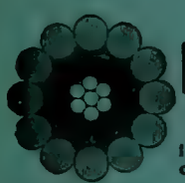
STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.



DAY'S KERITE INSULATION.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

Aerial Use, All Sizes Subterranean Use, *Lead Encased Wires.* Submarine Use Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., NEW YORK.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff St., New York. / 133 and 135 Wabash Ave., Chicago, Ill. FACTORIES: ANSONIA, CONN.

THE EDISON MACHINE WORKS,

MANUFACTURERS OF

Weatherproof Wire. Insulated Iron Wire. Magnet Wire. Rubber Covered House Wire.
Annunciator Wire. German Silver Wire. Office Wire. Flexible Brush Holder Cable.
Gas Fixture Wire. Arc Lamp Cords. Tinsel Cords. Flexible Cords.
Telephone, Telegraph and Electric Light Cables.
PARAGON TAPE.

JAMES F. KELLY, General Sales Agent. - 19 Dey Street, NEW YORK.

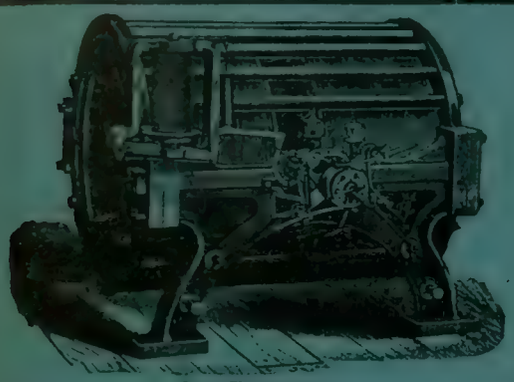
WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
234 Montgomery St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.

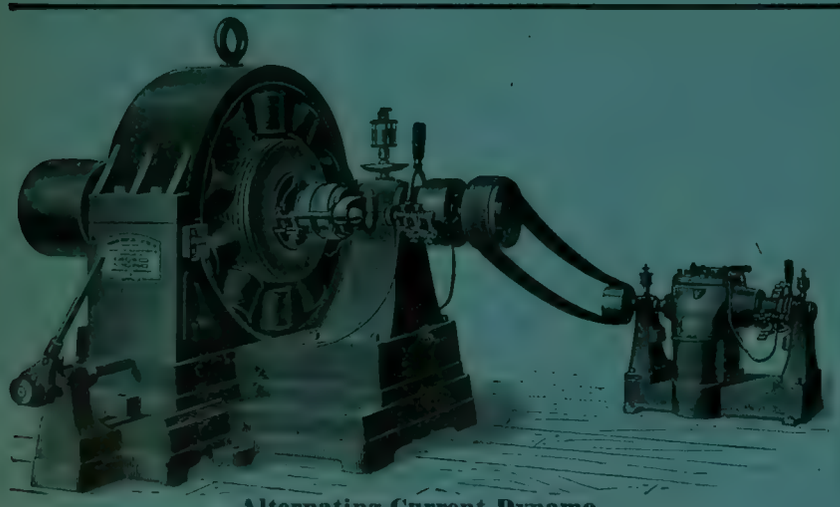


Arc Dynamo.

No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent, are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.

Direct Current Incandescent Dynamo.

Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.



Alternating Current Dynamo.

The problem of long distance incandescent lighting is practically solved by the alternating current dynamo, and to meet the demand for a machine of this character we have constructed what is unquestionably the most perfect alternater offered the public today, embracing as it does, all the features that combine to make a perfect dynamo—automatic regulation, perfect mechanical construction, highest efficiency, and economy of operation.

Motor.

The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

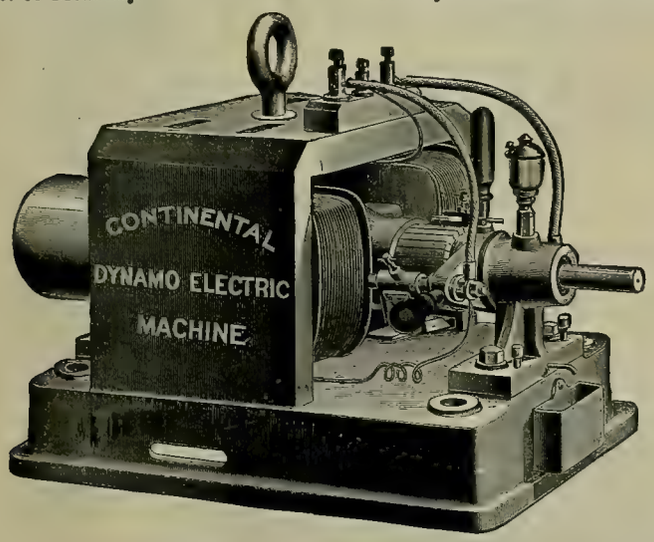
LIGHTNING ARRESTER.—All of our installations are protected from destruction and injury by our lightning arrester, which we will fully guarantee to operate successfully in every instance. The Company guarantees to repair or replace apparatus injured by lightning where these arresters fail to operate.

CONTINENTAL DYNAMO COMPANY,

DYNAMOS. **NEW YORK.** MOTORS.

C. SCHUMACHER, Pres't. VICTOR SCHALLER, Treas. P. CLAUS, Gen'l Manager.

Office: 63 Broadway. Factory: 162 and 164 W. 27th St.



Our Dynamo is cast in one piece, and combines indestructible solidity with the greatest simplicity of design and compactness; the highest efficiency with a total absence of the many objectionable features of the machines heretofore in use. No outside magnetism. Current generated without sparking, therefore steady light, and small wear of brushes and commutator.

C. J. THOMPSON, 100 East Fourth St., St. Paul, Minn., Agent.

THE HAWKEYE
ELECTRIC MFG. CO.,
DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station
AND
ISOLATED PLANTS,
ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps,*** Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

PHŒNIX GLASS CO
OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES SHADES

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

To Arc and Incandescent
POWER COMPANIES.

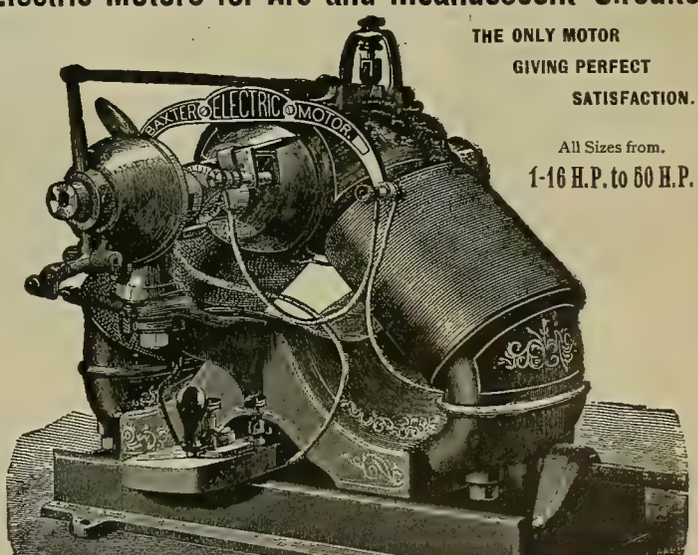
THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.



The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

P. MINTURN SMITH, Pres't. WILLIAM D. PERRY, Vice P. JAMES W. EASTON, Elect'n. S. N. ROBINSON, Secretary. CHARLES TREMAINE, Treas'r.

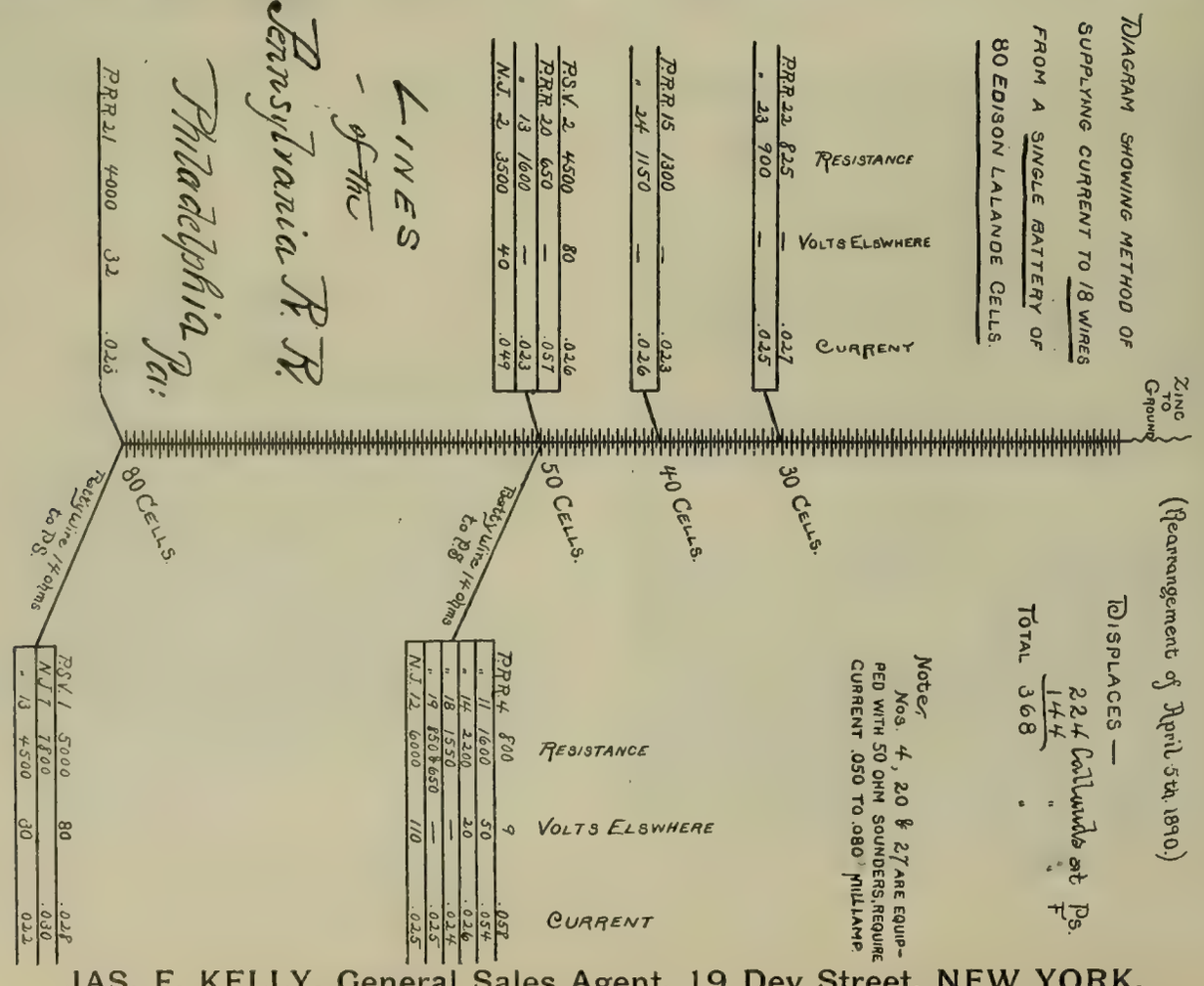
THE EASTON ELECTRIC CO

Electrical Apparatus for Arc and Incandescent Lighting. Factory Brooklyn, N.Y.

Office 45 BROADWAY, NEW YORK.

J. H. REID, General Agent, Room 9, Metropolitan Block, CHICAGO.

THE EDISON-LALANDE BATTERY.



JAS. F. KELLY, General Sales Agent, 19 Dey Street, NEW YORK.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190 & 192 Fifth Avenue, CHICAGO, ILL.

THE DENVER CONSOLIDATED ELECTRIC COMPANY,

General Office: 1534 Lawrence Street.

DENVER, COLO., June 26, 1890.

MR. GEORGE CUTTER,
Manager.

GREAT WESTERN ELECTRIC SUPPLY CO., 5th Ave., Chicago, Ill.

DEAR SIR:—Samples of *Simplex Wire* have arrived. Have had No. 6 in bucket of water with bucket connected to one side of Brush Dynamo and wire to other side, and nothing but insulation to prevent short-circuiting a potential of *2208 volts*, for *over 50 hours*, and it is as good as ever yet and apparently good for a long time. The *other wire* tested gave out under same test in *1 hour, 40 minutes*, and it is an expensive wire too.

(Signed.) **H. BOTTOMLEY.**

This talks better than the order for 1,000,000 feet which we refused, because the price offered was less than the cost of making a reliable insulation.

We will not Lower the Quality of Simplex Wire.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 10 AMPERES.

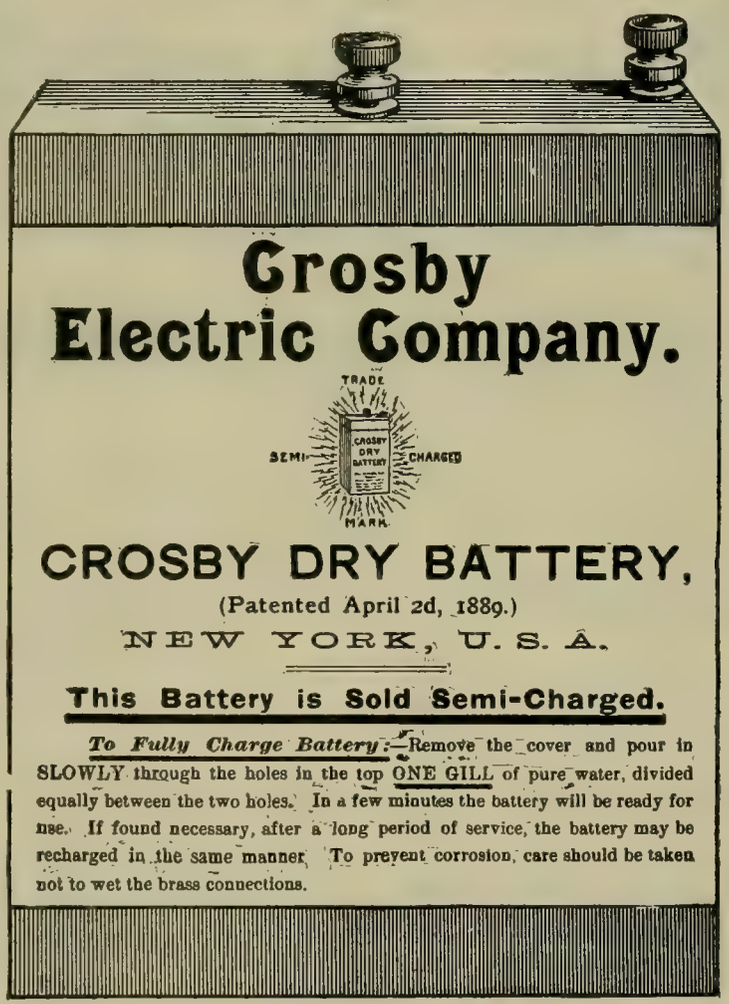
ADVANTAGES OF THE CROSBY DRY BATTERY

FOR OPEN CIRCUIT WORK.

THE CROSBY DRY BATTERY is the best Open Circuit Battery in the market. It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing more work than any other. In addition to this, it is the most reliable, most compact, most durable and simplest cell yet discovered. It is so constructed that it is not destroyed or seriously injured by short circuiting, and we are prepared to prove at any time that its power of recuperation is proportionately greater than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks, and all the uses to which Open Circuit Batteries may be put, it has no equal, whether it be compared with Liquid or other Dry Batteries. We guarantee depolarization, absence of offensive crystallization and perfect cleanliness.

The Crosby Battery is the only Dry Battery sold semi-charged. It does not work until wanted.

The preference as between Liquid and Dry Batteries should always be given to the latter, provided the amount of working power required and a constant current can be obtained. No form of Dry Battery has as yet been placed before the public, except the Crosby Dry Battery, which will do the work of Wet Batteries and give a constant supply of Electricity sufficient for reliable Open Circuit work at all times. The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with which their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance, and easily broken and injured. The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids, and, after once being properly connected, requires no attention whatever, while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.



The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for Open Circuit Work. If, however, through an accident, it becomes Short Circuited, it recoups itself. This cannot be said with equal truth of any other Dry Battery known.

The Crosby Dry Batteries are manufactured in different sizes and forms, to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in the Crosby Dry Batteries varies from one to ten amperes, according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

CYLINDRICAL.

	Size in inches. Height.		Diam.	Price.
No. 3	7¼	x	2½	$2 00

RECTANGULAR.

	Size in inches. Height.		Width.		Length.	Price.
No. 2	5	x	1⅛	x	4½	$2 00
No. 3	9	x	1½	x	8	3 00

TELEPHONE.

	Size in inches Height.		Width.		Length.	Price.
Long Distance	7½	x	2½	x	4¾	$2 00
Telephone	7½	x	2	x	4¾	1.50

N. B.—OTHER SIZES AND SHAPES TO SUIT PURCHASERS.

[COPY.]

OFFICE OF FLEMMING'S ELECTRO MEDICAL INSTRUMENT MANUFACTORY,
No. 1009 ARCH STREET, PHILADELPHIA, March 8, 1890.

CROSBY ELECTRIC COMPANY, New York.

GENTLEMEN:—The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan. 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29, when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan. 30; 7:30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing. Very respectfully,

(Signed) OTTO FLEMMING.

THE CROSBY ELECTRIC CO.,

JudgeBuilding, Fifth Avenue and Sixteenth Street, NEW YORK.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

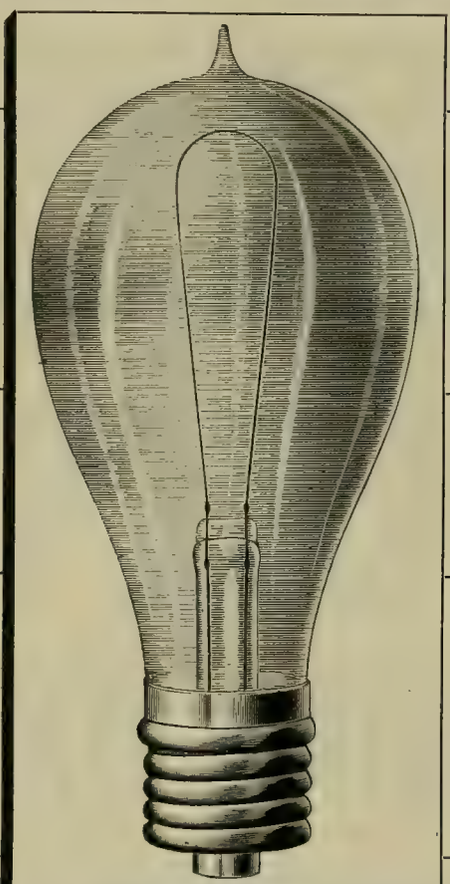
SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

UNITED
EDISON MANUFACTURING CO.,
65 FIFTH AVENUE, NEW YORK.
EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.

No. 2.
No. 2 is the Thomson-Houston.



The Edison Incandescent Lamp.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No. 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

SEND FOR CIRCULARS AND PRICES.

UNITED EDISON MANUFACTURING CO.,

Main District Offices:

Eastern District, 65 Fifth Avenue, New York City.
Central District, Rialto Building, Chicago, Ill.
Mountain District, 730 17th St., Denver, Colo.
Pacific District, Chronicle Bldg., S. Francisco, Cal.
Canadian District, Toronto, Canada.

THE BEST SOLID RUBBER CORE WIRE ON THE MARKET.

In order to meet the demand for an **ABSOLUTELY RELIABLE, YET LOW-PRICED** solid rubber core-wire, The Edison Machine Works have produced a new line of this class of goods made up in all sizes, from No. 0000 to No. 20. It is the equal in quality, finish and durability of their other well-known wires. Once tried, it will always be used in preference to any other.

IT IS THE NE PLUS ULTRA.

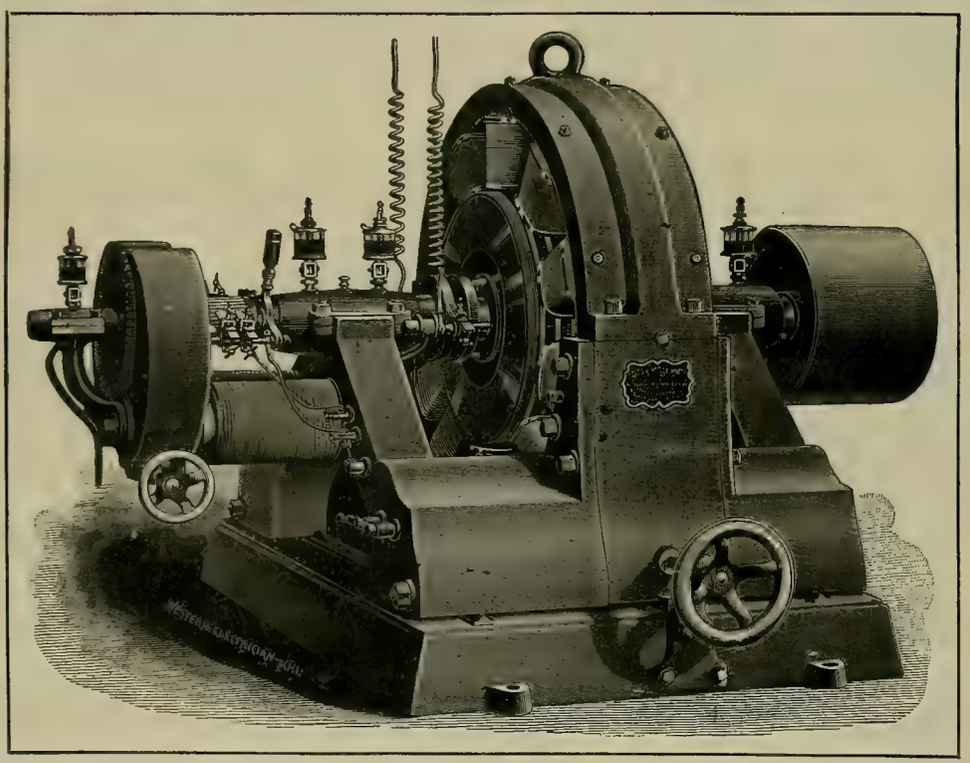
FOR PRICES, SAMPLES, AND OTHER INFORMATION, ADDRESS

THE EDISON MACHINE WORKS,

JAS. F. KELLY, Gen. Sales Agent, 19 Dey Street, NEW YORK.

THE BEST OF ALL

THE NATIONAL
TRANSFORMER SYSTEM
OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts.,
Seattle, Washington.
THOMAS WOLFE, Southwestern Agent,
Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.,
141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.,
1517 Larimer St., Denver, Colo.

CHAS. M. BLANCHARD, Agent,
Girard Building, Philadelphia, Pa.
L. N. COX, Agent,
16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent,
Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts.,
531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

Chicago, May 19th, 1890.

CENTRAL ELECTRIC COMPANY,
116 & 118 Franklin Street, CHICAGO.

Gentlemen:

Please furnish this company

1,000,000 FEET

No. 14 B. & S. braided Okonite wire.

CHICAGO EDISON CO.,
By Chas. B. Holmes,
Purchasing Agent.

THAT'S WHAT TALKS. The Chicago Edison Co. have tried all the low-priced imitations of Okonite, and the above order comes as the result of dearly bought experience.

CANDEE WIRE holds the same relative position among weather-proof wires. We are General Western Agents for both.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable System.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

COLUMBIA
Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,
MANUFACTURERS OF
INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

JUST COMPLETED

THE LARGEST AND BEST EQUIPPED
INCANDESCENT LAMP FACTORY
IN THE WORLD.

Sawyer-Man Electric Co.,

510-534 W. 23d Street,
NEW YORK.

ARMATURES REPAIRED AND REWOUND
COMMUTATORS TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

THE

WESTINGHOUSE ELECTRIC CO.'S

Alternate Current System of Incandescent Electric Lighting warrants your most careful investigation.

Three years ago half a dozen central station companies running a few thousand lights, had adopted it. To-day it is in use in three hundred towns and cities, and about 600,000 sixteen candle power lamps is the aggregate capacity of the 300 plants.

The first dynamos the Westinghouse Electric Company made are still in operation, but the improvement since that time has been great. Electrically and mechanically perfection has been attained.

The converters of the Westinghouse Electric Company have the highest attainable efficiency, and are from ten to fifteen per cent better in this respect than those of other manufacturers.

No central station can be operated to advantage without the Shallenberger Meter. No gas company, however small, would think of operating a station without meters, and the same reasoning is applicable to all electric light plants. Send for special circular on the Shallenberger Meter.

The Westinghouse Electric Company was the pioneer in the manufacture of alternate current dynamos in America, and all of its apparatus is celebrated in this country and abroad for its durability, efficiency and the satisfaction it has given to purchasers.

The Westinghouse Electric Company has recently utilized the alternating current for Arc lighting. Send for special circular just issued. A simple single carbon lamp runs four nights without renewal of carbons. Dynamos of the following capacities constantly kept in stock, together with a full outfit of detail, apparatus and lamps:

25, 40, 60, 125, 250.

No wall fixtures are required in the Alternating Arc System.

The machine is inherently self-regulating from full load to short circuit.

THE WESTINGHOUSE ELECTRIC CO.,

PITTSBURGH, PENN., U. S. A.

BOSTON, NEW YORK, CHICAGO, ST. LOUIS, CINCINNATI, SAN FRANCISCO. PORTLAND, ORE., CHARLOTTE, N. C., DALLAS, TEXAS.

BURNLEY DRY BATTERY.

PATENTED, Jan., 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortland St., N. Y.

CHICAGO:—Central Electric Co.

FOR SALE.

One 14½x16 latest type Buckeye double valve high speed engine. Run from October last to June 1st. First-class condition and complete. Sell because we have no further use for an engine of this size.

JAS. F. AYER,
Gen'l Supt.,
Municipal Electric Light & Power Company,
ST. LOUIS, MO.

PURDUE SCHOOL —OF— ELECTRICITY.

New laboratory, fitted with best appliances, dynamos, storage batteries, and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue. **Purdue University,**
LA FAYETTE, IND.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,
32 and 34 Frankfort St., - - NEW YORK.

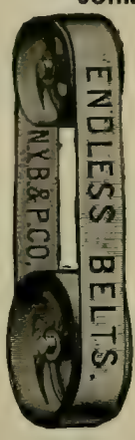
BROOKLYN, N. Y., U. S. A., June 8, 1890.
MESSRS. HAZAZER & STANLEY,
Electrical House Furnishings,
32 and 34 Frankfort St., New York.

GENTLEMEN:—We have in the past two years used several thousand of your duet proof bells, and are satisfied, after an experience of twenty-five years in the electrical business, that they are the best in construction, finish and operation I ever used. Yours truly,
J. I. CONKLIN, Empire Electric Mfg. Co.,
29 Walworth St.

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics
FOR MECHANICAL PURPOSES.
RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
ST. LOUIS, 907-911 N. Main St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
RICHMOND, 1206 East Main St.

IT KNOCKS THEM ALL!

BISHOP RUBBER COVERED WIRES.
BALATA INSULATED DROP CORD.

Prof. Henry Morton says: "These wires showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illum'nating gas."

THE "BISHOP"
Always Leads the Procession.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, - 341 ROOKERY BUILDING, CHICAGO.

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS } Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS } Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.
Edw. H. Johnson, President.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co

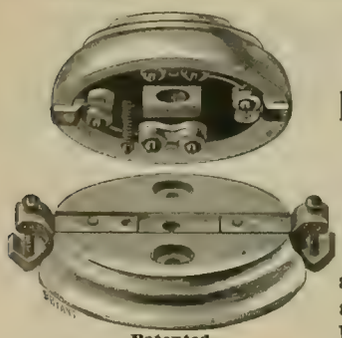
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.



DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

Patented.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.
Kept in Stock and for Sale by all Prominent Supply Houses.

—THE—
Celebrated P. AND B.
ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,
59 Maiden Lane, - NEW YORK.

Western Electrician.

EVERY SATURDAY.

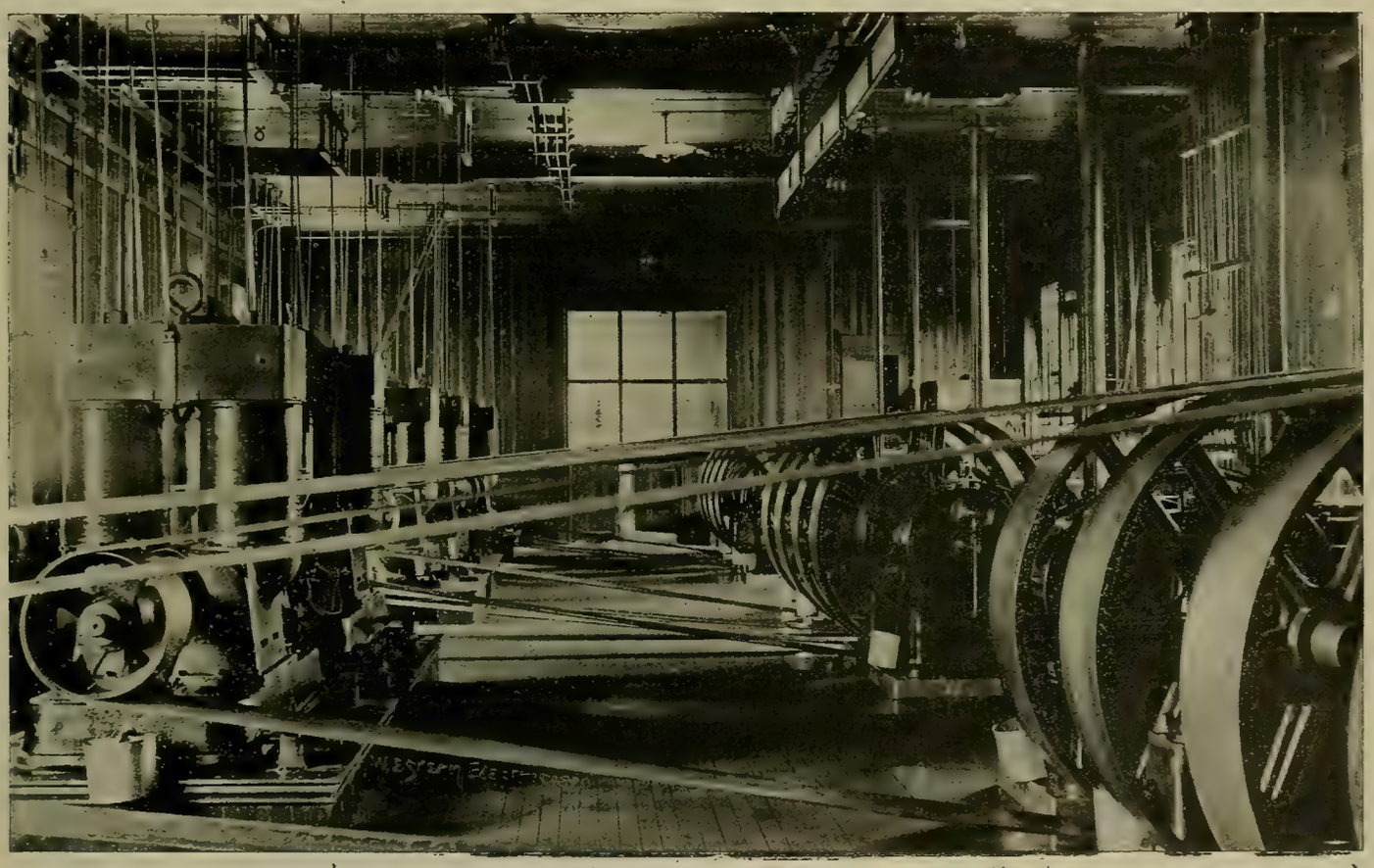
Vol. VII. CHICAGO, JULY 12, 1890. No. 2

Edison Electric Light and Power Company, St. Paul, Minn.

Among the pioneer Edison companies in the West that at St. Paul, Minn., occupies a prominent position. When it was formed in September, 1886, the incandescent lamp was still a luxury, and in that part of the country it had not yet ceased to be a novelty. The projectors of the St. Paul enterprise had faith in the development of the industry and constructed what was then considered an enormous building for an electric lighting station. The structure is of brick, both substantial and pleasing in appearance, and admirably adapted to the requirements of a central station. Its position is also advantageous, as it is in the heart of the city. The offices occupy the front of the ground floor facing College avenue. Directly behind are the dynamo and engine room and to the left the meter room. The steam plant is in the rear. The upper floor is used as a storeroom and repair shop where the company has facilities for overhauling its electrical apparatus.

When the building was completed and the company began operations in February, 1887, with 1,700 incandescent lights, the people of St. Paul wondered what would be done with the rest of the building and the stockholders themselves thought they had made ample provision so far as space was concerned for all the electrical apparatus that would be required for 25 years to come. Yet to-day the station is crowded, the last addition of machinery which was recently made completely filling every foot of space in the power room, as a glance at the accompanying view will show. The illustration represents the dynamo room on the ground floor. The dynamos are arranged on one side of the room and are belted directly to the engines, which are arranged in a row on the other side. The dynamos, twelve in number, have each a capacity of 1,000 lights. They are driven by six Buckeye engines, each of 150-horse power. The steam plant comprises two Root boilers of 123-horse power and six 150-horse power boilers, manufactured at Chester, Pa. The company found the fuel question one of its hardest problems. The smoke from the coal was pronounced a nuisance and the company was threatened with injunctions by the city as well as the property owners of the neighborhood. At this point fuel oil was resorted to, but at that time the burners used were of such a defective character that they could not be successfully operated. Moreover, the odor from the oil was of such an offensive nature that there was as much opposition to the new method as there had been to the old. After considerable trouble it was decided to adopt the McGinnis smoke consumer and fuel saver, and this device is now in use and the objections and complaints have ceased. The water supply is secured from an artesian well on the premises. This well is 750 feet deep.

The company has 85 miles of circuits. Kerite wire is used and all construction is overhead. The territory which is supplied with current from this station is confined to the business district. There are 12,000 lamps and 80 motors, aggregating 140-horse power capacity on these circuits. The company has long since ceased to solicit new business and will not extend its lines until the present quarters are enlarged or some provision is made for additional machinery. In spite of this fact the company has received orders for electric motors of all sizes and for all classes of work, aggregating 46-horse power capacity since January 1st. This will give some idea of the rapid development of the motor business in the west. Most of the motors in St. Paul are used in printing establishments and in operating freight and passenger elevators in the numerous sky-scrapers for which St. Paul is becoming noted. It will be remembered in this connection that St. Paul is not a manufacturing city but rather a wholesale depot. One of the latest motor installations which the Edison company made was a 10-horse power motor for operating a huge ventilating fan in the Central Presbyterian church.



EDISON ELECTRIC LIGHT AND POWER COMPANY, ST. PAUL, MINN.—DYNAMO ROOM

The company has been prosperous from the beginning and today its financial condition is unexcelled. The executive department is conducted by George H. Finn, secretary, treasurer and general manager. He has an efficient assistant in E. W. Hart. The president of the company is N. C. Thrall and its vice-president, C. B. Tamborn.

The Kensington Land, Coal & Iron company of Chattanooga, Tenn , will erect an electric light plant at Kensington, Ga.

Quitman, Ga., desires electric lighting and a franchise has been granted local capitalists who have expressed a willingness to undertake the management of the business.

Self Acting-Switch.

In the accompanying cuts is illustrated a form of snap or self-acting switch recently put on the market by the Detroit Electrical Works. The style shown is of the single pole double break pattern. The contact lever is formed of two pieces of phosphor-bronze, one of which is bent so as to form the handle. These pieces are riveted together at the ends, and are sprung outwardly at the center over an elliptical boss which has its greatest length nearly at right angles to the contact spring. When the switch

FIG. 2. FIG. 3. FIG. 1.

SELF ACTING SWITCH.

is closed, Fig. 1, a slight movement of the handle to the left carries the contact springs past the center. Their effort to contract to the smaller dimensions of the boss places the switch lever in the position shown in Fig. 2. The electrical contact is broken at two points rapidly and injury from sparking is prevented. Fig. 3 shows the switch covered.

Double Arc Lamp Litigation.

The final hearing in the suit of the Brush Electric company against the Western Electric Light & Power company of Toledo took place in the United States Circuit Court before Judges Brown and Ricks, in Toledo, last week. The suit was instituted in 1887 to enjoin the defendant company from using a lamp which is alleged to be an infringement of the Brush double carbon arc lamp patent of 1879. The defendant uses the Scribner lamp, manufactured by the Western Electric company, under patents applied for in 1886 and granted in the early part of the present year. L. L. Leggett and H. A. Seymour appeared as counsel for complainant and the defendant was represented by John W. Munday, Ephraim Banning and George P. Barton.

The argument was opened by Mr. Leggett for the complainant. He began with a history of arc lighting, showing what Brush had done, and asserting that the latter should be considered the pioneer in this field. He explained to the court the operation of the Brush lamp and the Scribner lamp, and read from the testimony of Prof. Morton, the complainant's expert, to show the grounds for his argument that the latter lamp was an infringement of the Brush patent.

On the following morning George P. Barton began his argument for the defendant. He emphasized the importance of the double carbon arc lamp invented by Day in 1873. He asserted that the Brush lamp was a minor improvement of this lamp. He read the brief deposition of James H. Warner, who had constructed the Day lamp from the patent. He called attention to the fact that the deponent and his father had been famous in England as mechanics and had received royal recognition. Mr. Warner had also made the first Morse instruments used on the first telegraph line between Baltimore and Washington. He read a deposition of Day describing how he had lighted the East river, New York, in 1874 by his double carbon arc lamp. At this point the current was turned on a Day lamp in the court room. The lamp was surrounded by a colored glass globe, so that the judges were able to watch the operation. The lamp was under the immediate charge of Ernest P. Warner of Chicago. The carbons in the lamp burn alternately, the current shifting from one to the other once in about fifteen minutes. In closing, Mr. Barton argued that a manufacturer should not be ensnared by a forced and unnatural construction of a patent.

Mr. Banning followed with an argument for the defendant. He confined himself more particularly to the law points, considering the effect of Mr. Brush's amendments to his patent while the application was pending.

Mr. Munday followed with his argument, going over the Brush patent in detail. Mr. Seymour, for the complainant, made the closing address, an evening session of the court being held. He made an able argument to the effect that the Brush patent should be construed liberally, so as to cover all means by which one set of carbons is completely consumed before the other set is brought into the circuit, without regard to the initial manner of separating the carbons.

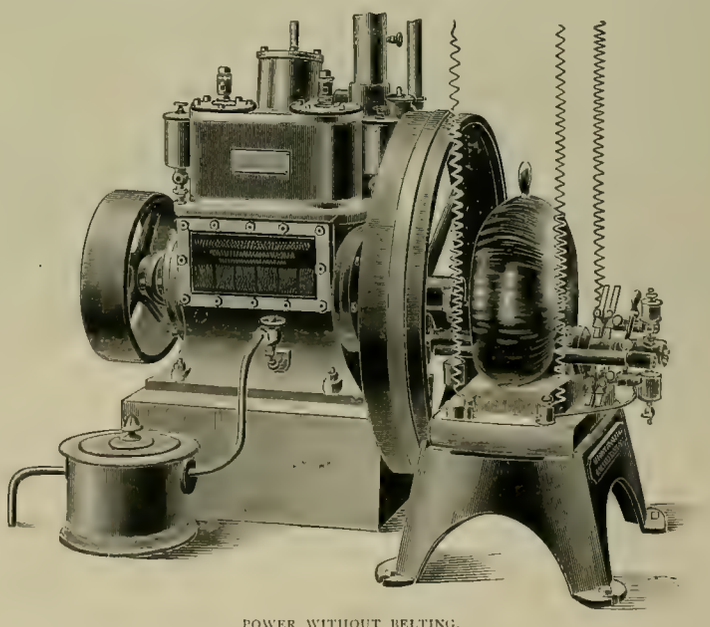
The court requested the defendant's counsel to submit a printed brief without delay, intimating that they would like to decide the case during July, as Judge Brown contemplates a trip abroad.

Power Without Belting.

The accompanying cut represents a method by which power is conveyed by an engine to a dynamo without the use of belting.

The dynamo in this instance, which is of 25 lights capacity, is run by a Westinghouse steam-engine of 5-horse power. This small Westinghouse engine has a fly-wheel 36 inches in diameter and 6 inches wide, around which is shrunk a wrought iron band one-half inch thick and one and three-quarter inches wide. The inside of the band wheel is lined with wood one-half inch thick covered with rubber belting. The dynamo pulley is entirely of leather and is set to run against the inside of the band wheel. The engine runs at a speed of 500 revolutions and the dynamo at a speed of 3,200 revolutions per minute. The pressure of the dynamo pulley against the inner face of the rim is regulated by means of a set screw, which moves the whole dynamo either forward or backward. The space taken up by both dynamo and engine is 4 feet 6 inches by 3 feet and 9 inches.

The arrangement illustrated was designed by J. F. Grant of Youngstown, O. For the cut we are indebted to the *Western Machinist.*



POWER WITHOUT BELTING.

Kemmler Again Sentenced.

For the third time William Kemmler was sentenced to death July 3, at Buffalo. The date of the execution was fixed at the week beginning Aug. 4. A dispatch from Buffalo says the prisoner, on his arrival in that city, was driven to the jail in a closed carriage. He was in charge of Warden Durston and an officer from Auburn when he was led before Judge Childs of the Supreme court. The scene is thus described in a dispatch from Buffalo: "The court room was crowded with spectators, many standing up to see what was believed to be the last act in Buffalo of the murderer's career.

"When Kemmler was called upon he arose to receive his sentence. Judge Childs told him that the appeals taken in the effort to save his life had failed.

" 'Yes, sir,' said Kemmler, obediently.

" 'Have you anything to say,' pursued the judge, 'why a time should not be fixed for carrying out the sentence previously passed upon you?'

"A moment's pause, and then Kemmler answered: 'No, sir.'

"The judge, continuing, said he hoped the long delay had given the prisoner time for deliberation on the enormity of his offence and the justice of his conviction. He concluded as follows:

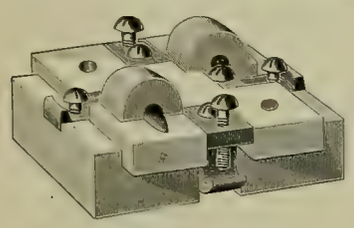
" 'All the court now has to say is that the sentence heretofore passed upon you be carried into effect within the week beginning August 4, 1890, and may God have mercy upon you.'

"No opposition was made to the sentence. Judge Childs' voice faltered in its delivery. He spoke in the most impressive manner.

"Kemmler betrayed no emotion. He sat down, glanced right and left at his guards, then out through a window at the dancing sunlight—and a moment later was led away. He was carried back to Auburn the same evening by the officers. A crowd assembled at the New York Central depot at 11:15 P. M. to see the murderer, but were thoroughly disappointed. Until this time his arrival was a secret. He went down on the direct line to Port Byron and was driven from there to the prison. Thus Kemmler once more returns to solitary confinement to await his doom. Charles S. Hatch, Kemmler's attorney, was asked if he contemplated making any further opposition to the carrying out of the sentence, and said: 'I don't think so.' "

A New Branch Cut-out.

The accompanying cut illustrates the Cutter branch cut-out complete. It consists of a peculiarly shaped porcelain base and four brass connecting pieces which are set into recesses in the porcelain, two of them clamping a reduced section of the porcelain and all four being firmly held by single screws from below. The screws extend far enough to admit a thick insulating coating between them and the back, so that the block may be safely set against a damp ceiling. The wires are readily fastened without removing screws. Neither the main nor the branch wires need be cut, but are merely bared opposite the fastenings. Owing to the shape of the porcelain block the main and branch wires can



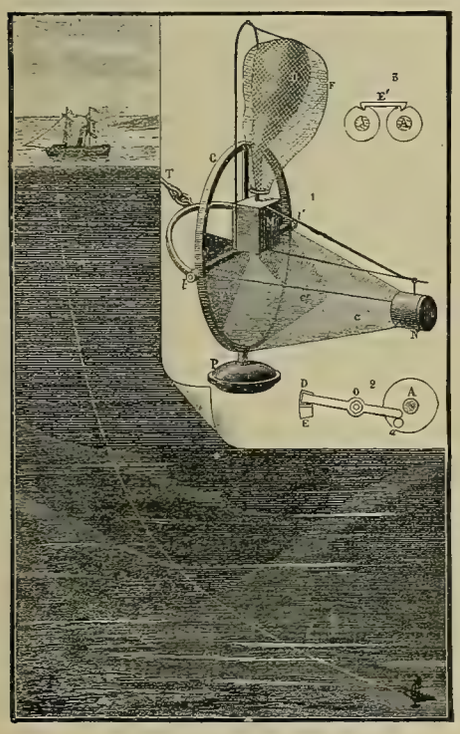
NEW BRANCH CUT-OUT.

never touch each other. As common screws are used throughout any lost ones can be readily replaced.

A still more novel feature is that of a bridge covering the central portion of each fuse. The fuse is easily put in place, and when it burns out the bridge restrains the sputtering and catches the metal. Thus the bridges give the effect of a cover, although fireproof, neater and cheaper. The whole is strongly made, nearly twice the size of the cut, and suited for 20 amperes or less. The device is put on the market by the Great Western Electric Supply company, Chicago.

New Pelagian Net.

The accompanying cut illustrates a netting device designed by Dr. Viguier, director of the zoological station at Algiers, for obtaining specimens of deep sea fish. The fact that the device in its operation is entirely automatic is considered its especial point of excellence. As the cut shows the net in the apparatus is attached to the



NEW PELAGIAN NET.

lower half of a circular framework. It is cone-shaped and is held in a horizontal position by supports. In using a device of this kind it is essential that the net be open for catching specimens only at a certain depth. The mouth of the net therefore must be closed until it reaches a certain point below the surface of the water. In the device designed by Dr. Viguier the net is closed by two metallic shutters which are raised by the operation of an electric motor when the depth at which it is desired to obtain specimens has been obtained.

The action is best explained by referring to the several figures in the composite illustration. *T* is a simple tow line leading to the vessel. *G* is the circular framework of the apparatus. It is ballasted by the battery box, *P*, which serves as the weight. *D* is a simple air balloon which serves the double purpose of tending to keep the apparatus in a vertical position, and of providing means by which the pressure corresponding to the depth can be rendered available for operating the mechanism, which is inclosed in the box *M*. *V* is one of the shutters which close the mouth of the net. In Fig. 2 the switch is shown. *A* is the spindle on which a shutter moves. The current from the battery enters by this spindle. A small arm is denoted by *a*. In Fig. 3 is represented a brake, *E'*, for locking the disks attached to the spindles on which the shutters turn.

Within the box, *M*, is a manometer or pressure gauge. On the index of the gauge is a contact leading to a small electric motor. The battery circuit is completed when the needle of the pressure indicator reaches the contact. As already stated the gauge is operated by pressure from the air balloon. Before the apparatus is submerged the gauge is so adjusted that the needle will reach the contact when the pressure corresponding to a certain depth of water has been attained.

When the circuit is completed the motor is set in motion, and by means of gears the two shutters are gradually raised. On the spindle of one of the shutters is a arm. As the shutters rise the arm acts to operate a switch, which shunts a portion of the current from the motor into an electro-magnet. Less and less current flows into the motor as the shutters are lifted until, when they reach the final position, all the current passes on to the electro-magnet and the motor comes to rest. The magnet then attracts an armature on which is attached the locking device, shown in Fig. 3, and the spindles of the shutters are held firmly in place.

The shutters will remain open and the net will be ready to receive victims as long as the circuit remains closed. If, however, the device for any reason rises or falls below the depth for which the gauge has been adjusted, the pressure on the balloon will change, the needle in consequence will leave its contact, and the shutters will drop of their own weight. The cut is reproduced from *La Nature*.

Duplicate Stock Certificates.

The case of Jonas Guilford against the Western Union Telegraph company was decided in favor of the defendant in the Supreme court at St. Paul last week. The case is of more than usual interest, and is of particular importance to holders of stock in companies. Jonas Guilford held several certificates of stock in the Western Union Telegraph company. Having lost them, he sought to obtain duplicates of them without giving an indemnity bond in case the first ones should happen to turn up in other hands. Upon the refusal of the company to issue such duplicates, Mr. Guilford sued the telegraph company. Upon an appeal to the Supreme court he lost the case, the court holding that the other certificates might be in existence. He then sought to have a rehearing of the case, and sought to obtain a judgment compelling the company to issue new stock certificates. The evidence in the case was again reviewed, and the following opinion in the case was handed down by Judge Mitchell:

I think the lapse of time after the alleged loss of stock certificates without their being heard from may be so long as to amount to almost conclusive evidence that they are no longer in existence, and hence justify the court in compelling the corporation to issue new ones without any bond of indemnity. Therefore, after a re-examination of this case upon the motion for re-argument, I am not entirely clear that a judgment requiring the corporation to issue new certificates upon condition that a bond of indemnity is first given is a bar to a subsequent action to compel it to issue them without any indemnity. Hence I prefer to affirm on the ground that this case was rightly decided by the trial court on the merits; that the lapse of time is not yet so great as to exclude danger of the reappearance of the old certificates, and therefore the defendant ought not to be compelled to issue new ones in place of those alleged to have been lost by plaintiff's assignor without its having been fully idemnified. The stock being, according to the terms of the certificates, transferable on the books of the corporation only upon their surrender, its liability in the case of their appearance in the hands of a bona fide holder is a matter of serious moment, according to the drift of modern authorities, especially the federal courts and the courts of New York, where the defendant corporation is domiciled.

The Blathy Alternating Current Meter.

The Blathy electric meter for alternating currents, which is being made by Ganz & Co., of Buda-Pesth, for their alternating current electric works, and a diagrammatic representation

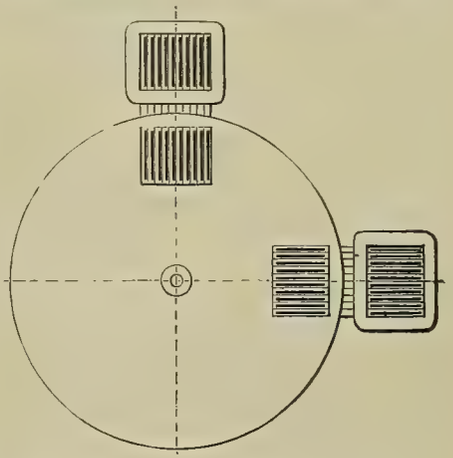


FIG. 1. BLATHY ALTERNATING CURRENT METER.

of which is given in Figs. 1 and 2, consists essentially, says the London *Electrical Review*, of a horizontal copper disk, which turns very easily upon a perpendicular axle. This disk sets in motion, by means of a spiral and several transfer wheels, a counting arrangement similar to those employed in gas meters.

The copper disk is exposed to the inductive action of two systems of electro-magnets. One of these systems is magnetically excited by the alternating current to be measured, and the magnetism developed in this main current magnet is proportional to the current transmitted. The second magnetic system is wrapped with a very thin wire and is connected to the two main leads. By this arrangement the magnetism of this second system becomes proportional to the tension of the main current. Both systems produce in the copper disk induced currents and act upon it, dynamically setting the copper disk in rotation. In consequence of the movement of the disk through the magnetic fields, currents are

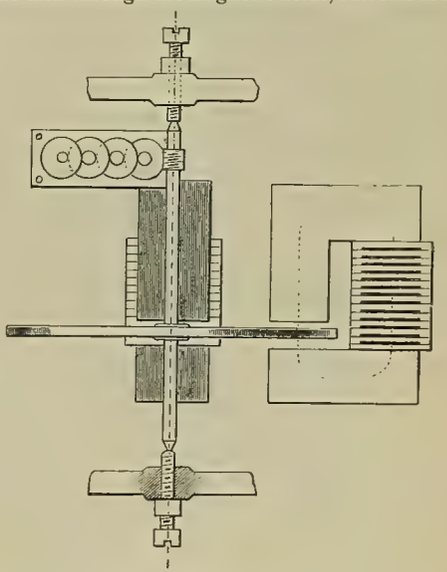


FIG. 2. BLATHY ALTERNATING CURRENT METER.

again induced in the same which act in opposition to the movement of the disk or counteract it. At a certain velocity an equilibrium is established between the propelling and the arresting forces; this velocity, under otherwise equal conditions, is proportional to the intensity of the main current. The counting works are so arranged that the fingers show directly on the dial

plates the number of ampere-hours which have been transmitted. The dial is set in motion by a current of 0.25 amperes.

This meter was closely tested last year by the international commission of experts in Frankfort-on-Main, and subjected to repeated practical investigations.

Electric Probe.

The form of electric probes shown in the accompanying cuts was designed by M. H. Schoentjes of Paris. The illustrations are practically self-explanatory. Two conductors, *A* and *B*, which are formed into a flexible cord, are connected to the telephone *T*, Fig. 1. At *a* and *b* the battery is located. The conductors terminate in the handles *C* and *D*. The former, it is stated, is of brass, Fig. 2, and the latter, Fig. 3, wood and of a somewhat larger size so

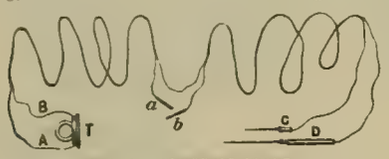


FIG. 1. ELECTRIC PROBE.

that it may be conveniently held in the hand. Probing needles forming part of the circuit are fitted into the handles and the apparatus is ready for the surgeon's use.

The particular object of the probe in question is to locate exactly a bullet. To effect this the surgeon thrusts the shorter needle *C*, Fig. 4, under the skin in the region where it is expected the ball has penetrated and uses the probe in the handle *D* for exploring. If his instrument comes in contact with the bullet he will hear a click or snap, and its position can be readily determined.

American Names for Electrical Units.

At the regular monthly meeting of the American Institute of Electrical Engineers, held June 17, the following resolution recommended by the council was introduced by Francis B. Crocker, with the request that it be taken up for

FIG. 2. ELECTRIC PROBE.

action at the next meeting of the institute in September:

WHEREAS, It has been the custom in the nomenclature of electrical units to perpetuate the names of men who have contributed most to electrical science; and

WHEREAS, In the names thus far adopted the eminent services of Americans have not been recognized; therefore,

Resolved, That in the opinion of the American Institute of Electrical Engineers, a just distribution of the honors thus bestowed necessitates a recognition of the splendid contributions to electrical science of one or both of America's great electricians, Benjamin Franklin and Joseph Henry; and

Resolved, That this institute will gladly co-operate with other bodies in this country and abroad to secure the general adoption of these names for electrical units; and

Resolved, That the name of Henry should be given to the practical unit of self-induction, since he was the discoverer and greatest investigator of this phenomena, and because this unit at the present time is called a quadrant, which is merely a numerical value and not a suitable name.

Resolved, That this institute recommend to electrical societies and electrical engineers the general use of the name of Henry for the unit of induction as being the quickest and surest way to secure its final adoption.

It is unfortunate that the name of Henry for the unit of induction was not adopted at the Paris Electric Congress of 1889. If the attention of the congress had been forcibly called to the fact that Henry discovered self-induction, and that his work on both self and mutual induction was of the greatest importance, his name would probably have been adopted then. Henry's discovery of self-induction, which is, of course, the fact that gives it the strongest claim, was made in 1832 and was published the same year in *Silliman's Journal*. In this paper he describes experiments showing that the spark obtained by breaking a circuit composed of battery and a long wire is greater than with a short wire, and that the spark is further increased by coiling the wire. He then clearly states that the phenomenon is due to the *action of the current on itself*, all of which is perfectly correct and would be a good statement of the facts even at the present time.

Some Points About Alternating Currents.

BY PROF. H. S. CARHART.

The extensive use of alternating electric currents in the transmission of energy for the purpose of lighting and, to a limited extent, for power, necessitates a more general and exhaustive study of their action than formerly. Alternating current dynamos were early in the field, but their importance was not fully apprehended till after direct current apparatus had come into extensive use, not in fact till transmission at high voltages for incandescent lighting was made possible by the application to alternate current circuits of the inverted induction coil, called a transformer or converter. Since then alternate current apparatus has come rapidly to the front, and many eager investigators have made brilliant applications of it to practical purposes.

The phenomena of alternating currents are so totally different from those of direct currents that the electrician, whose conceptions touching electrical action have been largely derived from the application of Ohm's law, finds himself entirely unable to comprehend alternate work-

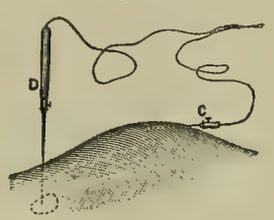


FIG. 4. ELECTRIC PROBE.

ing till his views have been modified by an attentive consideration of many new and perplexing facts.

The first of these facts is self-induction, which plays no part in direct current working, except on opening or closing the circuit, but which is exalted to a plane of prime importance with alternate currents. It is to Professor Joseph Henry that we owe the first clear apprehension and lucid explanation of this interesting phenomenon.

When a simple periodic e. m. f. is applied to a circuit so disposed that its different parts act inductively upon one another, then this e. m. f. does work, not simply against the ohmic or ordinary resistance of the conductor, by reason of which heat is generated, but also against a counter e. m. f. of its own creating. We are familiar with this division of work when power is transmitted to an electric motor. The impressed e. m. f. then meets with ohmic resistance generating heat, and with a counter e. m. f. in the motor, the armature of which revolves in a magnetic field, and, in virtue of this counter e. m. f., a part of the energy applied to the circuit is converted into mechanical work at the motor. Energy may thus be stored up by

FIG. 3. ELECTRIC PROBE.

means of the counter e. m. f. arising in the motor.

In an analogous way when energy is applied to an alternating current circuit a part of it is lost in heat and a part is alternately stored up in the magnetic field and again restored to the circuit. A small portion in practical working, probably a very small portion of the energy, is transmitted outward into space as electrodynamic waves with the velocity of light.

Such a circuit possesses two qualities, resistance and inductance. The former is a property by virtue of which the passage of a current is accompanied by the irreversible transformation of electric energy into heat; the latter is a property by virtue of which the passage of a current is accompanied by the absorption of energy in the form of a magnetic field. A part of the energy spent on the conductor is frittered away in irrecoverable heat, while the other part is associated with the circuit in a recoverable form. When the applied electromotive force diminishes or ceases altogether this stored-up energy operates to carry the current forward. On account of self-induction a current appears to possess inertia, and so resists any change tending in either the direction of increase or of decrease. A fly wheel, to which a turning force is applied to increase the angular velocity, is the mechanical analogue. Suppose no resistance except friction opposes the motion of the wheel. Then a part of the energy applied is converted into heat by friction and a part is stored up in the motion of the wheel in a recoverable form, to be given out or restored when the turning force is withdrawn. The effect of the inertia of the wheel is to resist the force tending to increase angular acceleration and to keep up the motion of the wheel in the positive direction when the twisting force is withdrawn. So the inertia or self-induction of a current opposes any change either of increase or decrease in the current. It does more; it continues the current in the positive direction even after the impressed e. m. f. is withdrawn. If the force applied to the fly wheel is gradually brought to a zero value and is then gradually applied with increasing intensity in the opposite direction, the wheel will continue to turn in the positive sense after the force is applied in the negative sense. In other words the phase of the wheel's motion lags behind that of the applied force, its zero occurring later than the zero of the force. During this period of motion in one direction and force applied in the other the wheel is doing work on the agent applied to it. While the angular velocity of the wheel is increasing, the agent is doing work on the wheel and the wheel is storing up energy.

In quite the same way when a simple periodic e. m. f. acts on an inductive circuit, the current lags behind the e. m. f. in phase. It reaches its maximum value after that of the impressed e. m. f. by an interval equal to the angle of lag expressed in time, and passes through its zero value at an equal interval of time later than the zero of e. m. f.

Hence there arises a second fact worthy of particular attention. The maximum current never reaches a value equal to the maximum e. m. f. divided by the resistance of the circuit, but falls short of this by a quantity depending upon the co-efficient of self-induction and the rapidity of alternation. By the co-efficient of self-induction is generally meant a constant L, such that the product of this constant and the rate of increase or decrease of the current is the e. m. f. of self-induction. By Ohm's law the current equals the e. m. f. divided by the resistance; with alternating currents in an inductive circuit the maximum current equals the maximum e. m. f. divided by a quantity $R^2+L^2p^2$, in which R is ordinary resistance, L is the co-efficient of self-induction or the inductance, and p equals $\frac{2\pi}{T}$, T being the period of alternation. The above expression is now often called impedance or sometimes "apparent resistance."

Another noticeable difference between direct and alternating currents is that while with the former the rate of doing work is the product of the current and the e. m. f., or CE, in the latter the mean activity is half the product of the maximum e. m. f., the maximum current and the cosine of the angle of lag, or—$\frac{1}{2}$ECcos,ϕ. When the angle of lag is zero the activity is a maximum or—$\frac{1}{2}$EC. When the lag is 90°, or a quarter of a period, the activity is zero. Thus we have the remarkable combination of a periodic e. m. f. applied to a circuit, a periodic current flowing through it, and still no work done upon the circuit. "In this case there is no frictional dissipation of energy, but simply a give and take of energy between the magnetic field and the

source of energy supplying the e. m. f." Thus the mains of an alternating circuit may be joined by a conductor of such high inductance that approximately no energy will be transmitted across from main to main. Such is the case with a so-called "choking coil," or with a transformer when the secondary circuit is open.

Another point to which the electrician may profitably devote extended contemplation is the measurement of electrical quantities on alternating circuits. Several devices have been invented to serve as current integrators, notably those of Mr. Shallenberger and Elihu Thomson; but these are instruments serving rather for the commercial purposes of central station work than for scientific measurements of precision. The Siemens electrodynamometer, when properly made of approximately non-inductive resistance, serves for the measurement of the mean square of the current. It can be shown that the square root of this mean square is equal to the maximum value of a current, following the simple periodic law, divided by the square root of two.

To measure voltages the ordinary high resistance instruments will not answer at all because they have high inductance. The Cardew voltmeter, which acts by the heat expansion of a straight wire, and some form of electrostatic instrument are the only device serving for the measurement of a simple periodic e. m. f. These again measure the mean square or the e. m. f., and this bears the same relation to the maximum e. m. f. as the mean square of the current bears to the maximum current. Hence the product of these two quantities equals $\frac{EC}{2}$. Neither of these instruments, however, gives any indication touching the important angle of lag, and therefore they give no information respecting the electrical energy in the circuit, nor of the alternate storing and restoration of energy by means of the magnetic field. Dr. Louis Duncan has measured the efficiency of a transformer by means of a huge calorimeter. This method is undoubtedly accurate if carefully applied, but it is scarcely simple enough for general laboratory use. Much remains to be done in this direction.

Very much might be said in favor of electric lighting by alternating currents. Scientific tests have shown that the efficiency of such a system is not so high as its promoters would have us believe. Its great and undoubted advantage lies in its ability to transmit energy to a distance at high voltage, transforming to low voltage at the points where the energy is to be utilized in lighting. For high voltage means small conductors and economy in transmission, and low voltage at the glow lamp is a necessity.

M. Albertson, J. S. Bailey and L. Johnson of Waycross, Ga., have incorporated the Satilla Manufacturing company with the privilege of operating an electric light plant, gas works, etc. The capital stock is $50,000.

Frankfort Electrical Laboratory.

It will be remembered that some months ago the city of Frankfort, Germany, instituted a series of tests of continuous and alternating apparatus to determine which should be used in the municipal electric light station. A commission was appointed to make examinations of the apparatus of several makers and extracts of its reports embodying the results of its tests have already appeared in the WESTERN ELECTRICIAN. The city of Frankfort constructed for the use of the commission a special laboratory in which tests were made. Two of the rooms are represented in the accompanying cuts. In the rear of the room shown in Fig. 1 is located the alternating current motor of which the commission made such an interesting report. This machine was belted to a continuous current dynamo shown in the foreground. The latter machine furnished current for the bank of lamps on the wall on the left. At the rear of the room is an automatic device which controls the exciter for the alternating current dynamo. At the left is a device for manipulating the transformers which are located under the bank of lamps. More or less transformers are put in the circuit in accordance with the amount of current. In front of the transformers is located a Blathy meter of which a description is given elsewhere in this issue. On the shelf on the left is a small alternating current motor which drives a little Edison dynamo. Fig. 2 shows the second testing room. The regulating apparatus is located on the wall on the left, in front of which is a Schuckert 40-horse power motor. The two machines in front are continuous current motors of the same make. The machine at the extreme right is a Ganz 5-horse power alternating current motor.

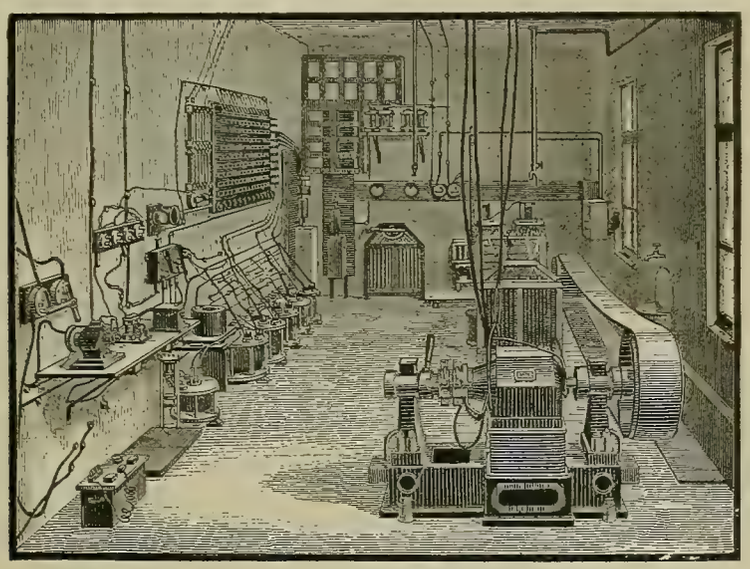


FIG. 1. FRANKFORT ELECTRICAL LABORATORY.

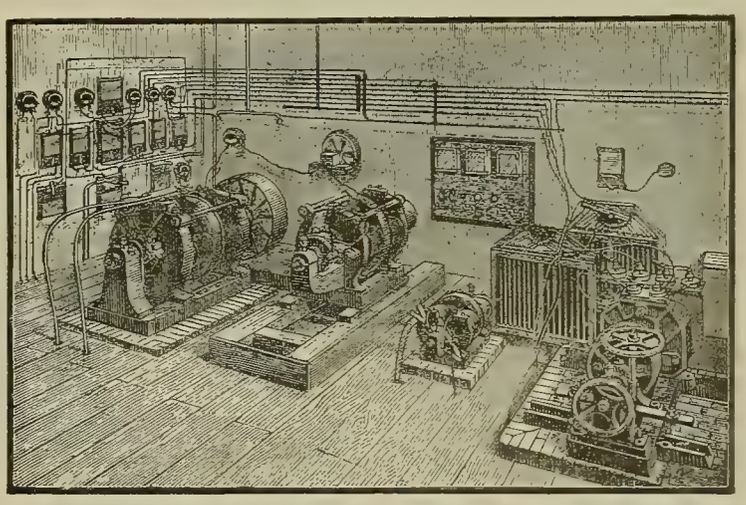


FIG. 2. FRANKFORT ELECTRICAL LABORATORY.

Advancing Copper Prices.

Advancing prices and active demand in the copper market have been among the more noteworthy features of mercantile operations during the past three months. Both in the United States and Europe the metal is going into consumption with unusual, if not unprecedented, rapidity. All sorts of electrical and mechanical concerns in which copper is ordinarily employed are making free use of it, notwithstanding its comparatively high cost. Before the French syndicate began its operations the market had dropped to 10c. per pound for Lake Superior ingot, with other descriptions on the same basis. At that price consumption was large, and it was generally assumed that any decided rise in value would curtail the use of the metal. This assumption was temporarily borne out. The unnatural inflation of values through the corner unquestionably reduced demand to some extent. Now, however, there is no corner, but trade is on a natural footing, and buyers are taking the metal for use without hesitation, notwithstanding the fact that it costs almost, if not quite, as much as when the syndicate was at the height of its power. The American market has been strong lately at 16½c. per pound. So large sales as have been made during the past season, and so extensive and general demand for actual consumption at this price, or a few points lower, would have been deemed wholly out of the question three or four years ago.

There has been this spring a steady diminution of the supply of copper abroad. The amount on hand in Europe and afloat on the 16th inst. is reported at 75,690 tons, against 82,090 June 1. The supplies and deliveries of the last three years ending June 1 are stated as follows:

	Tons. Supplies.	Deliveries.
1888	113,321	98,604
1889	117,347	69,414
1890	110,417	145,796

These figures for 1888 and 1889 show clearly enough the effect of the unnatural inflation caused by the corner. When prices were rapidly advancing from 10c. without any apparent reason therefor in the conditions of supply and demand the use of copper was restricted somewhat, though perhaps not so much as was generally supposed. Unusual quantities of old metal and of "invisible supplies" generally were worked up, and there was consequently an accumulation of visible copper During the past year the conditions have been exactly the reverse. The visible supplies have been apparently reduced, and, with very heavy and in some respects extraordinary consumption, the production of the mines has been more than taken. Production, moreover, has been and is steadily increasing. The American mines are running to their full capacity, and yet the accumulated stores of copper are growing smaller and smaller. One factor in the situation is set forth in a recent English circular as follows: "The demand for the purpose of sulphate of copper-making continues, and it is estimated that 25,000 tons (5,600,000 pounds) of fine copper per annum are now being used for this object. Some estimates run very much higher, but the figure named, if the demand becomes permanent, is likely to have as much influence on the course of prices as any of the causes which led to the fall. The peculiarity about this trade is that the copper is used once for all, and never returns to be worked up afresh."

Lake Superior and other fine brands of copper seem to be apparently in better demand than the cheaper sorts. It is believed that no very great amount of the stocks accumulated by the French combination remain undisposed of. Speculators have taken advantage of the situation as well as manufacturers. This, of course, tends to sustain the market, and predictions of 18c. and bets of 20c. per pound for lake copper within six months are not unheard of.

These conditions are naturally reflected in the market for copper stocks. The leading mining shares at Boston have advanced rapidly from the lowest quotations of 1889. Calumet and Hecla, for example, which sold at 199 at one time last year, has been quoted recently at 324, while Tamarack has risen from 96, the bottom of last year's depression, to the phenomenal price of 227. Investments at such prices, however, it must be said, are risky; and if this is true of standard properties like the above it is, of course, doubly true of concerns whose position is less assured, and the numerous wild-cat copper schemes which always come to the front under favorable conditions.—*Bradstreet's.*

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building, - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Edison Electric Light & Power Company, St. Paul, Minn., Illustrated	17
Self Acting Switch, Illustrated	18
Double Carbon Arc Lamp Litigation	18
Power Without Belting, Illustrated	18
Kemmler Again Sentenced	18
A New Branch Cut-Out, Illustrated	19
New Pelagian Net, Illustrated	19
Duplicate Stock Certificates	19
The Blathy Alternating Current Motor, Illustrated	19, 20
Electric Probe, Illustrated	20
American Names for Electrical Units	20
Some Points about Alternating Currents, by Prof. H. S. Carhart	20, 21
Frankfort Electrical Laboratory, Illustrated	21
Advancing Copper Prices	21
Editorial	22
Arc Lamp Pulley, Illustrated	23
Chicago City Electric Light Plant	23
Lightning Conductors	23, 24
Electricity in the Navy	24
Electric Lighting in the Railway Service, by M. B. Leonard	24, 25, 26

DEPARTMENTS.

Correspondence	26, 27
The Electric Motor	27, 28
The Telegraph	28
Electrical Patents	28

IN our Pittsburg letter this week is mentioned the fact that an electric railway company in that city proposes to use cars built after the English style, with seats on the roof. Such a plan will doubtless be extremely popular with the public during the warm months. With outside seats a street car becomes a sort of poor man's tally-ho coach, not stylish, but fully as comfortable as the fashionable vehicle. The scheme of the Pittsburg company is a good one, and doubtless the example will be followed by many electric railway corporations within the next few years.

THE Louisville letter of this week contains an account of an interesting suit against a street railway company of that city. The action was instituted by a local manufacturing company to enjoin the Central Passenger Railway company from stringing trolley wires in front of its factory. The ground taken was that the line was a nuisance, interfered with business, and actually menaced the lives of the employes of the factory. The decision, however, was rendered in favor of the defendant, the judge failing to see what danger there could result from the operation of cars in the manner described. This decision it is needless to say is in accordance with common sense ideas. While without doubt overhead wires are not generally ornamental and in some instances might be called nuisances, still, the great benefit to be obtained by their introduction should not be overlooked. When we think of the overhead trolley wire which can only inflict injury when handled under certain well understood conditions and call to mind that in all probability this same plaintiff company permits its employes to work day in and day out in the closest proximity to the "deadly" steam boiler, the apparent anxiety displayed by the plaintiff in suit, seems rather ridiculous.

EVERY American electrician will heartily endorse the recommendation of the American Institute of Electrical Engineers that the names of Henry and Franklin be adopted to designate practical electrical units which are as yet unnamed. The resolution which was adopted by the organization is presented elsewhere in this issue. It is substantially the same as that adopted by the Meteorological Society in Washington a few weeks ago. In view of the magnificent contributions that Americans have made to electrical science the electrical congress undoubtedly will adopt the recommendation of the institute and thereby gratify every American worker in the electrical field.

THE prices of copper seem to be steadily increasing, and financial writers both in this country and in England incline to the opinion that a still further rise may be anticipated. The situation is reviewed in another column. The fact that the price has risen is ascribed not to any manipulation of the market, but to a marvelous increase in the demand for the metal. An English writer says: "The recuperative power of the copper market has been a matter of surprise to all but the very few who have an intimate knowledge of the industry. Many believed that it would not recover from the Secretan disaster for years, and that with the accumulation of stocks consumption would not overtake supply for an indefinite period. Here we are, however, in about eighteen months with the reserved stocks reduced to little more than two months' supply, which all cautious men will admit should be a minimum if the trade is to be protected against risks from stoppage of supplies."

A PAPER of more than usual interest on "Electric Lighting in Railroad Service," by M. B. Leonard, is presented elsewhere in this issue. It was read at the recent convention of railway telegraph superintendents. Mr. Leonard first takes up the subject of lighting in freight yards. The introduction of the arc light has, he says, resulted in a decrease in the number of accidents to employes, has wonderfully facilitated the handling of freight, and has caused a substantial reduction in the amount of property lost and stolen. After referring to electric headlights, which he thinks will prove of great value in railway work, Mr. Leonard speaks at considerable length of the use of incandescent lamps in switch stands. There is every reason, he believes, to warrant the general employment of the incandescent lamp for this service. Satisfactory operation and greatly reduced expense are powerful arguments in favor of its adoption. Mr. Leonard devotes considerable space to electric train lighting, and after referring to the systems now in operation says: "It is confidently believed that the cost of train lighting by electricity in the United States can be greatly reduced by adopting the method so largely used abroad of getting power from the axle." He refers to the success which has attended the adoption of this system in England, where it has been found that the cost of electric lighting was no greater than that of common oil. The failures which have attended experiments of obtaining power from car axles in America are due, Mr. Leonard thinks, to the fact that on roads in this country there are numerous curves, on which wheels slide without turning the axle a single revolution. Damage to the electrical machinery and continual changes in speed have been found, therefore, to be invariable results in experiments. The ingenuity of American engineers, he thinks, will eventually be equal to the task of solving the problem of utilizing the power from the car axle, and then will follow a very general adoption of electric train lighting. In concluding his paper Mr. Leonard makes this prediction: "So much has already been accomplished, and so numerous are the workers in the new field that before another decade of years has rolled around steam will have been supplanted as the motive power of our railroads." The author is more sanguine than the majority of electrical engineers. They expect to see the steam locomotive give way eventually to the electric motor, but they do not look for the change, we think, within the next ten years.

ELSEWHERE in this issue is presented an abstract of an article on lightning conductors by S. Alfred Varley. It will be remembered that the last issue of the WESTERN ELECTRICIAN contained a paper on the same subject by Prof. Lodge. To what extent the views of the former differ from those of the latter may be judged from the following lines which we quote directly from the paper: "In the days when the laws of common 'divided circuits' were supposed to govern these matters, the lightning rod," writes Prof. Lodge, "had to be of highly conducting copper, and of such dimensions that no other path to earth could hope to compete against it. But now it is known that low resistance is no particular advantage; it is not a question of resistance. The path of a flash is a question of impedance, and the impedance of a conductor to these sudden rushes depends very little on cross-section and scarcely at all on material. A thin iron wire is nearly as good as a thick copper rod, and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy, and tends to damp out the vibrations sooner."

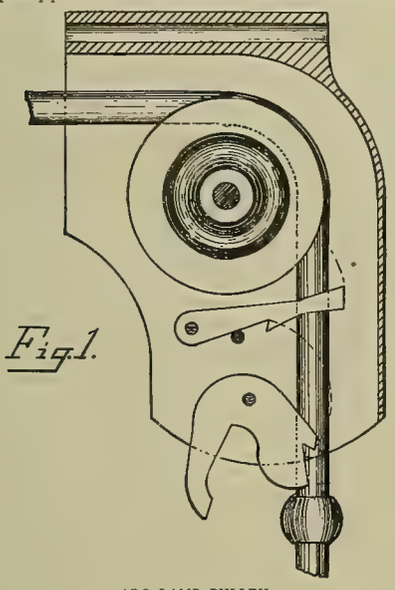
Mr. Varley offsets this with: "To practical common sense it seems impossible to understand that mathematicians can in any other, than in an academical sort of way, really believe that iron is capable of transmitting rapid electrical alternations as efficiently even as copper, not to say more efficiently. That mathematical reasoning, having for its basis the newer electrical theory, leads Prof. Lodge to such a conclusion is evidently so from his published statements, and one of the reasons he has given for preferring iron to copper is its higher melting point and less liability to be fused."

The above paragraph relates more particularly to a passage quoted from a previous paper by Prof. Lodge in which he states that "A few words may suffice to explain the nature of the impedance which alternating currents meet with in passing through a conductor, and of the reason why iron is as good as or even better than copper for the purpose of conveying currents alternating with extreme rapidity."

While a perusal of the two papers will doubtless leave some unprejudiced reader with a thorough appreciation of the force of the oft repeated saying in regard to the disagreeing doctors, both writers have advanced ingenious theories. While, with Mr. Varley, we can not reconcile ourselves to the statements of Prof. Lodge that "iron is as good as or even better than copper for the purpose of conveying currents alternating with extreme rapidity," and that the extra resistance of a thin iron wire used as a lightning conductor, has advantages over those offered by a thick copper rod, at the same time we may state that Prof. Lodge's treatment of his subject is evidently undertaken in the light of the more recent discoveries as to the true nature of electrical phenomena. "Attention is now directed," writes Prof. Lodge, "not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between." Hertz's experiments, undoubtedly, will tend to turn the tide of investigation in the direction of a more thorough consideration of the relation existing between charged conductors and the separating dielectric. With the remembrance, though, of the theory that the electric discharge, to quote Prof. Lodge, "like the recoil of a spring or the swing of a pendulum, is very apt to overshoot itself, and is by no means likely to exhaust itself in a single swing," and with the realization also of the immensity of the charge to be conducted, it is feared, many will fail to see in the thin iron wire the same advantages which, it is claimed, are offered by the heavy copper rod.

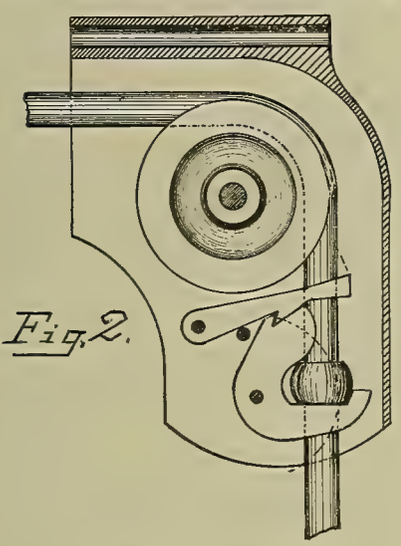
Arc Lamp Pulley.

A number of pulleys for suspending arc lamps have been brought out in the last few years, most of them having covers to protect them from the weather. The latest of these sleet-proof pulleys was devised by J. A. Lounsbury of the National Engineering Bureau at Chicago. It is called a "combination pulley," because it combines a weather-proof pulley with an effective lamp-supporter. As such it takes the strain



ARC LAMP PULLEY.

from the hoisting rope and will hold the lamp securely, even if this rope should slip or be cut. The releasing mechanism is simple, no extra rope or wire being needed. Fig. 1 shows a section of the pulley with the two pawls dropped, while the lamp is being raised. The knob which is fixed on the lamp cord raises the lower pawl until it engages the upper one, as in Fig. 2. Then the whole weight of the lamp is off the



ARC LAMP PULLEY.

pulley and the hoisting rope may be left slack. To release the lamp the rope is given a sharp pull, raising the knob as shown in Fig. 3, and disengaging the lower pawl. As this falls by its own weight no springs are needed. The whole mechanism is simple and adds much to the value of the pulley. The Great Western Electric Supply company, Chicago, is putting it on the market.

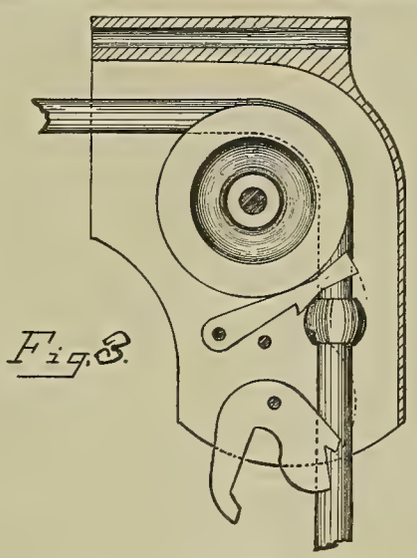
Chicago City Electric Light Plant.

It is expected the South side power plant of the Chicago city electric light system will soon be well under way. All the contracts for the building and material for the structure have been awarded, the last one being for the iron roof, which was placed with Lane & Co. of Chicago. The structure will be erected under the supervision of the department of public works, and when completed will be delivered to the electrical department. The steam plant was provided for last week when it was decided to purchase six 150-horse power Portland water tube boilers, with smoke consuming device. It will be remembered that the district to be supplied with current from this station is already provided with a complete system of underground conduits, and but very little additional cable will be required. The lights would have been operating in this district several months ago but for the unlooked-for opposition to the use of the Lake Front property for a power house. It will be remembered that the city had already constructed its subways and placed its cables in the conduits when the injunction was secured which made it necessary to secure quarters elsewhere. It will be necessary to connect all the conduits with the new station. The Cobb vulcanite cable has been selected and an order for 30 miles has been placed.

Lightning Conductors.

The following abstract from an article on "Lightning Conductors," by S. Alfred Varley in the London *Electrical Review*, will be of interest to those who read the paper on "Lightning Conductors from a Modern Point of View" by Prof. Oliver J. Lodge, presented in the last issue of the WESTERN ELECTRICIAN:

It must be admitted that the results recorded by Prof. Lodge may be taken as demonstrating that copper conductors of large section are more effective for bringing about rapid discharge, and therefore it is a fair inference that lightning conductors of solid copper wire of large section, conduct lightning discharges more quickly to the earth than solid conductors of smaller section, and that consequently lightning conductors made of copper, of large section, would be more efficient than conductors made of copper of smaller section. Prof Lodge's recorded results, it must be admitted, go to show that if the function of a lightning conductor is to conduct, and not to obstruct and delay the passage of lightning, that copper is a very superior material to iron for lightning conductors, chiefly on account of its relatively low specific magnetic inertia, but



ARC LAMP PULLEY.

also on account of its much higher conductivity. What was observed and recorded by Prof. Lodge in connection with his "alternative path" experiments, it is thought, can be simply explained with the aid of the working theory developed in the course of this article. According to the writer's theory, all physical phenomena have their basis in energy and inertia, and, secondly, that all things are linked together by a process of continuity, no hard and fast lines dividing one thing from another, which the mathematical method of investigation practically assumes to be the case.

Inertia is the most distinctive feature of matter, and the overcoming it has been described by the writer as imparting energy to matter, the matter acted upon by energy unwillingly acquiring a new property or force for which it has no affinity. As matter resists energy being imparted to it, work has to be performed proportionate to the resistance encountered; but what is called work is simply a transformation, and not an expenditure of energy, the energy transformed existing in some shape or other in the matter to which it has been transferred, and this imparted energy can be parted with, only, when the conditions are such as enable it to pass into some other receptacle.

After what has been already stated, it will be seen that the specific difference observed between copper and iron paths admits of easy explanation. Iron opposes about six times the conductive resistance of copper, but, at the same time, it possesses an enormously greater capacity for the storage of energy in the shape of magnetism than is possessed by copper. Owing to this greater capacity, and the existence of something akin to affinity between magnetism and iron, and although iron opposes much more inertia than copper, an iron path parts with magnetism much more slowly than a copper one, and consequently the potential of the current developed at the time demagnetization is occurring, is not so great. Copper not only demagnetizes more quickly than iron, but it demagnetizes also more completely, and the current produced by the demagnetization is conducted six times as freely; whereas iron on the other hand, parts with magnetism comparatively slowly, retains more or less of it permanently, and conducts current very much less rapidly.

Prof. Lodge's own experiments demonstrate clearly that Leyden jar discharges are completed more quickly through solid copper conductors of large section than through copper conductors of smaller section notwithstanding the inertia encountered is greater when the section of a conductor is increased. It was also pointed out that within the limits embraced by Prof. Lodge's experiments the superiority of copper over that of iron for effecting rapid discharge, was so great that the Leyden jar was observed to discharge in less time through a No. 19 B.W.G. copper wire than through a No. 1 iron wire. It was also further pointed out that the simple theory developed in the course of this article was capable of explaining in a natural common sense manner all that which was observed in connection with the "alternative path" experiments.

The writer annexes an extract from Prof. Lodge's paper of 1889, read and discussed at the Institution of Electrical Engineers, and he does so lest it might seem that he has incorrectly stated the conclusions mathematicians have arrived at. The passage referred to reads as follows:—"A few words may suffice to explain the nature of the impedance which alternating currents meet with in passing through a conductor, and of the reason why iron is as good as, or even better than copper for the purpose of conveying currents alternating with extreme rapidity." But if what is stated in the passage quoted be true then copper bars should be more readily heated by an alternating current welding machine than iron ones, and iron conductors might be substituted with advantage for the copper mains now employed in connection with high pressure alternating electric systems.

To practical common sense it seems impossible to understand that mathematicians can in any other than in an academical sort of way, really believe that iron is capable of transmitting rapid electrical alternations as efficiently even as copper, not to say more efficiently. That mathematical reasoning, having for its basis the newer electrical theory, leads Prof. Lodge to such a conclusion is evidently so from his published statements, and one of the reasons he has given for preferring iron to copper is its higher melting point and less liability to be fused.

For the protection of buildings Prof. Lodge has suggested that in place of a single point the roof of the building should be surrounded with galvanized iron wire, bristling with points, and he seems to think that such an arrangement would help to bring about discharge quietly; the observations made by the late Andrew Crosse with an exploring wire afford evidence that atmospheric discharge does take place silently in a very large degree, and it seems probable that discharge by lightning is the exceptional form in which discharge occurs between the clouds and the earth. In a passage too long to quote in its entirety, Andrew Crosse states that "when the edge of a thunder cloud is perpendicular to the exploring wire, a slow succession of discharges takes place between the brass ball of the conductor and one of equal size connected with the nearest spot of moist ground. I usually connect a large jar with the conductor which increases the force of, and in some degree regulates the number of explosions." He goes on to say 'that after a certain number of explosions, say, of negative electricity, which at first may be 9 or 10 in a minute, a cessation occurs of some seconds or minutes, as the case may be, when an equal number of explosions of positive electricity take place; and he further states that the alternate discharges of positive and negative electricity increase in rapidity as the cloud passes over the exploring wire, "until a regular stream commences. interrupted only by the change into the opposite electricities," and that "when the middle of the cloud is overhead a crashing stream of discharges takes place, the effect of which must be witnessed to be conceived."

The surface of any single building is so small, relatively, and the distance intervening between it and the cloud is so large that the writer is disposed to think it can practically make very little difference whether there be one or numerous points, providing the single point is a considerable height above the highest point of the building. The writer tried the experiment a great many years ago of substituting a single point for the comb of a cylinder frictional machine and he found the single point to act as efficiently as the comb, a Leyden battery, consisting of a number of jars, being charged to the discharging potential with the same number of turns of the handle, when there was only a single point, as was the case with the comb, which consisted of a row of points.

A thunder cloud the writer considers to be fairly comparable to a reservoir of water situated on a height. It sometimes occurs that owing to the pressure of the water the retaining walls of a reservoir give way; leakage of water takes place usually before the actual catastrophe, and such leakage assists to break down the cohesion of the structure, which gives way at first slowly, and afterward rapidly, letting loose a flood of destructive energy. The fact that there are drains in the valley will have no influence whatever, so far as the bursting of the reservoir is concerned, but their capacity to carry away the flood, when it does come, is of very considerable importance in mitigating the destructive consequences. Now, a thunder cloud is, after all, only a reservoir of energy, the retaining wall being the dielectric atmosphere separating the clouds and the earth. All the time charge is being accumulated, more or less discharge is quietly occurring; but if the potential accumulates faster than it is being lowered, the electrical pressure becomes sufficient to break down the cohesion of the air molecules; before this actually occurs the electrical leakage usually increases, and such electrical leakage acts in a very similar way as the leakage of water through the wall of a reservoir subjected to great pressure, and it helps to undermine the dielectric wall which gives way at last suddenly the heat then developed in the path of discharge greatly

re[illegible] the resistance opposed and a flood of energy is poured [illegible] the purpose of a lightning conductor [illegible] harmlessly away. Were it not for the great red[illegible] resistance which occurs in the air path immediately after it has given way, the whole of the energy [illegible] a thunder cloud would be dissipated in forcing a passage through the air. As it is, seeing the enormously greater resistance of a mile of even highly heated air compared with that of a few hundred feet at the [illegible] and seeing also the very [illegible] surface of the earth as well as that of the clouds, by far the greater amount of energy [illegible] dissipated at the time of a lightning discharge must be spent in the clouds themselves, the air path, and [illegible] the earth [illegible] nevertheless, owing to the reduction of resistance in the air path, which occurs in the very [illegible] down, a [illegible] of energy is liberated which the lightning conductor is designed to deal with.

Now, certain of our mathematical physicists would have us believe that the flood of energy, which after the cohesion of the air molecules has been broken down, forces its way through a path of great resistance, instead of going through the mass of the lightning conductor, passes down an outer skin of microscopic thickness, and oscillates backward and forward between the clouds and the earth. They would like to persuade us that electricity and energy, whose rate of motion (as neither possesses weight, *i. e.*, inertia) would be infinitely great, were it possible to obtain a conductor which opposed no resistance, and whose actual speed, as it is, is determined solely by the resistance encountered, passes up and down the conductor, and further they call upon us to believe that an entity not possessing inertia is capable of oscillating, although they admit, at the same time, that all oscillation involves inertia, *i. e.*, weight; and why is this demand made upon our credulity? Simply because the mathematical development of a theory, propounded by a very eminent physicist, seems to demand it, and it would really seem

> That when a [illegible] is in the case
> [illegible] sense must then give place.

The efficiency of a lightning conductor, in the opinion of the writer, depends upon its low magnetic inertia and specific conductive capacity; and, as the magnetic inertia of copper is very much less than that of iron, while its conductivity is six times greater, copper he considers to be a very superior material to iron for the construction of lightning conductors.

The actual resistance opposed by a lightning conductor, compared with that encountered in the air path, is so very small that a copper wire of comparatively small section is sufficient to conduct harmlessly away ordinary lightning discharges, but Prof. Lodge's own experiments demonstrate clearly, that solid copper conductors of large section are more efficient than conductors of smaller section, and the fact that the points of a lightning conductor are occasionally fused is evidence that conductive resistance is an element which should be taken into consideration.

The most efficient conductor, according to the writer's views, is a multiple copper conductor constructed either of ribbon copper or a number of wires. The writer would prefer wire simply, because it is more practical, and can be stranded; but a series of parallel copper ribbons, the writer is disposed to think, would be theoretically more perfect.

Electricity in the Navy.

At the annual meeting of the American Institute of Electrical Engineers, a paper on "Electricity in the Navy" was read by Gilbert Wilkes, U. S. N. The article appeared in the WESTERN ELECTRICIAN of May 31st last. After its presentation the following discussion took place:

DR. OTTO A. MOSES: There is a very interesting point touched, about which I would like to inquire; whether Mr. Wilkes has himself made observations as to the deviation of the compass on board ship

MR. WILKES: I would say that I have not made any observations on ship board; but the observations have been made by navigators and turned into the office of the naval inspector. I have seen the reports and have made the tests on shore myself. The effect does vary between 1-20 of the horizontal component of the earth and as high as 5, 6 and 7 times this component at a distance of 12 feet.

DR. MOSES: This subject came up before a meeting of the National Electric Light association, when a lieutenant of the navy declared, to my astonishment, and I think to that of the other members of the association, that there was no action on the compass at all. Have you tried experiments with the alternating current to see if that would affect the compass?

MR. WILKES: I have never tried the alternating current because none of our ships have alternating current dynamos on board. As to the exact amount of deviation on board ship caused by the dynamo, I will state one instance in the case of the Chicago where the variation is 2 per cent.

TOWNSEND WOLCOTT: I would like to ask Mr. Wilkes if he has ever experimented with the class of dynamos like the Continental and the Eickemeyer called "iron-clad dynamos," and whether there is really much difference in their effect.

MR. WILKES: I would answer that I have. Those are the small deviations that I referred to.

R. N. BAYLES: In setting an engine aboard ship is particular care taken to set it so that the plane of the fly wheel is set fore and aft or athwart-ships? This point came out in connection with a proposed system of lighting our lightships with an incandescent plant. Those ships roll and pitch a good deal, and one objection raised to this plan was that in case of high running machinery on board a ship, pitching around as they do, we would have the tendency of the wheels to maintain their plane of rotation—the gyroscopic effect, and that the effect would be to maintain the strain on the bearings and cause them to heat.

MR. WILKES: I would answer that the main trouble with heating on board our men-of-war has been from having the axis of dynamo and engine faced to thwart-ships, in which case the oil is likely to fly from the bearings and it is so bad that where the available space will allow we get the shaft fore and aft. But our space is usually so cramped that we are apt to make the most of it.

MR. BAYLES: The remark was made that this effect of the dynamo on the compass could of course be corrected. I would like to ask if there is any particular method of correcting this effect on the compass, assuming that the load is variable when running.

MR. WILKES: I would answer that the effect on the compasses is not due to the lamp load as far as observation goes. The dynamos being compounded of course always exert the same effect. The mains are run so closely together that their effect is *nil*. I believe that in the English service where they use the ship as a return they have considerable trouble from this cause

MR BAYLES: But can it be corrected and is there a practical method of correcting it?

MR. WILKES: I believe it has been suggested to use a larger electro magnet to correct it. But it has never been tried in this country, and I believe that the easiest plan of correcting it is to get a dynamo which doesn't have a large external field.

F. T. BIRDSALL: I would like to ask if that 12 feet Mr. Wilkes speaks of, was clear space or were there any iron bulkheads intervening:

MR. WILKES: The measurements were either made in engine rooms or machine shops. In the cases where the deviation is least the iron was not uniformly placed at all. It was just as you find it in any machine shop where you go to see a dynamo built, for testing it.

MR. BIRDSALL: On almost all that I have seen of the cruisers there was at least an iron partition, I think, between the dynamo room and any of the compasses. We know that iron of that sort has some shielding action.

MR. WILKES: The deviations have been found on shipboard and I have often thought of the shielding action of those bulkheads, but I believe it is anything but shielding, because they are not complete magnetic circuits and they only bring the lines of force close to the position which the compass occupies.

ROBERT S. DOBBIE: I would like to ask the lecturer if he attributes the effect only to the leakage of magnetism from the fields of the dynamo, or does he think it is the effect from the main going to the lamps. I have had a little experience with that in an alternating machine—one of the early types of Siemens machines on board a merchant vessel, and the waste of magnetism is much greater than in modern machines, and a compass adjuster from Southampton, I forgot his name, a well-known man, came on board and made the most elaborate tests, The ship was wired returning through the hull. That is, the current was grounded after passing through the lamp and no perceptible difference found on that ship, not the slightest

MR. WILKES: The experiment has been roughly tried by changing the position of the compass in reference to the mains and keeping approximately the same distance from the dynamo It leads to the conclusion that the effect does come to all observable amounts, from the dynamo itself. Did I understand you to say that you had had other experience?

MR. DOBBIE: Well, the machine was of the alternating description, so I suppose the lights made very little difference, but the magnetism escaping from the field magnets of the dynamo was, I should say, very much greater than with the modern machines. The theory of the dynamo was not so well understood in those days. There were two dynamos, an alternating dynamo with a field of eight magnets, and a small exciter.

Electric Lighting in the Railroad Service.[1]

BY M. B. LEONARD.

The extraordinary development during the past fifteen years of the art of lighting by electricity, and the success attending its daily use on our streets and in our houses have been so apparent that its utility and benefits were quickly recognized in the railway service, not only in this country but abroad, with this difference, however, that in the United States only the illumination of depots, yards and train sheds by means of the arc lamp was at first attempted, while abroad the lighting of trains and station houses primarily engaged the attention of the profession. Its progress, however, has been so great and its advances so manifest that in this country our important trains are now lighted by electricity, and in Europe the arc light has been so extensively adopted that in one station alone of the Great Western Railway of England (Paddington) not less than 100 arc lamps are used; while the French, German and Italian railways are gradually lighting up the larger stations and yards in this way.

For many years one of the most prolific sources of injury to railroad men and loss to the company has been the switching of cars in the yards at night, with only a hand lantern to indicate the movements required, the engineer, owing to the darkness, was obliged frequently to depend more on luck than otherwise to guide him in handling his engine, the result being often a crushed hand or shoulder for the brakeman, if he escaped being caught between the bumpers, or the engineer miscalculating his distance in the darknesss would come back too hard, and thereby break the drawheads and smash in the ends of the cars.

The introduction of the arc light in the large yards where a great deal of switching or making-up of trains at night is performed, was found, as had been expected, to work a wonderful improvement in this direction, and the use of the arc light for this purpose is now so widely extended that there is scarcely a railroad from the Atlantic to the Pacific, which does not use the electric light in its important yards.

It enables yard and engine men to see one another almost as clearly as in sunlight, and in addition to preventing accidents, permits the work to be done with almost as much dispatch as during daylight, while without the light double the amount of time would be required to perform the same service, and even then with less safety to machinery, cars and men.

An extended inquiry among the men using these lights develops the general belief that they pay for themselves several times over in the single item of repairs saved to rolling stock by enabling the engineers to do the switching more carefully, and with less damage to the cars. These arguments seem strong enough to warrant the use of electricity for this service, wherever the business is large enough to require night work.

Other important features in the use of the electric arc lamp are the greater amount of loading or unloading of cars that can be carried on at night than with the oil lamp system, and the reduction of the number of car robberies and shortages in freight packages.

The experience of the Chesapeake & Ohio Railway company at its Newport News, Va., terminus affords an excellent illustration of the benefits of the electric light in these respects. Through its connections with the Old Dominion Steamship line from New York, large quantities of freight are transferred to cars at Newport News for western points. As the New York steamers arrive at night generally it is important that the freight be at once loaded, billed and forwarded with the utmost dispatch. Under the old oil-lamp system it was found impossible to get the freight billed and cars loaded and started within less than twelve to fourteen hours after the steamers' arrival. The number of claims for shortage and damage were very great, and reports of freight astray were numerous.

In the hope that this condition of things might be improved, a 50-arc light plant was put up, and the piers illuminated by electricity. Immediately a new order of things prevailed, freight was billed and loaded correctly, there being no dark corners, the shortages and damage claims began at once to diminish, and the trains were forwarded in nearly one-half of the time it formerly required, while a substantial rebate was made by the insurance companies from the premium hitherto paid, which offset not a little of the cost of the electric plant, and the reduction of the premium goes far towards paying the cost of maintenance and operation at present.

The lighting was extended to the immense coal piers of the company, and the coaling of steamships, which up to that time could be done very slowly, and only at great hazard during the night, was rendered almost as easy as in daylight. It is, therefore, safe to say that the Chesapeake & Ohio is satisfied with the investment, and that its experience is not exceptional, is evinced by the fact of the Pennsylvania Railroad company using no less than 80 arc lights on its coal wharves, yards, engine houses and depots in the city of Philadelphia.

While arc lights are usually designated as of 1,200 or 2,000 candle power, experience has shown that an arc lamp will give more light in some directions than others, and that while the use of globes very much diminished the intensity of the light, in certain cases they distributed it very much better.

For these reasons it is very difficult to determine just how many lights is necessary to illuminate a certain amount of space, frequently, therefore, the best results could only be determined by a number of trials of the lamps in designated positions, changing them about until the desired results are obtained.

A series of experiments, outlined in the *Railroad Gazette*, was recently instituted in Germany to ascertain the candle power of arc lamps, in which it was found, that in a Siemen's differential lamp, supplied with a current of 14 to 15 amperes at from 48 to 52 volts, the horizontal intensity was about 196 candles (German, very nearly the same as the English), it increased rapidly to about 20 degrees below the horizontal, where it was 1,150 candles, then more slowly, until it reached a maximum at about 42 degrees below the horizontal plane, where the light was 2,014 candles; it then began to sink rapidly until below 60 degrees there was no light, but only shadow. The average intensity was 1,228 candles, with the globes on, the actual light obtained ranged from 510 candles downward to 1,183 in a direction inclined 40 degrees below the horizontal, with an average illuminating power of 834 candles when freshly whitened reflectors were used.

In this country the best results seem to be obtained from the 10 ampere long arc, or from 40 to 50 volt lamps set on poles 35 feet high, and from 400 to 600 feet apart. The clear glass globes give the best illumination, as but few of the light rays are absorbed by the glass, but it is found that the unshaded glare of the arc is very trying to the eyes of the trainman, and consequently the half ground globes are preferred.

In examining the systems in use, it is found that the Thomson-Houston and the Brush are most preferred, though the Western Electric and the Jenney are very popular in the west, while the new alternating system of arc lighting of the Westinghouse company, owing to the greater life of the carbon, is making rapid strides.

A new and important improvement has recently been made in arc lamps, which results in an enormous increase in the luminosity of the arc, and consequently a most brilliant and economical light. This has been effected by making the lower carbon hollow and fitting it with a reservoir of oil and a wick, the oil ascending the wick by capillary attraction is converted into carbon vapor by the heat of the electric arc re-inforcing the light of the arc by luminous particles of incandescent carbon, thereby increasing its brilliancy. The tests of this lamp recently made by Dr. Hopkinson of London, show that the efficiency of the arc in watts per candle is nearly doubled, the color of the light being changed to a clear yellowish white, while the increased cost of the hollow carbon and the oil, is so small that it is not worth mentioning—a single drop of the oil lasting nearly a minute. It is claimed for this new lamp that it reduces the cost of arc lighting to such an extent, that it is equal to gas at 10 cents per 1,000 feet. Very little or no alteration is required to utilize this improvement

[1] Read at meeting of the association of Railway Telegraph Superintendents, Niagara Falls, N. Y., June [illegible]

in the present styles of arc lamps, and it is confidently expected that its adoption will soon become universal.

ELECTRIC LOCOMOTIVE HEAD-LIGHTS.

In still another direction the arc lamp will probably prove of great value to the transportation departments of our railroads. For several years experiments have been carried on with the view to adapting the arc light for use in the head-lights of locomotives. It was quickly ascertained, however, that the constant vibration of the locomotive seriously affected the feeding mechanism of the lamp, and consequently the brilliancy of the arc, but recently the improved feed apparatus and the adoption of a copper negative pencil instead of the carbon hitherto used, have been found to eliminate the difficulties, and the National Electric Locomotive Head-Light company of Indianapolis is now ready to furnish head-lights of this description, the current being generated by a small combined dynamo and engine, carried on the locomotive. The engine is about 3 horse power and has four cylinders, with the dynamo, which is about 2,000 watts capacity. It weighs about 700 pounds, and is placed over the smoke arch of the locomotive between the head-light and the smoke-stack.

The trials of this apparatus made last November on the Vandalia line showed that on very dark and rainy nights, the fences to the cattle guards could be seen three quarters of a mile away; a light-colored car would show as an obstruction on the track at about that distance, while one of dark color would not plainly be seen more than half a mile off; twelve telegraph poles would be plainly visible, while a white mile post would appear as a spot of light half a mile away. At 800 feet a tie at the side of the track would be plainly shown. Horses and cattle would show up clearly 1,000 feet ahead, and the colors on a switch target could be seen a quarter of a mile distant.

This shows that any serious obstruction on the track except in case of a very thick fog, could be plainly distinguished far enough ahead to stop an air-braked train traveling at a speed of 45 miles per hour, while at a reduced rate of speed during heavy storms and freshets, the liability of running into open draws, or into trestles or bridges carried away by high water, would be greatly reduced.

Another method has been experimented with to some extent, in which groups of incandescent lamps are placed in the head-light; this has given good results, but the beam of light is not as penetrating as when the arc is used, and the carbon filaments in the lamps are soon broken on account of the vibration of the locomotive.

THE ELECTRIC LIGHT IN SWITCH STANDS.

On May 30, 1887, the Southern Pacific Railway company, owning and operating its own electric light plant at Oakland, Cal., comprising a horizontal slide valve engine, locomotive boiler, and a 65-light 10 ampere Brush dynamo, finding it difficult to keep the oil lamps lighted in the interlocking and automatic signals in its yards at that point, on account of the variable draughts sweeping across the Bay, decided as an experiment to light twelve of these lamps from its electric light circuit, wiring the lamps in multiple.

So satisfactory were the results, that the number of signals so lighted have been increased gradually until 134 lamps in the interlocking and automatic signals, switch-stands, switch lights and signal towers are now lighted by electricity. Thirty-one of these lamps are in switches and signals that have underground wire connections, 16 of them light up four signal towers, while the balance are in signals located on posts and connected by over-head wires, all being supplied by the arc light dynamo, above referred to.

The signal lamps were made to take 38 volts, and are wired from 10 to 15 in multiple according to the number of signals within convenient distance to form a group, so reducing the e.m.f. that the lamps use to from 20 to 28 volts pressure, thus lengthening their life and yet giving sufficient amount of light to illuminate the bulls-eye lens of the lantern.

In wiring up the lamps, for the purpose of preventing trouble in each, in case they should break or are burned out, a simple switch is used with paper between the contact points, so that in case a wire leading to a number of lamps is broken, an arc will form at the switch, burn the paper, and thus close the circuit.

In putting up the lamps for the signals, the lamp with its socket is screwed on to a rubber nipple placed in the center of a wooden base made the same size as the oil lamp bottom which it displaces, wires passing down through the rubber nipple and in grooves cut in on the underside of the base, connect the lamp with binding posts on the corner of the base, which makes a complete and portable device for placing in almost any style of lantern.

For the signals on posts, a tin box or case was designed, 7x6x3, with lens on one or both sides, and with wooden bottom made to hinge or screw at one end, and fastened by a thumb screw at the other end, secured to the post by a pocket constructed on the narrow side of the case and an iron bracket on the post in the usual manner.

This box is made from one sheet of tin and is soldered tightly together with no openings except a bottom which is closed by the wooden lamp base. If well painted, white inside and green outside, this lamp case will last indefinitely. Where the lamps are most exposed to the assaults of the hoodlums with their little guns and stones, a wire netting of one-fourth inch mesh is fitted over the lens in the form of a pocket open at the top so the glass can be cleaned. After being placed in position and wires connected, no further care or attention is required beyond occasionally cleaning the outside of the lens.

The lamp complete, including case, base, lens, socket and lamp, costs about $2 each, as compared with about $500 each for the oil lamp complete, which lasted on an average two years only. The lamps first installed over three years ago are still in use, and have required no other care or attention than renewing the underground wire to two of them.

I am informed by Mr. Slater, the master of signals for the Southern Pacific company, to whom I am indebted for many of these details, that the actual expense for the installation and maintenance of these lights beyond the interest on first cost for wire, lamps and fixtures, etc., is very small, the additional amount of fuel required for the signal lamps being only about 5-horse power. Though in the system of accounting in use on the Southern Pacific Railway company, $90 per month is the proportion charged to the signal lights out of the total expense for maintenance of the whole system of arc and incandescent lights in use at that point, 30 arcs being required for depot passenger yard and road crossings, with fifty-six 16 candle power multiple series incandescent for depot room and offices, and one 65 and one 50 candle power series incandescent lamps for outside buildings. The total expense includes the cost for four attendants, fuel, oil waste and supplies, repairs, etc.

The division of the expense seems hardly fair, as in the installation of the signal lamps nothing was added to the expense for attendance or repairs to dynamo, engine or boiler, and very little to general supplies. All of these had to be maintained on account of the arc and incandescent lights already in use.

So well satisfied has the Southern Pacific company been with the results from the electric light plant at Oakland, that it has in consideration a larger one there to light the railroad shops, coal yards, ship and lumber yards, freight yards and ferry slips—and are operating electric plants at various other points on their line.

The details of this system have been so well worked out at Oakland, that there seems but little room left for improvement, save that it might be well to have the lanterns made large enough to contain two lamps so arranged that one is automatically lighted on the extinction or destruction, from any cause, of the other. This feature has been adopted by the Edison company for side lights of ocean or river steamers lighted by electricity, where it is extremely important to keep the lamp burning at night.

The above mentioned plant seems to be the only one thus far in talled on so large a scale, and the results obtained evidence a large economy as against the use of the oil lamp for this purpose, where a railroad company owns and operates its own electric light plant of sufficient capacity to supply the signal lamps. As an illustration, the Central Railroad of New Jersey has 45 interlocking signal lamps at their Jersey City station, which consume five gallons of No. 7 oil daily, at ten cents per gallon or $15.50 per month; with the two lamp men at $40 and $45 per month, the total expense for the 45 lamps is $100.50 per month, as against $90 for the 134 lamps of the Southern Pacific at Oakland, without considering the cost of breakage, the trouble from lamps blowing or bursting which is liable to occur at Jersey City.

LIGHTING PASSENGER TRAINS.

In regard to the electric lighting of trains, this subject was so fully treated by Mr. Selden, in his admirable paper read at the last meeting of the association, that there is little left for me to add; however, some facts have come to my knowledge that may be of interest in this connection.

In the United States, at least, the system of lighting from storage batteries, charged at each end of the run, does not appear to increase in popularity. The Boston & Albany Railroad company, after two and a half years' trial, recently abandoned electricity on the two trains that were so lighted between New York and Boston, and substituted the Pintsch gas system. It is stated that the principal cause of this action was the cutting down of the overhead wires in New York, preventing them from charging the storage batteries at that end of the line, as the cars were not equipped with oil lamps which could be used during that time, but it is also claimed that considerable trouble was experienced from the lamps frequently breaking, and that the expense of maintenance was too great.

The Pennsylvania company, however, still continues to light power cars from storage batteries, using a low voltage lamp.

The Intercolonial Railway company of Canada has adopted the accumulator system alone on the trains between Halifax and Quebec, and now has more than forty cars fitted up with electric lamps, which are of 10 candle power, and vary from 11 to 22 to a car. The accumulators are charged at four different points on the line, running about 500 miles with the one charge, and the results thus far obtained are very satisfactory, but to provide for emergencies oil lamps have been retained in each car.

The combination of dynamo and storage battery first adopted by the Pullman company is gradually being extended in this country, and is giving great satisfaction in the East and West, but, it appears, at a large expense for maintenance. The Chesapeake & Ohio vestibule train, "Fast Flying Virginian," running between New York and Cincinnati with six cars, is supplied with 118 lamps divided up thus: two Pullman coaches with 30 lamps each, dining car with 26, day coach 16, combination car 13, and the baggage car three. Up to May 1, 1890, the average cost per lamp for maintenance and renewals was $1.10 per month; yet where the exhaust steam is utilized for heating the train the cost can be very materially decreased.

With this object in view, the Chicago, Milwaukee & St. Paul Railway company has recently added to its equipment two independent light and heat tenders, which carry their own boilers for steam heating, and for running a Westinghouse automatic engine attached to a No 4 Edison compound wound dynamo, supplying the current direct for lighting all the cars in the train, thus doing away with the dynamo on the baggage car and storage battery combination.

The results have been very favorable, and during more than six months of constant service there has not been a single failure. This company has four trains covering about 45 cars lighted by electricity, and expects to adopt this system of illumination on all of its through trains. A full description of the tender with drawings and other details of the electrical arrangements will be found in the Railroad *Gazette* of June 13, 1890. It is stated that the expense of building and equipping these tenders is not much greater than the cost of the storage battery, dynamo combination, with the expensive wiring required in that system.

It is confidently believed that the cost of lighting trains by electricity in the United States can be greatly reduced by adopting the method so largely used abroad, of getting power from the axle.

Mr. Houghton, the telegraph superintendent of the London, Brighton & South Coast Railway company, one of the patentees of the system advises me that there are sixteen trains running on that road, which are so lighted—thirteen of them local trains and three express. The speed of the express trains reaches 70 miles an hour, while that of the locals run from 20 to 60 miles per hour.

The express trains are wired for an average of 70 lamps and the others 40. The candle-power of these lamps varies from 8 to 16, according to the speed of the train.

The dynamo furnishing current for these lamps is placed in the baggage-car, and has a pulley at each end connected by belts direct with the axles of the car. No intermediate shafting being used, the slack is taken up by loose pulleys that can be pressed upon the belts.

The dynamos on these trains have a maximum capacity of 5,000 watts varying with the speed of the train, which, at 10 miles an hour gives about 48 volts and 35 amperes, and at 60 miles 65 volts and 75 amperes. The e. m. f. and current of the dyanmo gradually increasing with the speed. The brushes are mounted in pairs on a rocking frame so arranged that either set of brushes can be brought in contact with the commutator as required by the direction of the train.

In the same car with the dynamo, 22 accumulators weighing about 4,000 pounds are placed in parallel with the dynamo for use whenever the train stops.

Connected by a belt from the dynamo is a centrifugal governor which joins up the circuit at any desired speed, causing the dynamo to charge the accumulators. When the lamps are not lighted, the governor introduces resistance into the dynamo field reducing the output to about 40 amperes, in order not to damage the accumulator plates. When, however, it is necessary to light the lamps, the dynamo makes the full current, of which about 35 amperes pass into the lamps, the balance being stored in the accumulators.

In each lamp circuit a regulator is placed in order to keep the light in the lamps at the same power regardless of the speed of the train, and shunt any surplus current into the accumulators; so that 42 volt lamps may be used with a dynamo of any e. m. f. above that voltage without any variation in the light of the lamps.

The connections between the cars are made by coupling two cables together, and when the dynamo runs below a certain speed a cut-out breaks the circuit of the armature, preventing the cells from discharging themselves through it and burning it out. Should the dynamo not furnish enough current for the lamps, the accumulators supply the balance, and in doing so strengthen the field magnets and thereby cause an increase of current in the dynamos.

One arrangement of the circuits of these trains, has the field magnets of the dynamo wound with two wires in opposite directions, one of which is in shunt to the armature, as if the dynamo were an ordinary shunt machine; the other is wound in the reverse direction, as if the dynamo were a compound machine, and the accumulators are in series with the wire. The lamps are also in shunt with the armature.

The trains on which this system is used, consist mostly of ten cars which run solid, that is, are not broken up, and average forty 12-candle power lamps to a train. By using accumulators in each car, however, no difficulty would be found in splitting up the car at various points.

The figures given by Mr. Houghton are as follows:

Total weight of the plant on each train, three tons;

Cost of plant, on each train, 400 pounds sterling;

Cost of maintenance per annum, 65 pounds sterling.

The only attention given the trains is at each terminus, where one man inspects the apparatus, oils the pulley bearings, etc., before the train pulls out. One of these trains has been running since December 19, 1883, without a single failure being reported. During the first eleven months of its use it made 2,352 trips and ran 27,322 miles.

The Midland Railroad company of England is running three trains lighted by electricity, and has recently fitted up two others. Two of these are short trains always run solid, and the others main line trains made up at various points. The dynamo is placed in the baggage car and is also driven from the axle with about the same electrical arrangements as are used on the London and Brighton road. The short trains have 85 lamps run from one set of storage batteries in the baggage car. On one train the batteries are in series, but on the others in parallel. This seems to be the most satisfactory. Eight candle power lamps are used on this road, two to each compartment, which can be turned down, and this feature is found to be very convenient to through passengers.

This system of illuminating passenger trains is becoming very popular in England, and it is believed that all such trains on the important roads of the kingdom will shortly be equipped in this way. The expense as shown by seven years' experience on the London & Brighton road is certainly not greater than where common oil is used, and seems to corroborate the report made by Sartiaux and Weissenbruch, to the International Railroad Congress at Paris a year or two ago, in which it was stated that for lights of the same candle power, gas supplied by the Pintesch system would cost about 11.3 centimes, and coal oil about 16.9 centimes per lamp-hour as against 5.6 centimes for the electric light.

Compared with the practice on American roads, the economy of this method of generating the current is remarkable. It has been stated, however, by various authorities, that it is impossible to secure even fair results in train lighting in this country where the power is supplied by the car axle, owing to the numerous curves on American roads, around which the wheels will often slide, without

turning the axle [illegible], thus seriously damaging the [illegible] armature, and the constant changes in speed, while English roads are almost always tangents, and a high and [illegible] rate of speed is maintained. The experiments made here some years ago seem to corroborate these statements.

In [illegible] Mr. Barrett of Springfield, Mass., fitted up a train on the Connecticut River railroad to be lighted with electric lamps run from a dynamo, obtaining its power from the car axle. A countershaft was used and a peculiar arrangement of a friction clamp transmitted the power to a pulley on the shaft. This clamp was governed by centrifugal weights balanced by stiff springs. When the dynamo ran at its normal speed, these springs just balanced the friction of the clamp, and there was no slip; any increase of speed then caused the friction to diminish and the pulley slipped upon the shaft until the equilibrium was restored; 24 accumulators were connected with the circuit as a regulator, keeping the lamps lighted when the train stopped, and a centrifugal governor broke the accumulator circuit when the train slackened its speed. The brushes were attached to a rocking arm, or lever, which was tilted by magnets in either direction in accordance with the forward or backward movement of the train.

Owing to the arrangement of the car trucks, it was found very difficult to obtain the proper speed of the dynamo, and after successive trials with belts, ropes and chains, it was finally abandoned. Since that time there have been no further experiments of this character in the United States, but it is said that such improvements are now being made in the driving gear as will obviate the difficulties heretofore encountered, and that further trials in this direction may be looked for within the next six months

The electric lighting of trains has been hitherto considered very much as a luxury, but its superiority has been demonstrated in so many ways that it is now being regarded almost as a necessity; yet before it can be generally adopted it must be practicable to light the cars on a large scale; and to maintain the plant on each train in good order without expert assistance; it must also be so simple and at the same time so durable, that mechanics of ordinary ability can be utilized to make the few repairs it will require; its cost, therefore, must be reasonable as compared with other methods of lighting, and the character of trains on which it is to be used.

From the facts above mentioned, it will be conceded that all of these requirements are filled by the English system of taking power from the car axle; it is therefore confidently expected that the well-known ingenuity of our American engineers and inventors will be found sufficient to overcome the obstacles which now prevent us from utilizing in the same way the motion of the trains on our roads.

The successful illumination of the Hoosac Tunnel in Massachusetts by 1,250 incandescent lamps placed 40 feet apart on each of the two tracks, affords a remarkable illustration of the flexibility and superiority of the electric light over other illuminants and the advantages of the arc and incandescent light for the illumination of our depots, waiting rooms, train sheds and offices are so apparent and well understood, and their use so extensive, that it is unnecessary to make more than a passing notice of this branch of the subject.

In thus considering the various directions in which the electric current has been adapted for illuminating purposes in the railway service, one is struck by the extraordinary progress that has been made in the art during a few years, and the enormous possibities that the future opens up for the utilization of this most wonderful of nature's forces. So much has already been accomplished, and so numerous are the workers in the new field, that before another decade of years has rolled around, steam will have been supplanted by electricity, as the motive power of our railroads, and the locomotive of the future will indeed be the fiery steed called lightning harnessed and subject to the control of man.

CORRESPONDENCE.

New York Notes.

New York, July 5.—The recent explosions in lower Broadway led the grand jury to hand down a presentment to Judge Martine regarding the dangers arising from present underground construction in the streets of the city. Large damages will undoubtedly be awarded the injured business houses. These accidents will lead to the establishment of a higher standard of construction. Engineers, electricians, and practical business men gave testimony as eye-witnesses of the eruptions and the grand jury announced at the conclusion of its work that, "From evidence presented, the contiguity of steam, water and gas pipes, and of sewer and electric subways in and under the roadbed of our principal streets, is an evil which demands immediate relief. The uptearing of the pavement caused by the laying of new pipes, and the frequent repairs is an obstruction to travel and a needless expense to the city. The overheating of the soil and the adjacent water pipes is destructive to pavements of asphalt and makes Croton water unfit to drink. The saturation of the soil with poisonous gases and dirty fluids is damaging to health. The explosions of gas and the liability to explosions of steam are a constant menace to life and limb. These evils have increased from year to year and will continue to increase unless some remedy is found. As a present remedy we suggest that steam and gas companies be held to strict accountability for all damage occasioned by their neglect; that penalties be rigidly enforced against companies that delay repairs and obstruct travel, and that no more permits be granted for the laying of additional lines of steam or gas pipes in streets that are now overcrowded. As a further remedy we suggest the appointment of a commission of strictly non-political experts, who shall consider the feasibility of vesting the management of street paving and all underground pipes and sewers in one department only, and of devising a new system by which the benefits of steam, gas, water, electricity and sewerage may be had with some safety and with less official obstruction."

The electrical companies in placing their wires beneath the pavements have discovered the rottenness of underground New York and are doing a good work in bringing it to light. The onslaught against overhead wires and poles and the building of electrical subways have revealed startling facts. Judge Martine appreciates the condition evidently and credits the grand jury with good sound sense, saying: "The evil which you present is certainly an evil which ought to be promptly remedied. The present situation is such that a citizen cannot walk safely in some of our principal thoroughfares. He is exposed to the danger of suffering at any moment through the explosion of pipes beneath him all the consequences of a volcanic eruption. I shall take great pleasure in calling the attention of the proper authorities to your presentment. I shall seek the assistance, too, of the district attorney in making your presentment effective and in making the citizens safe against the dangers menacing them from the subways containing gas and steam heating conduits."

The State Railroad Commission at Albany plays an important part in the present tendency toward the adoption of electric traction in many of the cities in the state. Arguments before this commission by the Buffalo Street Railroad company for a change from horses to electric power were heard during the week. The company claim the consent of the requisite number of property owners to the change, by including the consent of the park commissioners who control the park system of the city, because the city which owns the parks has consented to the change. The opposition take the ground that the direct consent of the park commissioners has not been obtained and thus the necessary number of property owners is lacking. The Coney Island & Brooklyn Railroad company has applied for permission to change its motive power from steam to electricity.

It is reported that the Electric Light & Power company has bought the Newark electric lighting plant, Thomson-Houston system, thus placing the electric lighting business of that city under one management.

The fire department has positively refused the police department space in its conduit for fear of serious crippling of both systems from electrical contact. The Subway company is in a quandary as to what measures to take to provide for the existing differences The next meeting of the Board of Electrical Control will take some action to settle the matter. It is claimed that the Subway company is attempting to double up the wires of both departments in order to give the electric light companies more space.

The third annual convention of the American Boiler Manufacturers' Association of the United States and Canada was held at the Park Avenue Hotel this week. Over one hundred delegates, representing nearly every state in the Union and some Canadian provinces, were present. Among them were Edward A. Magee, chief engineer of the United States navy; James A. Dumont, United States supervisor inspector general of steamboats, and Supervisor Inspectors George H Starbuck and Alexander McMaster. The objects of the association are thus briefly stated by the secretary:

To establish such standard for materials and workmanship as will insure uniform excellence of construction of all American boilers.

To concert such measures and take such action as shall be for the interest and advantage of its members especially.

To procure and furnish to its members statistics of the trade, domestic and foreign, and

To take such action as shall from time to time be deemed advisable regarding the regulation of prices and production.

The necessity of thorough inspections was discussed and measures taken to secure more attention on this point.

The Consolidated Telegraph & Electrical Subway company filed its first and second mortgages in the register's office yesterday. In the first mortgage, which is given to the Atlantic Trust company, the telegraph and telephone companies issue $1,125,000 of bonds; the Edison company, $125,000, and the electric light companies, $1,125,000. In the second mortgage, which is given to the Mercantile Trust company, the amounts are similar. The bonds, which are for $1,000 each, are payable on June 1, 1940, at an interest of six per cent per annum. As security the company mortgages on its franchises, working apparatus, etc., to the respective trust companies. The directors authorized the issue of the bonds on May 20 to enable them to continue the construction of subways.

The Empire State Subway company (limited) has filed a certificate of incorporation in the Secretary of State's office. The company is formed to manufacture, maintain, equip, operate, lease or sell electrical conductors, subways, conduits, ducts, and house and other subsidiary connections in New York City, and elsewhere in the state, and to lease spaces in said subways and conduits to any person, company or corporation having lawful power to operate electrical conductors in any street in New York City or state, including any company or corporation having or which shall acquire lawful power to manufacture, use or supply electricity. The location of the business is in New York, and the capital stock of the company is $500,000. The incorporators are William T. Bouchelle, John C. Reilly, Union N. Bethell, Hiram F. Stevens and David B. Parker.

A colored man while passing along W. Thirteenth street, Tuesday, was struck by a line wire which dangled over the walk. He cried out that he had been stabbed, and attracted the attention of schoolboys near by. One of them picked up the wire and received a shock, burning his hand and swelling his arm. He was able to go home though.

The test of a new audible electric signal for railroads was made at the One Hundred and Thirty-third street station of the Suburban railroad. Through the system an electric gong rings in the engine in case it passes into a block before the train ahead has gotten out of the block, thus the engineer is notified audibly in case a blinding storm or fog hides the ordinary signal from view. Twenty signals will be placed on the road which will give it a thorough test. A strong primary battery is used to supply necessary electric current.

W. H. T.

St. Louis, Mo.

St. Louis, July 5.—Score another point for electricity. The St. Louis & Suburban Railway company, the new organization which was formed to pull the owners of the old St. Louis Cable & Western road out of the mire of financial losses, will soon knock at the door of the city council for an important franchise granting it the right to equip its new road with electricity. Lee, Higginson & Co., Boston bankers, sunk about $665,000 in the old Cable & Western, and not a single dollar has glittered before their eyes in return. On the contrary, the road became deeply involved in debt and is covered a foot deep in mortgages, amounting to $1,000,000. Besides, judgment creditors obtained claims of about $300 000 in the United States Court against the road. It was placed in the hands of a receiver, A. de Figuelredo, who, with the assistance of Supt. Shipley, managed the concern better than it had ever been handled before, and also put the narrow gauge division on a paying basis—something which had not previously been accomplished Lee, Higginson & Co., in order to save themselves, organized a new company, known as the Central & Western, and obtained a franchise alongside part of the route of the old Cable & Western and down Union avenue to Forest Park Afterwards the same stockholders, with the addition of several St. Louis people, organized the St Louis & Suburban Railway, and then obtained a decree of sale from Judge Thayer for the sale of the old Cable & Western road. It sold for $150,000, and was bought in by Mr. Higginson. The St. Louis & Suburban company completed its organization this week by the election of officers, Charles H. Turner being made the president. The new company will ask the city council to give it a franchise to use electricity from Forest Park down to the eastern terminus, at Sixth and Locust streets. A branch will be constructed out to De Hodiamont, on which electricity will be used. Nothing will be done this winter except in obtaining franchises needed. No request will be made of the council, perhaps, until the Fall session of that body. As to the rumor that the St Louis & Suburban would consolidate with the Olive street cable line and the Market street and Laclede avenue lines, and thereby obtain a bulge on the control of the Forest Park travel, the officers of the St. Louis and Suburban say that it is entirely without foundation in fact. It is admitted, however, that such a consolidation of interests, if manipulated harmoniously, would be a most important move in street railway business in this city. With the Lindell Railway company's electric line soon to begin operation, there is a strong possibility of a lively street railway war next summer.

The attractions already secured for the exposition which will open in September guarantee a fine line of exhibits and novelties. The electrical department will be complete in all kinds of motors, dynamos and electrical appliances to fully represent the uses of electricity. Even a company manufacturing high-speed engines as far west as Sioux City, Ia., will send in an exhibit. An electrical fountain, with its hundreds of incandescent lights of vari-colored

hues tinging the cascade of water, will dazzle the eyes of thousands of visitors again. A prominent brewery firm will construct an exact duplicate in miniature of Mammoth Cave in the basement—the dark caverns, rocky walls, submarine lakes, ceiling covered with glittering stalactites, and all the other appurtenances thereto belonging being faithfully reproduced, so far as possible. Gold and silver medals will be awarded. One attraction will be an electric unicycle street car for an elevated road, which will run on one wheel at the rate of 130 miles an hour. O.

Pittsburg, Pa.

PITTSBURG, July 5, 1890.—The Pleasant Valley Street Railway company is about to try an experiment in novel car service. For some time past workmen have been busily engaged in the shops of that company constructing what is known as a double decker. This particular car is constructed after the plan of the omnibuses in Paris or the Fifth avenue stages in New York. It is much longer than the cars now in use but not quite as wide There are fourteen windows on each side, and seating capacity in the interior for forty-two persons. On the roof are two long seats extending the length of the car. These are placed almost back to back with the exception of a narrow space which will be occupied in part by the trolley pole. The Sprague electric motor system is now used on the Pleasant Valley line.

The Oakland and Linden electric line, which is a feeder of the Fifth avenue cable line in this city, was successfully started a few days ago

A local electric railway company is said to have been conducting experiments with a storage battery system with a view to adopting it on the cars of the company. So far those initiated are maintaining strict silence upon the subject and the details have not been divulged. All that could be learned is that the projectors of this new system of storage battery propose to do away with the use of lead and other material which now render that system more or less impracticable on account of weight.

There is no doubt that Pittsburg is the greatest field for the electric motor in the country. Not a week passes that one or two charters are not granted to some corporation or other in the city proposing the establishment of a street railway line. Not a session of councils has been held lately without granting the privileges of street railway franchises to several companies. The result will be that in less than two years, those streets in this city, which are not graced by an electric railway will be in the minority. At the last meeting of councils, ordinances giving the right to the use of certain streets for railway purposes were granted to the Pittsburg and Mt. Lebanon company; the McKean Street Railway company; the Jane Street Railway company; the Arlington Avenue Railway company and the Bingham Street Railway company. E. H. H.

Louisville, Ky.

LOUISVILLE, July 2.—Judge Sterling B. Toney of the Louisville Law and Equity court has handed down an opinion in the electric railway case that will be received with interest by those having capital invested in electric street railways

The decision is, practically, that electric street cars, at least in Kentucky, are not a menace to the lives of the people, but a necessity. As the immediate equipment of all the Louisville lines with electric motors was dependent upon this decision there is now nothing in the way to prevent the completion of the Green street line on Walnut street as far as the river terminus.

The suit referred to above was brought by the Louisville Bagging Manufacturing company to enjoin the electric company from stringing its overhead trolley wires along Walnut street at Nineteenth, in front of the plaintiff's factory. The ground taken was that the line was a nuisance, interfered with business, and actually menaced the lives of the employes of the factory. It was claimed that all the employes would leave if the wires were put up and used.

Judge Toney advised the company to get other and intelligent workmen.

This is the first case of the kind ever decided in this state and will establish a precedent. Judge Toney's opinion was as follows.

'It is a physical fact, demonstrated by proof, beyond a reasonable doubt, that the overhead single wire trolley system, adopted by the defendant for the operation of its street cars, does not involve danger to the property of the plaintiff, nor to the lives of its officers and employes. The proof in this case shows that in the operation of street cars by electricity there is less danger to the lives of foot passengers and to people upon the streets than in the operation of street cars by mules and horses. The car is under the immediate physical control of the conductor. The proof shows he can exercise a power of instant reversal of the motors, which power to reverse and stop the car increases with its speed. In no other system, it is shown by the proof does this immediate power of control over the car by the conductor exist. What danger, therefore, there can be in the defendant's operation of its street cars under this system to the factory of the plaintiff, or how said operation will deprive the plaintiff of the reasonable and ordinary use of his factory, it is impossible for the court to understand."

The points made by Judge Toney are given in detail as follows:

"First—That the Central Passenger Railway company has full and complete authority, both from the legislature and city council, to erect and operate a single trolley wire electric street railroad on the streets of Louisville where street railroads are now operated.

"Second—That the operation of electric street railroads along streets does not create a new servitude such as to require compensation to be paid to the abutting property owners.

"Third—That the abutting property owner has no right to back his wagon up at right angles to the street for purposes of loading and unloading, thus obstructing the travel of the street railroad and others; but it is his duty to stand his wagon lengthwise in front of his lot, so as not to obstruct any more than is necessary of the street in loading and unloading.

"Fourth—That the single wire overhead trolley system is the only successful system of electric street railroad, and that it is safe, prudent, desirable and not dangerous.

"Fifth—That the interference with telephones by the operation of the electric railroad is not ground for issuing an injunction against the railroad company." L.

THE ELECTRIC LIGHT.

Pulaski City, Va., will soon erect an electric light plant.

The Santa Cruz Incandescent Electric Light & Power company started its new plant recently. This company now furnishes 1135 lights, Thomson-Houston system.

The Blacksburg (S. C) Land & Improvement company has awarded the contract to the Schuyler Electric Light company of Manchester, Conn., for its electric light plant.

J. A. Hart, S. R. Read, R. M. Barton, Jr., and others, have incorporated the Farrell Electric Heat, Steam & Light company to operate the electric plant at Chattanooga, Tenn.

The Charlotte (N. C.) Electric Light company has added an engine to its power plant and will soon install a new arc dynamo to supply the increasing demand for electric lights.

One of the latest towns in New York state, in which the Westinghouse alternating apparatus has been introduced, is Tonawanda. The plant has a capacity of 500 incandescent lamps.

An exchange says: "Lieut. Steele U. S. A., is said to be investigating Chattanooga, Tenn., with a view to selecting a site for an electric plant, to be operated on a French system."

Bids will be received until July 14 by the Los Angeles city council to construct and maintain an electric light plant, and light the streets of Los Angeles for two years, commencing Jan. 1, 1891.

The Archer Electric Light company has been incorporated at Chicago; to furnish electric light and power; capital stock $15,000; incorporators, Henry Schmidt, Peter Schmidt and Chas. F. Kroll.

The Oakland, Cal., Gas, Light and Heat Company has enlarged its plant by the addition of three 50-light arc machines of the Thomson-Houston type; 125 2,000 candle power lamps have also been purchased.

Yazoo City, Miss., has accepted the proposition of the Thomson-Houston Electric company of Boston, Mass., to erect an electric light plant The company has an exclusive franchise for 20 years, and will expend $60,000 on the plant.

The Westinghouse Illuminating company of Schenectady, N. Y., has been making considerable improvement in its central station plant of alternate current electric lighting. A new arc light machine of the Westinghouse alternate current arc light system has lately been added to the capacity of the plant.

Arc light apparatus, of the new Westinghouse arc light system, was sold for central station purposes in the following towns, during last month: Valdotsa, Ga., 40; Ogden, Utah, 80; Schenectady, N Y., 60; Rockville, Ind. During the month a large arc light plant was also ordered for the Zoological Gardens at Cincinnati.

The Westinghouse Electric company is installing alternate current apparatus for a central station plant of electric lighting in Carrollton, Mo. The plant will have a capacity of 500 lights. An electric light plant is to be installed in Crystal Falls, Mich. The Westinghouse Electric company has received the contract to furnish alternating current apparatus of a capacity of 750 lights.

The Westinghouse Electric company reports the following orders received during the month of June, for alternate current central station apparatus: Moundsville, Va., 500 lights; Valdosta, Ga., 500; Newark, N. J. (increase), 1,500; Cleburne, Tex., 500; Newport, R. I (increase), 500; Hamilton, O., 500; Tacoma, Wash. (increase), 1,500; Vinton, Iowa, 500; Hiawatha, Kansas, 500; Saginaw, Mich., 750; Tonawanda, N. Y., 500; Philadelphia, Pa., 750; Crystal Falls, Mich., 750; Oconto, Wis. (increase), 750; Ogden, Utah, 1,500; Baltimore, Md., (increase), 3,000.

An action has been commenced at Pittsburg in the United States Circuit court by the Brush Electric Light company against the Westinghouse Electric company for an injunction restraining the latter from making, using or selling any electric arc lamps embodying the claims of the plaintiff. The case is for the alleged infringement of electric lamps, using the double carbon system, designated in this case as "Indianapolis Jenney double carbon lamp," and in which two pairs of carbons are independently adjusted, controlled and burned successively, one pair of carbons being consumed, or practically consumed, prior to the establishment of the arc and the burning of the other pair.

The Ries Electric Traction & Brake company has recently been incorporated with a capital stock of $2,000,000. The company has purchased the United States patents granted to Elias E. Ries for methods of and apparatus for increasing traction electrically, and for electric braking, and will carry on a general manufacturing business in connection with the introduction of its electric traction increasing and brake appliances. The incorporators and officers of the company are John M. Denison, president; John B. McDonald, vice-president; James Sloan, Jr., treasurer; Elias E. Ries, consulting electrician; Charles Selden, director; John W. Snyder, director, and Charles H. Jones, Jr. The principal offices of the company are in the Chamber of Commerce Building, Baltimore.

A dispatch from Pittsburg, under date of July 7, says that the Westinghouse Electric company has instituted proceedings against two Thomson-Houston concerns. One action is directed against the Second Avenue Passenger Railroad company for infringement of what is known as the Finney overhead wire patent, which plaintiff claims to own, and also for infringement of the Forbes patent carbon brush. The Union Switch & Signal company, another Westinghouse concern, has also brought action against the same railway for the use of the metallic connections from rail to rail. The Westinghouse people have likewise brought suit against the Wilkinsburg Electric company, a liceesee of the Thomson Houston, for the infringment of certain patents for converters and for muitiple arc distribution of alternating currents by converters.

The Thomson-Houston Electric company, through its Chicago office, reports the following sales for the month of June: Capitol Electric company, Nashville, Tenn., 7 motors from ¼ horse power to 50 horse power. Mt. Clemens Electric company, Mt. Clemens, Mich., 650 light alternating incandescent machine; Salt Lake Power, Light & Heating company, Salt Lake City, Utah, 150 arcs; Atchison Gas & Electric Light company, Atchison, Kan., 650 light alternating incandescents; B. Nugent & Bro., St. Louis, Mo., 1 horse power motor; Logan Light, Power & Heating company, Logan, Utah 650 light alternating incandescents; Gogebic Electric company, Bessemer, Mich., 1950 alternating incandescents; Dodge Manufacturing company, Mishawaka, Ind., 650 alternating incandescents; Inter Ocean Publishing company, Chicago, 2 motors; Capitol Electric company, Nashville, Tenn. 350 arcs; Huntington Cotton Manufacturing company, Huntington, Ark., 750 direct incandescents.

THE ELECTRIC MOTOR.

The first trips on the electric railway at Kearney, Neb., were made on the Fourth and formed a part of the day's celebration.

The Capital City Railway company of Salem, Ore., has received permission to extend its electric line down State street to Commercial to Trade street. Other extensions are also contemplated by this company.

The incorporation at Springfield, Ill., of the Metropolitan Electric Street Railway company, to build an electric street railway, is announced; capital stock, $5,000,000; incorporators, Leo Fox, Michael Durand and Herman Vollmer.

The Aurora Street Railway Light and Power company has been incorporated at Aurora, Ill., to operate street railways and furnish electricity for light, heat and power; capital stock $10,000; incorporators Benjamin W. Dodson, D. J. Hogan and M. C. Orton.

The syndicate which recently purchased the street railway lines of Buffalo, N. Y., has reorganized the entire system and the new owners have taken possession. It is estimated that $5 000,000 will be expended in rebuilding the lines and installing electrical machinery. Murray A. Verner was made general manager of the entire system.

An Omaha paper says: "E. A. Benson says he intends to sue the Omaha Street Railway company for failure to comply with a contract. This agreement, it is claimed, was entered into early in spring when the Omaha Motor company accepted the offer of citizens along Military avenue as follows: To give the motor company the right of way, belonging to the Benson line, along that thoroughfare, and south on Lowe to Mercer avenue, a bonus of $25,000 with which to erect poles and string the wires necessary for an electric road; an additional bonus of about 200 lots variously estimated at from $60,000 to $80,000. The contract entered into on the part of the Military avenue people was with the Omaha Motor company, which was popularly known as Mercer's line. Soon after it had been entered into the motor line consolidated with the street railway company, under which name the corporation is now known Mr. Benson holds that the new company is responsible for the contract of the motor people, to whom they succeed

When the Rochester, N. Y., Street Railway company decided to introduce an electric system, the telephone company called attention to the fact that its system would be practically ruined. In the controversy that followed the railway company's position was thus expressed by its secretary, John N. Beckley: "It is the complaint made by the telephone companies in all places where electric cars are used. They claim that some part of the electricity passes from our rails through the ground to their poles and wires, thus affecting the operation of their system. Well, the truth is, the telephone company claims to own the earth,

and in the opinion of the managers no one has a right to use any of the earth except them." The local press takes up the cudgels in the cause of the railway company and assails the telephone company's policy. It looks very much as if another telephone war could be easily provoked in the Keystone City. There could be very little satisfaction in such a controversy, however, and it is to be hoped that an amicable agreement can be reached.

It was announced in Newark last week, that John Radel had effected the sale of the South Orange and Newark Street Railway for $1,750,000 or $100,000 more than he asked for it a month or two ago, when some speculators took his option and let it lapse. It is said the prime mover in the new bargain is Steven V. White of Brooklyn, and that Brooklyn capitalists are behind him. Mr. Radel bought the road in 1888 for $350,000, and recently has been making $75,000 a year from it, it is said. It is one of the best street railroads in Newark or its suburbs. All the other completed roads are under control of the Philadelphia syndicate, which recorded a $6,000,000 mortgage on all its property last Tuesday. It was made payable to the Solicitor's Loan & Trust company of Philadelphia, and it has forty years to run at five per cent. It is given to secure an issue of coupon bonds with which the old bonds will be retired at maturity, and an old mortgage of $2,000,000 will be wiped out. Deeds transferring the Irvington and Newark, and Elizabeth and Newark roads to the new company were also recorded. In the first case the consideration is $2,200,000, and in the second $1,000,000. Of the $6,000,000 the new company will have over a million to spend for improvements and will have to earn $300,000 a year to pay the interest charges alone. This it expects to be able to do, says the New York *Sun*, through the use of electricity as a motive power.

A Reading dispatch says: "The Neversink Electric Mountain Railway, which promises to rival the famous Switchback at Mauch Chunk, and to surpass the Mount Penn Gravity road of Reading, now in successful operation, has been completed, and was formally opened to the public, according to announcement, July 4. The route covers a distance of nine miles, circles about the summits of the mountains surrounding Reading, and affords a constant panorama of scenery that is unexcelled for beauty anywhere in Pennsylvania. The enterprise is somewhat of an experiment in its electrical features, but its success is already assured, and its projectors have spared no outlay to render all the appointments of the road complete. The cars will be run by electricity from Ninth and Penn streets, Reading, to the White House, where they will be propelled by locomotive engines to the summit on the north side of the mountain. From this point the cars will run down the mountain by the force of gravity to Klapperthal. On the return trip the cars will be drawn up to the summit on the south side; whence they will be run again to the White House by gravity, and thence by electricity to the starting point, Ninth and Penn streets. The gauge of the road is the same as that of the Philadelphia & Reading Railroad, which is interested in the success of the Neversink road, and is now making extensive arrangements to handle excursions at the southern terminus from cities throughout the Eastern and Middle States. An electric light plant has been established which will furnish light along the route for night excursions. The electricity will be supplied at the Big Dam by two Edison dynamos of 80,000 watts each. The turn-outs along the road are 3,000 feet apart. The view of the adjacent country and the city at night is one of the finest to be seen anywhere."

THE TELEGRAPH.

It was announced last week that the Bermuda cable had been completed, but an official denial of the statement has since been sent out from Halifax. The cable is laid to the coast of Bermuda, but, as it must pass over some reefs, several days will be required to complete the work.

A fire started in the Western Union building in Cincinnati July 3, from the spontaneous combustion of a pile of greasy rags. The fire was discovered by one of the Associated Press operators, who was working on the fifth floor. The operators' room was quickly deserted. The blaze was soon extinguished and no damage of importance was caused.

A cablegram from London says: The agitation among the telegraph operators for higher wages is assuming serious proportions, and is causing great delay in the service. It is rumored to-day that the British government will apply to the American telegraph companies for a large force of operators in case the dissatisfied men go on strike. The employes are indignant over this proposed action and will request their American craftsmen not to help the government to grind them down to starvation wages. Several employes were discharged to-day for participating in the indignation meetings. A wholesale strike is expected on Monday.

Business Mention.

The Interior Conduit & Insulation company has just issued an interesting pamphlet containing flattering testimonials of the efficiency of the system. Among those who commend the system are Thomas A. Edison, Elihu Thomson, Foree Bain, Frank Kitten and others.

"Electric Power for Printing Offices, Machine Shops and Similar Work" is discussed in a neat little pamphlet just issued by the Thomson-Houston company. The advantages of this method of distribution of power are clearly pointed out and illustrations of plants operated by electric motors are presented.

The Western Power Construction company of Chicago will equip the new Thomson-Houston Hyde Park central station with a complete steam plant including two MacIntosh & Seymour engines of 200-horse power each. It is the intention to make this one of the finest plants in the West. The same concern has just secured a contract for installing a steam plant for the electric light station at Owatonna, Minn. MacIntosh & Seymour engines and Hazelton boilers will be used.

Messrs. Bleckert & Nelson of Chicago, have recently purchased the business of Noyes Bros and have very materially increased their facilities. They are now turning out a very high grade of work in the line of gas fixtures, electric light and combination fixtures. Their business is growing rapidly and the excellence of their work is making them new friends daily. They are preparing to issue a new catalogue, which when ready will be one of the most complete of its kind and will be glad to send it to any address on application.

The Western Power Construction company, Chicago, has settled in its new offices in the Rookery and has every facility for conducting its rapidly growing business. The entrance to the offices is from Adams street and as the location is in the heart of the business district within easy access of all the electrical companies, visitors to the city can always find time to call. This company makes a specialty of electric light, railway and power plants and employs a large force of first-class engineers. Waldo P. Adams, general manager of the company, is a gentleman of experience in construction work and is well known in electrical circles.

A. L. Ide & Son, Springfield, Ill., report the following sales and shipments of their Ide and Ideal engines: Wm. Barr, St. Louis, 50-horse power; the Prescott company, Atlanta, Ga., 35-horse power; Marinette Iron Works company, West Duluth, Minn., 35 horse power; City of Newton, Ia., 100-horse power; Moffett, Hodgkins & Clarke, La Grange, Ill., 65-horse power; Minonk Electric Light & Power company, Minonk, Ill., 35-horse power; Union Rapid Transit company, Salt Lake City, Utah, 250-horse power; Minnesota Institute for Defectives, Fairbault, Minn., 65-horse power; Browning, King & Co., Minneapolis, Minn., 35-horse power; Mansfield Machine Works, Mansfield, O., 100 horse power; Chicago City Railway company (2d order), Chicago, 80-horse power; Peter Schmidt, Milwaukee, Wis., 80-horse power; Springfield Electric Light & Power company, Springfield, Ill., two 125-horse powers; Nordyke & Marmon Co., Indianapolis, Ind., one 65-horse power; English, Morse & Co., Kansas City, Mo., two 40 and one 50-horse power; Northern Pacific Railway company, Cinnabar, Mon., one 50 horse power; Camden Electric Light & Power company, Camden, Ark., one 80-horse power; J. A. Fay & Co., Chicago, Ill., one 35-horse power; Creston Gas & Electric Light company, Creston, Ia., one 100-horse power; Ft Wayne Electric company, Ft. Wayne, Ind., one 65-horse power; Riverton Land company, Sheffield, Ala., one 35-horse power; Texas Ice & Cold Storage company, Galveston, Tex., one 10-horse power; Pittsburg Gas Light company, Pittsburgh, Kan., one 125-horse power; Findlay Electric Light & Power company, Findlay, O., one 100-horse power; Colorado Electric Supply & Motor company, Denver, Col., one 15-horse power; Shreveport Street Railway & Land company, Shreveport, La., one 150-horse power; Thomson-Houston Electric company, Clinton, Ia., one 150-horse power.

Electrical Patents.

Issued July 1, 1890.

431,035. Electric Cut-Out. Leo Daft, Plainfield, N. J.

431,038. Ceiling Block Connector for Incandescent Lamps. Louis W. Dillon, North Attleborough, Mass.

431,062. Fuse Block. James L. Kimball and Herbert C. Wirt, Boston, Mass.

431,073. Electric Battery. Myron W. Parrish, Detroit, Mich.

"Claim 1. An electrode for a voltaic battery which consists of an irregular piece or mass of graphite in its crude state as it comes from the mine."

431,088. Individual Call Devices for Telephones. Chas. H. Vincent, Lynn, Mass.

The invention consists in the combination of the electro-magnet, the armature, hammer, and bell, the arm to which the armature is connected, the electrode or contact which co-operates with the said arm, and the weighted lever connected to said arm.

431,092. System of Electric Locomotion. Frank Wheeler, Meriden, Conn.

A principal feature of the invention consists in two bifurcated frames having a yielding connection between them, the upper ends of the bifurcations having inwardly-projecting axles and contact rollers on such axles.

431,093. System of Electric Locomotion. Frank Wheeler, Meriden, Conn.

431,094. Switches for Electric Railway Systems. Frank Wheeler, Meriden, Conn.

431,095. System of Electrical Locomotion. Frank Wheeler, Meriden, Conn.

431,104. Protective Covering for Electric Cables. John H. Cheever, New York, N. Y.

"Claim 2: An electric cable, having a continuous seamless covering composed of rubber, plumbago, asbestos and sulphur."

431,118. Electric Switch. Osborn P. Loomis, Somerville, Mass.

431,134. Dynamo Electric Machine. Charles F. Winkler, Troy, N. Y.

431,141. Electrical Call Box. George F. Gale, Winthrop, Mass.

431,170. Electro-Magnetic Drill System. Harry N. Marvin, Syracuse, N. Y.

431,181. Electric Bell. Patrick B. Delany, South Orange, N. J.

431,185. Multiple Fusible Cut Out. Lorenzo B. Favor, Bridgeport, Conn.

431,186. Multiple Thermal Cut-Out. Lorenzo B. Favor, Bridgeport, Conn.

431,213. Electric Motor for Railway Cars. Wm. M. McDougall, East Orange, N. J.

431,216. Regulation of Dynamo-Electric Machines. Wm. Stanley, Jr., Great Barrington, Mass.

The method consists in generating currents in a set of armature coils and maintaining a field of force thereby, causing a portion of the lines of force constituting such field to pass outside of such coils and controlling the number of the lines of force passing outside of such coils by means of current developed in a second set of armature coils lying within such field."

431,217. Self-Regulating Dynamo Electric Generator. William Stanley, Jr., Great Barrington, Mass

Claim eleven follows:

"The hereinbefore described method of controlling the electromotive force of an electric generator, which consists in establishing lines of force for the armature, modifying the number of lines of force in which the armature revolves by alternating currents generated synchronously with the reversals in the position of the armature, and causing such alternating currents to develop lines of force constant in direction with reference to the first-named lines of force."

431,218. Self-Exciting Alternating Current Electric Generator. Wm. Stanley, Jr., Great Barrington, Mass.

431,235. Dynamo Electric Machine. Oliver B. Shallenberger, Rochester, Pa.

431,248. Electric Meter. Jules Cauderay, Paris, France.

431,256. Suspended Electric Railway and Car. Frederick E. Drown, Pawtucket, R. I.

431,271. High and Low Water Alarm for Steam Boilers. James MacFarlane, Malden, Mass.

431,320. Electric Lamp Fixtures. Sigmund Bergmann, New York, N. Y.

431,341. Secondary Battery. Theodore M. Foote, Allston.

431,408. Electric Railway Signal Apparatus. William Snee, Pittsburg, Pa.

431,412. Electric Connector. Hermann Studte, Dom Kruk, near Inowraclaw, Prussia, Germany.

"Claim: In combination with a spring-mounted contact-cap, a spring-mounted ring surrounding the said cap, and a corresponding cap and ring adapted to cover the first cap and ring."

431,414. Electric Railway Conductor. Elihu Thomson, Lynn, Mass.

"Claim 9. A contact device for a conduit electric railway having a protecting casing, provided with a depending portion before and behind"

431,439. Electric Soldering Iron. Charles L. Coffin, Detroit, Mich.

431,447. Secondary Battery. Theron S. E. Dixon, Chicago, Ill.

"Claim 3: In a battery cell, the combination of two electrodes provided, respectively, with peroxide of lead and spongy lead, with a third electrode of zinc."

431,460. System of Electrical Distribution. Ludwig Gutmann, Fort Wayne, Ind.

"Claim 1: In a system of alternating current distribution, the combination of an electric converter, a cord, a primary coil, and a secondary coil for the converter, translating devices in circuit with the secondary coil of the converter, an additional coil mounted on the converter's core independent of the converter's coils and means, such as a switch, for including said additional coil in circuit with one of the converter's coils."

431,482. System of Distribution for Electric Railways. Elias E. Ries, Baltimore, Md.

431,492. Reciprocating Electric Engine. Chas J. Van Depoele, Lynn, Mass.

431,493. Reciprocating Electric Engine. Chas. J. Van Depoele, Lynn, Mass

431,414 Reciprocating Electric Engine System. Chas. J. Van Depoele, Lynn, Mass.

431,495 Reciprocating Electric Engine. Chas. J. Van Depoele, Lynn, Mass.

431,496. Reciprocating Electric Engine System. Chas. J Van Depoele, Lynn, Mass.

431,516. Automatic Cut-Out. Alvin Z. Haines, Pittsburg, and James H. Curry, Wilkinsburg, Pa.

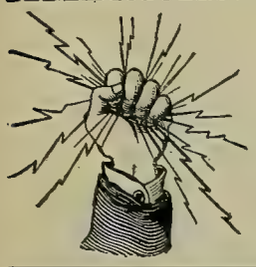
431,519. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

431,531. Telephone Signal Apparatus. John A. Seely, Brooklyn, N. Y.

"Claim 2. A metallic telephone circuit containing at the terminal stations thereof and at an intermediate station thereon clearing-out signal devices wound neutrally with respect to the said metallic circuit, in combination with a telephone and ground branch and switching apparatus at each of said stations, and a generator or source of current at each of the terminal stations adapted to be included in the ground branch thereof, whereby current from the ground branch at either terminal station operates the clearing-out signal devices at the other stations, while the voice-currents sent over the metallic circuit when the telephones are in use act neutrally upon the clearing-out signal devices."

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

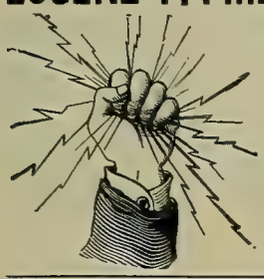
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

NOTICE TO CONTRACTORS.

Electric Light Plant and Gas Works.

The council of the city of Clinton, in Henry county, Missouri, will receive sealed proposals until July 15, 1890, for lighting the streets of the city, upon one or all of the following plans, viz.:

1st. FOUR ELECTRIC ARC LIGHTS, of 2,000-candle power each, and eighty Electric Incandescent Lights of 32 candle power each

2d. EIGHT ELECTRIC INCANDESCENT LIGHTS of 100-candle power each, and eighty Electric Incandescent Lights of 32-candle power each.

3d. SEVENTEEN ELECTIC ARC LIGHTS of 2,000-candle power each.

4th. TWELVE GAS LIGHTS of 100 candle power each, and eighty Gas Lights of 32-candle power each.

Said lights to be distributed and located according to plans and specifications on file in the City Clerk's office.

Such proposals will be made upon each of said systems separately, and separately for an all-night or moonlight and a midnight light, and for a term of five years, with an option to the city to renew the same for another term of five years.

The council reserves the right to accept any one, or reject all of said proposals. Address

A. HAYNIE, City Clerk, Clinton, Mo.

Dated CLINTON, Mo., June 23, 1890.

SITUATION WANTED

By an Electrical Engineer, long experience in both practical and theoretical electric work; has also had a thorough course in a prominent foreign Electrical College, and is well acquainted with the electrical profession in the United States and England; will take a position in any part of the world.

Address **E E.**

2518 Tenth Ave. So., Minneapolis, Minn.

THE TURNER BRASS WORKS
MAKE ANYTHING IN BRASS.
4 LASALLE AVE CHICAGO.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

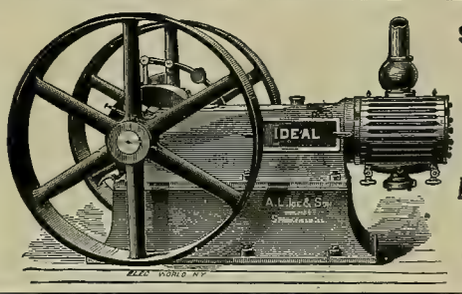
Fletcher & Fletcher Electric Co., Cleveland, O.

WANTED.

2 DRUM ARMATURE WINDERS.
2 INCANDESCENT WIRE MEN
2 MACHINISTS.

Address **Royal Electric Co.,** PEORIA, ILL.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers

SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

OKONITE
TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

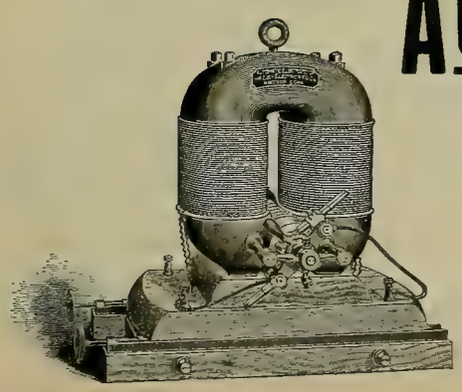
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

NOW IS THE TIME TO BUY

AYRTON & PERRY'S

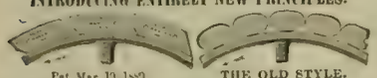
Celebrated Spring Ammeters & Voltmeters.

No permanent magnets. Scale divisions equal throughout. Portable. Direct Reading.

We have received large consignments from the makers, and are prepared to fill orders for all ranges AT ONCE.

QUEEN & CO, PHILADELPHIA.

INTRODUCING ENTIRELY NEW PRINCIPLES.



Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

FRANCIS W. PARKER,

Patent Lawyer and Solicitor.

SPECIALTY, ELECTRICITY.

1001-3-5-7 OPERA HOUSE BLOCK,

CHICAGO, ILL.

WILLIAM S. BATES.

PATENT LAWYER,

204 Dearborn Street, CHICAGO.

17 YEARS EXPERIENCE IN THE PATENT OFFICE AND THE COURTS.

FRANK T. BROWN, Late

PRINCIPAL EXAMINER ELECTRICITY,

U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

ELECTRICAL WOOD.

Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

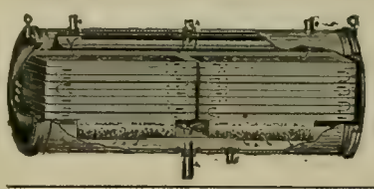
Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

The Rae "Horn" Ammeter

A New Measuring Instrument.

Send for Circular and Price List.

LOCKWOOD INSTRUMENT CO.,

91 Griswold St., - DETROIT, MICH.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,

We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

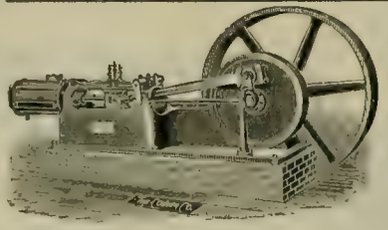
Send for New Descriptive Circulars.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.



RICE AUTOMATIC ENGINES.

Simple, Compound, Compound-Condensing.

BOILERS,

HANCOCK INSPIRATORS, FEED WATER HEATERS, Etc.

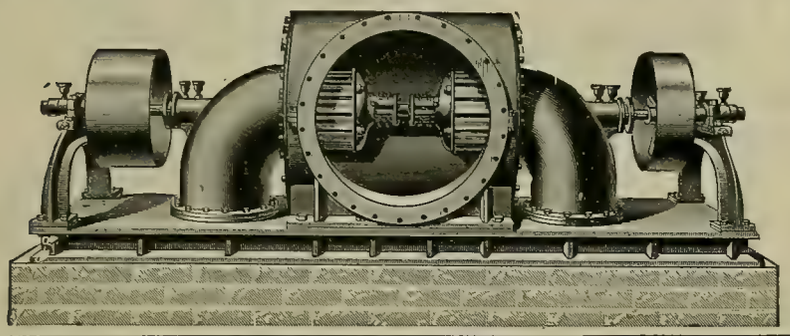
We make a Specialty of Erecting Complete **Steam Plants.**

SMITH-VAILE STEAM PUMPS for every purpose.

FAIRBANKS, MORSE & CO.,

ST. LOUIS. **CHICAGO.** KANSAS CITY.
DENVER. OMAHA. ST. PAUL.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO.

1221-1223 Union Ave.

KANSAS CITY, MO.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

BALL AUTOMATIC CUT OFF ENGINE

MADE ONLY BY THE BALL ENGINE CO ERIE PA.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

THE CENTRAL THOMSON-HOUSTON CO.,

A. STUART, President.

215 West Fourth Street, CINCINNATI, OHIO.

ELECTRICAL ENGINEERS AND CONTRACTORS,

BUILDERS OF ARC, DIRECT AND ALTERNATING INCANDESCENT LIGHTING, CENTRAL STATIONS AND ELECTRIC POWER PLANTS.

ELECTRICAL SUPPLIES OF ALL KINDS. { SIMPLEX WIRE AND GRIMSHAW RUBBER COVERED WIRE ALWAYS ON HAND. } Bottom Prices. Quick Shipments.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

THE SPERRY ELECTRIC CO.,

D. P. PERRY, Vice-President and General Manager,

—MANUFACTURERS OF THE—

SPERRY IMPROVED SYSTEM

—OF—

ARC LIGHTING,

HIGH OR LOW TENSION.

WE GUARANTEE:

1. The new Sperry apparatus free from repairs for twelve months.
2. That the new Sperry improved Dynamos can be coupled in series with perfect safety.
3. That any number of lamps from one to capacity of dynamo can be cut in or out of circuit, singly or in groups, with perfect safety, and without sparking at the brushes.
4. To absorb power in exact proportion to number of lights burning.

WE BELIEVE:

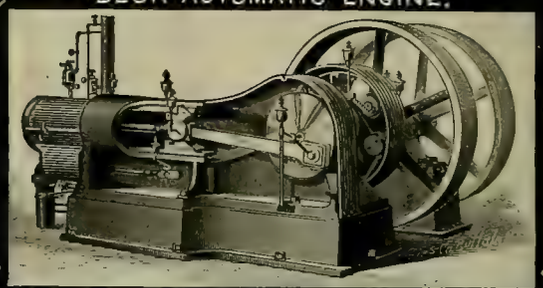
1. The new Automatic Sperry Dynamos and Lamps surpass in efficiency those of any other make.
2. That there is greater economy in operating the new Sperry System than any other.
3. That our automatic regulation has no equal; no rheostat, no wall boxes, no solenoid or dash-pot.
4. That if you will visit our factory we can show you the best arc lighting apparatus in existence.

We invite correspondence with electrical engineers, intending buyers, and interested people everywhere.

THE SPERRY ELECTRIC CO., 195 to 207 South Canal Street, CHICAGO ILL.

MATERIAL AND WORKMANSHIP OF THE BEST.

BECK AUTOMATIC ENGINE.



ECONOMY UNEXCELLED

REGULATIONS PERFECT

HOT BEARINGS UNKNOWN

PRICES MODERATE

TAYLOR Mf'G Co. CHAMBERSBURG, PA.

COMPLETE STEAM PLANTS A SPECIALTY.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE, out August 1st.

The Detroit Electrical Works

ELECTRIC RAILWAY SYSTEM.

RAE PATENTS.

CHEAPEST.

SIMPLEST. BEST.

The Detroit Electrical Works, Detroit, Mich.

THE EVANS FRICTION CONE CO.

Have had their System of Transmission of Power in use for four years, driving all classes of machinery.

THE FIRST APPLICATION OF THE SYSTEM TO THE RUNNING OF

DYNAMOS

WAS MADE JUST ONE YEAR AGO.

There are now 50 Dynamos and Railroad Generators running by the system, varying from 10 to 80 H. P. in twenty-three different stations, all giving perfect satisfaction, and there are in process of erection plants for the use of the system, aggregating 1,200 H.P., and at the present rate of increase this amount will be over 5,000 H. P. by July 1.

Illustrations of Plants using the System, with testimonials, will be shown in this space from week to week.

Send for Catalogue and General Information to **EVANS FRICTION CONE CO., 85 Water St., BOSTON, MASS.**

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS M. WILKINS. E. WARD W LEINS

—TRADING AS—

PARTRICK & CARTER,

Manufacturers of and Dealers in Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

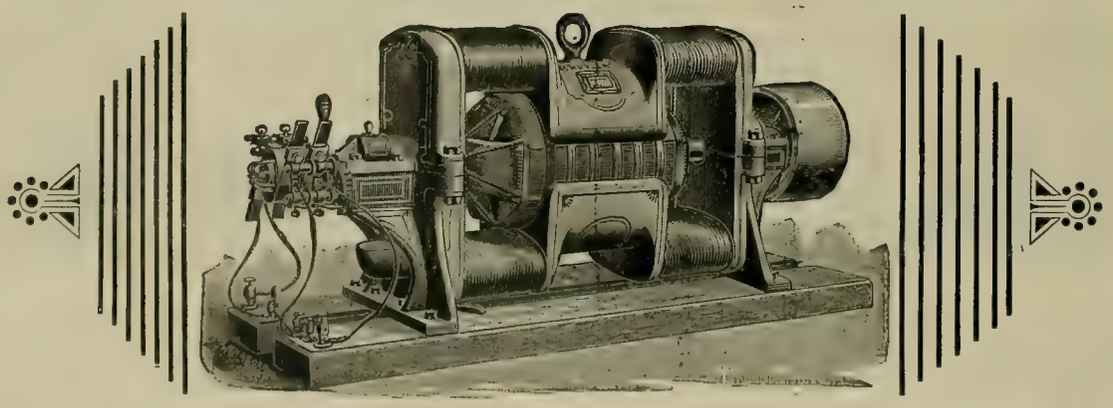
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S
Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

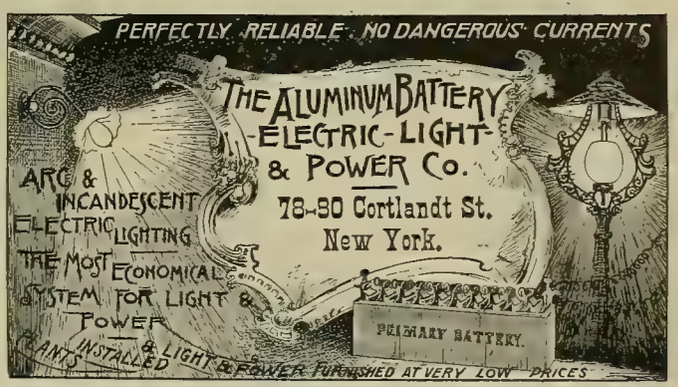
Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

OKONITE
TRADE MARK.
WIRES, CABLES, TAPE and CORD
FOR
PROMPT SHIPMENT.

HOGGSON'S
IMPROVED
Door Spring.
Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

WHEN YOU BUY A MOTOR

From ANY Manufacturer or Dealer,
State that you WANT IT SUPPLIED WITH the
Whittingham Automatic Switch.
Send for Catalogue.
Automatic Switch Co.,
No. 8 Keyser Building,
BALTIMORE, MD.



GONDA

The Standard Open Circuit Batteries of the World.

AXO

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

TRADE
GONDA
MARK.

THE ONLY
Genuine Leclanche Batteries
Made or Sold in America.

LECLANCHÉ BATTERY CO., 149 West 18th St., NEW YORK.

WESTERN ELECTRIC CO.,

We are the Exclusive Western Agents for the sale of
Washburn & Moen's
Galvanized Iron Wire,
Galvanized Steel Wire, and
Hard Drawn Copper Wire.
Prices on Application.

CHICAGO. NEW YORK.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
—FOR—
ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.

BERGMANN & CO.,

ELECTRIC LIGHT, COMBINATION AND GAS FIXTURES,

ADAPTED TO ANY SYSTEM OF INCANDESCENT LIGHTING.

ALL APPLIANCES FOR THE EDISON ELECTRIC LIGHT.

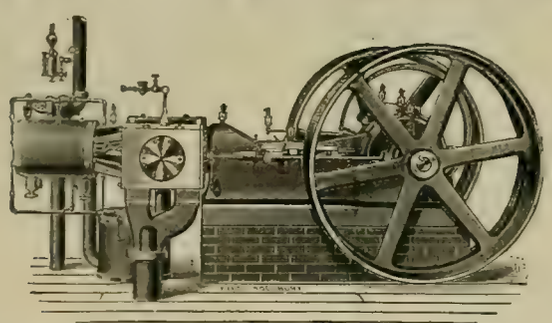
Illustrated Catalogues, Designs and Estimates Furnished on Application. Correspondence Solicited.

Office and Works, 292-298 Avenue B, } **NEW YORK** { Show Rooms, 65 Fifth Avenue.

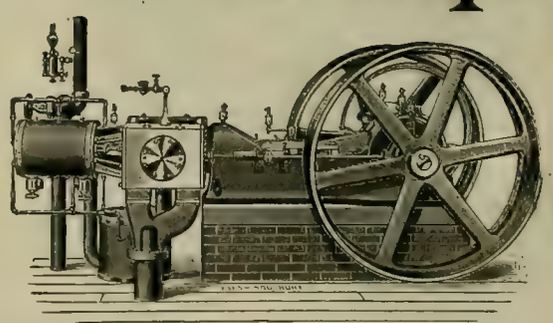
T. W. WILMARTH & CO., 227 State Street, CHICAGO, ILL.

AGENTS FOR OUR FIXTURES IN THE NORTHWEST.

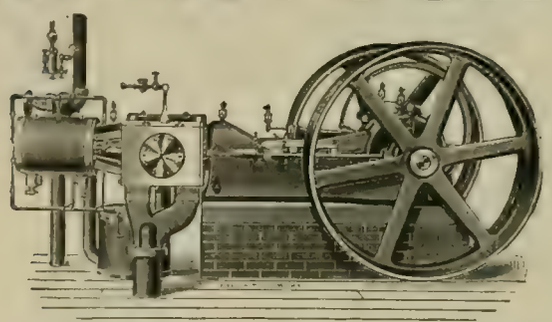
None so Good, None to Equal.



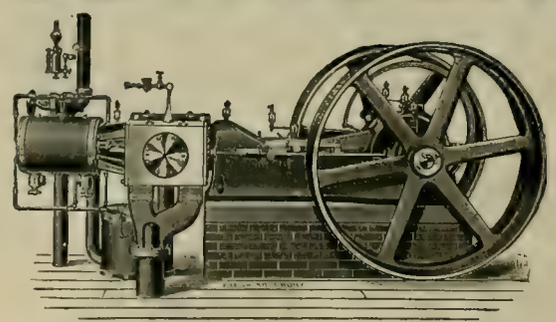
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

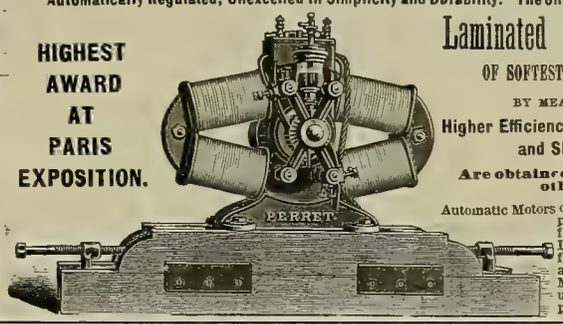
THE ELEKTRON MFG. CO.,
79 and 81 Washington St., Brooklyn, N. Y.,

MANUFACTURERS OF THE

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-pr. of Motors and Dynamos for use in Mines and damp places.

ST. LOUIS ELECTRICAL SUPPLY CO.,

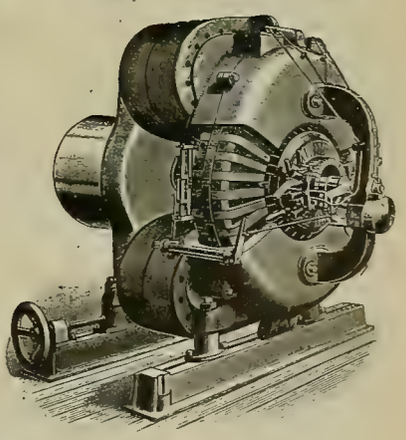
High Grade Wires, Weatherproof Wires, Pins, Brackets, Cross Arms, C. & W. Mica Railway Insulators, Cut Mica, Sheet Mica, Fuse Wire, Soldering Salts, Tapes, Tubing, Glass and Porcelain Insulators, Sleet Proof Pulleys and Arc Light Windlasses, Incandescent Lamps, Porcelain Cut-outs and Switches, Everything Electrical Required for Electric Light, Power and Railway Companies. Agents for Novelty Electric Supply Co.'s Specialties, and Gould & Watson Co. Write for Quotations.

Favor Us with Your Orders. **403 North 8th Street, ST. LOUIS, MO.**

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

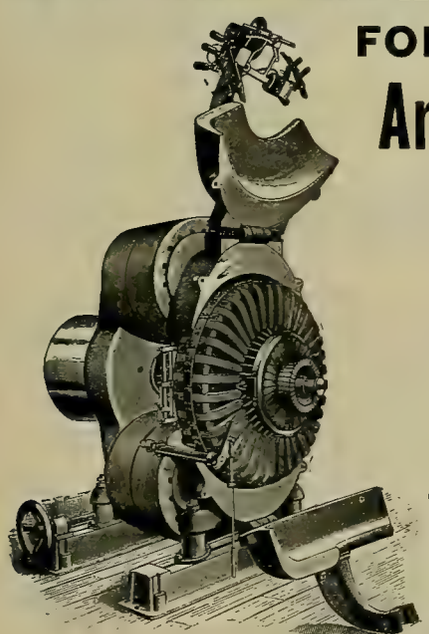
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features:

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

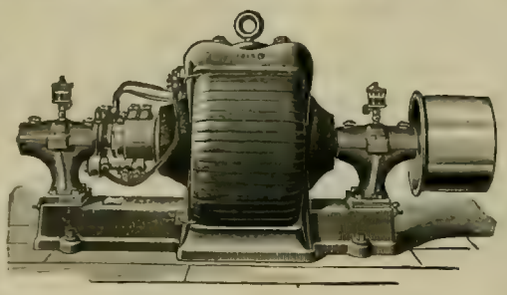
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 8,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

C., M. & ST. P. R. R.
The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

THE MONON ROUTE

Affords choice of Four (4) Fast Trains each way, commencing June 1, 1890.

EVERY DAY AND SUNDAY, TOO

In Pullman's Patent Perfected Safety Vestibuled Buffet Sleepers and Chair Cars between

CHICAGO and the OHIO RIVER.

These are all solid Pullman trains of latest design and improvements, consisting of Elegant Day Coaches, Chair Cars, Composite Cars, Dining Cars and the very finest of Buffet Sleeping Cars, equipped with Pullman's Perfected Safety Vestibules.

Trains from Cincinnati and the Southeast, and from Louisville and the South, arrive at Chicago in ample time to connect with the morning and evening fast trains for Milwaukee, Minneapolis, St. Paul, Omaha and all points in the Northwest.

Morning and evening connections made both at Louisville and Cincinnati with the Fast Express Trains of connecting lines for Memphis, Knoxville, New Orleans, Jacksonville and all points South.

At Indianapolis connections are made with all diverging lines.

Special Features: Steam Heat, Electric Light, Perfected Safety Vestibules.

For rates, through and local schedules, address any Ticket Agent of the Monon Route.

Wm. F. Black, General Manager.
W. H. McDoel, Traffic Manager.
James Barker, General Passenger Agent.

POND ENGINEERING CO.

707 and 709 Market St., St. Louis.
427 "The Rookery" Chicago.
31 Waterworks Building, Kansas City.
319 Ramge Building, Omaha.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

Erected Ready for Service.

SPECIALTIES:—The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, etc.

SEND FOR LATEST CATALOGUES.

ELEMENTS OF ELECTRIC LIGHTING.

BY PHILIP ATKINSON, Ph. D.

260 Pages, Cloth Binding, Illustrated, Price $1.50.

This book is an elaboration and revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. It treats of: Principles of the Dynamo; Alternate Current Dynamos; Direct Current Dynamos; Electric Terms and Units; Electric Measurements The Arc Lamp; The Incandescent Lamp; The Storage Battery; Electric Distribution.

Sent, postage prepaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, Chicago

Binders FOR THE Western Electrician $1.00.

GEORGE P. BARTON,

LAW OFFICE,

225 DEARBORN STREET,

CHICAGO, ILL.

Patent and Trademark Cases.

C., B. & Q. R. R.
—IS THE—
Best Appointed Line
—FOR REACHING THE—
West, Northwest and Southwest.

C. H. & D. R. R.

BEST ROUTE

From CINCINNATI to the North and North West.

DICTIONARY
—OF—
ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

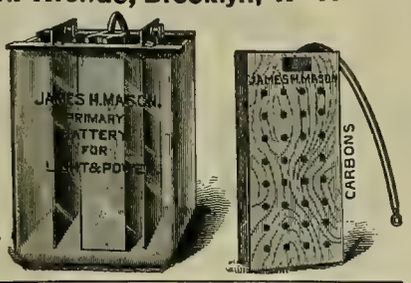
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN.
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

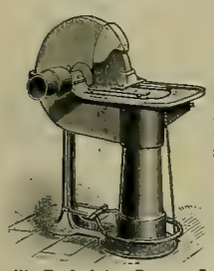
COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



THE BARNES WATER EMERY Tool Grinder.



It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.
Sold subject to approval. Send for full description and price.
W. F. & John Barnes Co., Rockford, Ill.,
Address No. 761 Ruby Street.

Barnes' Patent
UPRIGHT DRILLS.
20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.
Barnes' Patent
ENGINE LATHE,
15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.
They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to W. F. & JOHN BARNES CO., Rockford, Ill., Address No. 761 Ruby st.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.
ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.
AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.
Factory: JERSEY CITY, N. J.

SPRAGUE
ELECTRIC RAILWAY SYSTEM.

More than one hundred different street railways in operation or in course of construction.

MORE THAN 175
SEPARATE ORDERS
From Street Railways for Electrical Equipments.

The Sprague Electric Railway System has been proved to be the most

DURABLE,
RELIABLE,
ECONOMICAL,
CONVENIENT.

Sprague
ELECTRIC RAILWAY & MOTOR COMPANY,
16 and 18 Broad St., NEW YORK.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1870.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires, Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

THE

THOMSON-HOUSTON

ELECTRIC RAILWAY SYSTEM

BY THE VERDICT OF OVER FIFTY RAILWAY COMPANIES HAS BEEN DECLARED

A PRACTICAL AND COMMERCIAL SUCCESS.

Schedule Time Regularly Maintained,
No Destruction of Apparatus,
Slight Cost for Repairs,

—ARE THE DISTINCTIVE FEATURES OF THE—

Thomson-Houston Railway System.

FIFTY ROADS IN OPERATION.
THIRTY ROADS UNDER CONSTRUCTION.
TWENTY CONTRACTS JUST CLOSED,

—MAKING A GRAND TOTAL OF—

ONE HUNDRED ELECTRIC RAILWAY COMPANIES

USING THE THOMSON-HOUSTON SYSTEM.

Illustrated and Descriptive Pamphlets Furnished to Prospective Purchasers.

THOMSON-HOUSTON ELECTRIC CO.,

MAIN OFFICE: 620 ATLANTIC AVE., BOSTON, MASS.

BRANCHES:

148 Michigan Ave, Chicago, Ill. Wall and Lloyd Sts., Atlanta, Ga. 403 and 406 Sibley St., St. Paul, Minn.

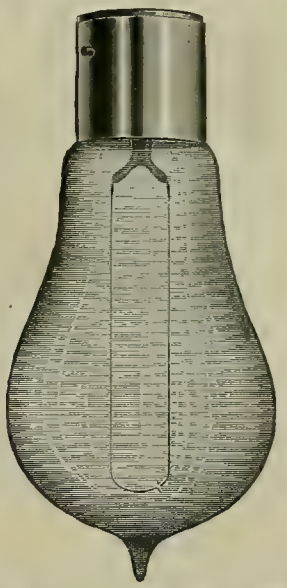
THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,
ALL CANDLE POWERS,
ANY VOLTAGE,
ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT Co., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER Co, Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

GRIMSHAW WHITE CORE
WIRES AND CABLES.

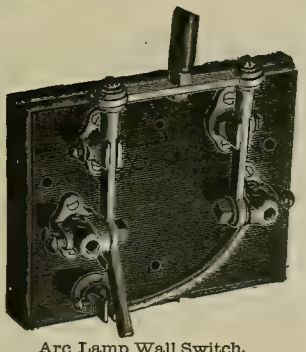
—FOR—

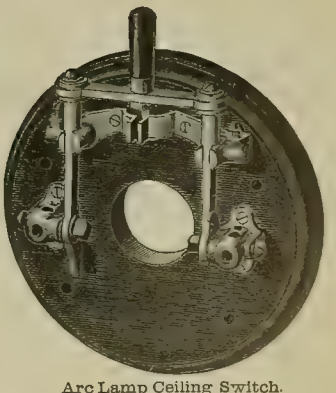
TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

Switch-Board Cables,
Grimshaw White Tape,
Grimshaw Black Tape,
GRIMSHAW SPLICING COMPOUND.

McLennan Switch.

Paiste Switch.


Arc Lamp Wall Switch.


Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.,* CHICAGO, ILL.

THE Electrical Supply Co.,

171 RANDOLPH ST.,

C-H-I-C-A-G-O.

MANUFACTURERS OF

BARE AND INSULATED

WIRES AND CABLES

AND

GENERAL ELECTRICAL GOODS.

Catalogues or Quotations upon Application.

NO CHARGE MADE CUSTOMERS FOR EXPERT ADVICE.

A large and well assorted stock of Shield Brand and Habirshaw Wires constantly on hand.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

Manufacturers of the

SLATTERY INDUCTION SYSTEM

—OF—

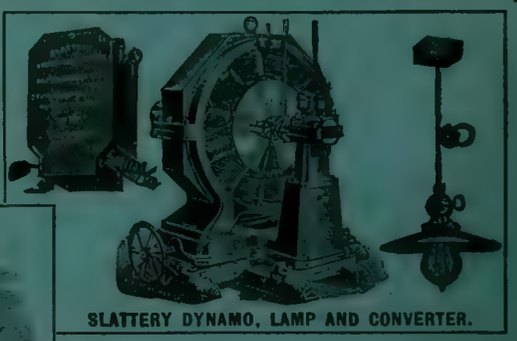
Incandescent Lighting,

—AND THE—

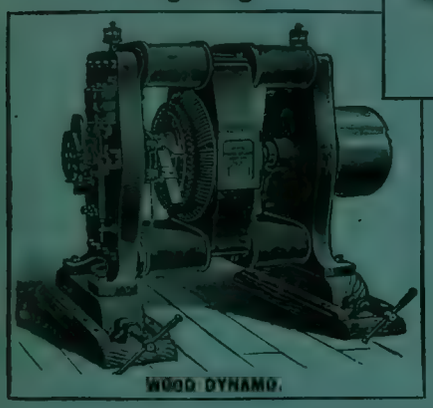
WOOD SYSTEM

—OF—

Arc Lighting.



SLATTERY DYNAMO, LAMP AND CONVERTER.



WOOD DYNAMO.

The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12–16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.

CORRESPONDENCE SOLICITED.

MAIN OFFICE AND WORKS, FORT WAYNE, IND.

NEW YORK OFFICE, 115 Broadway, Boreel Bldg.

SAN FRANCISCO OFFICE, 217 Sansome Street.

CHICAGO OFFICE, 185 Dearborn Street, First Floor, W. J. BUCKLEY, Manager.

PHILADELPHIA OFFICE, 907 Filbert Street, C. A. WILBUR, Manager.

PITTSBURGH, PA., 533 Wood Street.

CITY OF MEXICO OFFICE, F. ADAMS, Successor.

The Consolidated Electric Storage Co.,

MANUFACTURERS OF

THE JULIEN

ELECTRIC STORAGE BATTERY.

Exclusive licensees for the whole of the United States Of the Storage Battery Patents of Charles F. Brush [lately owned by the Brush Electric Company], and sustained by the Circuit Court of the United States.

Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

BATTERIES FOR LIGHT AND POWER,

Sold at Prices so Low as to Defy Competition.

For Agencies and Licenses apply at the Company's Office at

120 Broadway, NEW YORK CITY.

All other inquiries, more especially those in relation to Purchase of Batteries, should be addressed to the Philadelphia Office of the Company.

926 Drexel Building, PHILADELPHIA, PA.

Western Electrician.

$8 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, JULY 19, 1890. No. 3.

ALUMINUM BRASS AND BRONZE COMPANY,

MANUFACTURERS OF

COWLES' ALUMINUM AND SILICON COPPER ALLOYS,

IN INGOTS, SHEETS, RODS, WIRE AND CASTINGS.

Sheet Copper, Sheet Brass, PURE ALUMINUM.

STEWART BUILDING, 53 Chambers St., New York. ROLLING MILLS, Bridgeport, Conn.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { BAKER, BALCH & CO., Seattle, Wash. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufactures can be found at our Agencies.

THE ACME OF FINE CONSTRUCTION.

OUR WIRES

OUR CABLES

STANDARD UNDERGROUND CABLE CO.,

Westinghouse Building, PITTSBURGH, PA.

G. L. WILEY, Manager, New York. F. E. DEGENHARDT, Manager, Chicago.

MAGNOLIA METAL.

—INDORSED BY THE—

United States and German Governments.

BEST ANTI-FRICTION METAL

For Dynamo, High-Speed Engine, Steamship, Car, and all Machinery Bearings.

MAGNOLIA ANTI-FRICTION METAL CO.,

Owners and Sole Manufacturers,

London Office: 75 Queen Victoria St.
Chicago Office: 41 Traders' Building.

74 CORTLANDT ST., NEW YORK.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

DAY'S KERITE INSULATION.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling. Aerial Use, All Sizes Submarine Use *Lead Encased Wires.* Subterranean Use, Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., NEW YORK.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff St., New York. 133 and 135 Wabash Ave., Chicago, Ill. FACTORIES: ANSONIA, CONN.

THE EDISON MACHINE WORKS,

MANUFACTURERS OF

Weatherproof Wire. Insulated Iron Wire. Magnet Wire. Rubber Covered House Wire.
Annunciator Wire. German Silver Wire. Office Wire. Flexible Brush Holder Cable.
Gas Fixture Wire. Arc Lamp Cords. Tinsel Cords. Flexible Cords.
Telephone, Telegraph and Electric Light Cables.
PARAGON TAPE.

JAMES F. KELLY, General Sales Agent, - 19 Dey Street, NEW YORK.

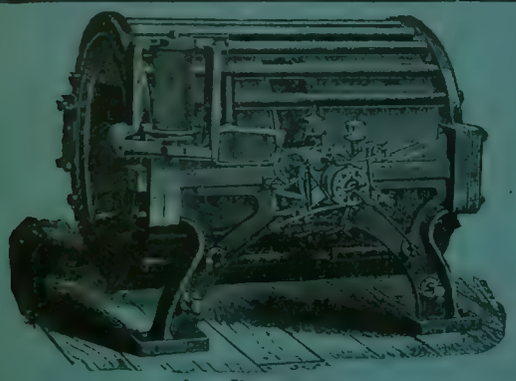
WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave., CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
234 Montgomery St., SAN FRANCISCO, CAL.

Electric Railway Equipment. Electric Motors.

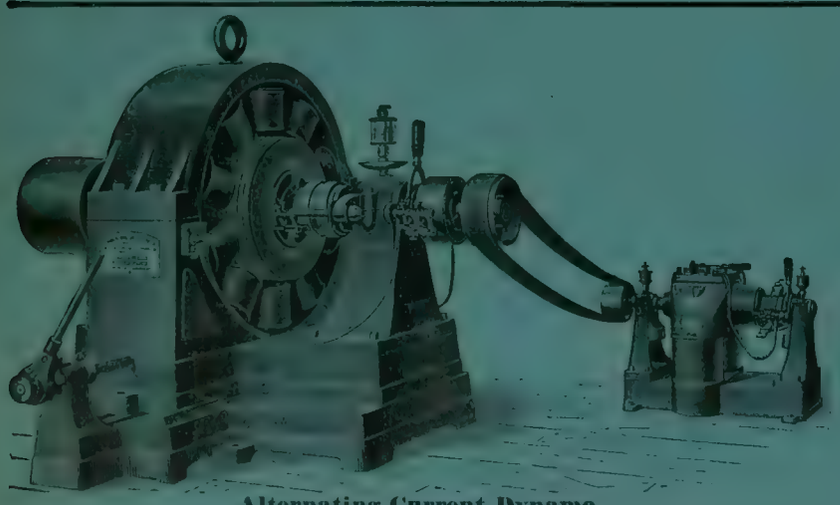


Arc Dynamo.

No better proof of the superiority of our arc apparatus can be offered than the fact that of the 21,000 arc lamps operated by Gas Companies in this country, over 11,000, or 52 per cent, are Thomson-Houston. The dynamo is entirely automatic in its regulation, perfect in mechanical construction, and economical in operation. The lamps burn steadily and uniformly, and hold their adjustment better than any other lamps on the market.

Direct Current Incandescent Dynamo.

Our direct current incandescent dynamo is rapidly gaining favor with practical electric lighting men, as its many features of excellence are recognized. Like the arc dynamo its regulation is automatic, permitting any number of lamps to be thrown on or off without in the least affecting the others in service. Our incandescent lamps have an unequaled record for long life.



Alternating Current Dynamo.

The problem of long distance incandescent lighting is practically solved by the alternating current dynamo, and to meet the demand for a machine of this character we have constructed what is unquestionably the most perfect alternater offered the public today, embracing as it does, all the features that combine to make a perfect dynamo—automatic regulation, perfect mechanical construction, highest efficiency, and economy of operation.

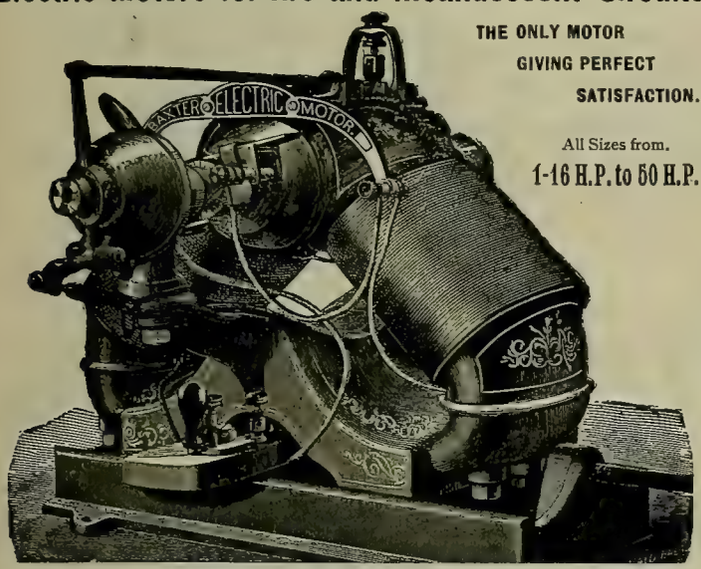
Motor.

The employment of electric motors for driving small machinery is becoming so common, and its advantages so well known, that it is unnecessary to elaborate in this direction. In the construction of our motors we feel that we have reached a point where their superiority cannot but be admitted.

LIGHTNING ARRESTER.—All of our installations are protected from destruction and injury by our lightning arrester, which we will fully guarantee to operate successfully in every instance. The Company guarantees to repair or replace apparatus injured by lightning where these arresters fail to operate.

To Arc and Incandescent
POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,
MANUFACTURERS OF
Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

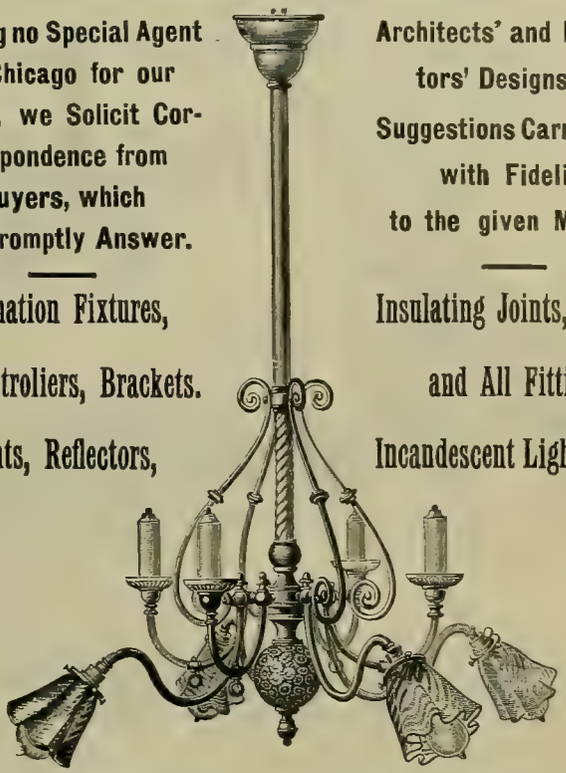
Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

THE MITCHELL VANCE CO.,
(Successors to MITCHELL, VANCE & CO.)
DESIGNERS AND MAKERS OF
ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.



Combination Fixtures,
Electroliers, Brackets.
Pendants, Reflectors,

Insulating Joints,
and All Fittings for
Incandescent Lighting.

MANUFACTORY,
24 and 25th St. and 10th Ave.,

SALESROOM,
836-38 Broadway and 13th St.,

NEW YORK CITY.

The Detroit Electrical Works
ELECTRIC RAILWAY SYSTEM.
—— RAE PATENTS. ——

CHEAPEST.
SIMPLEST. BEST.

The Detroit Electrical Works, Detroit, Mich.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

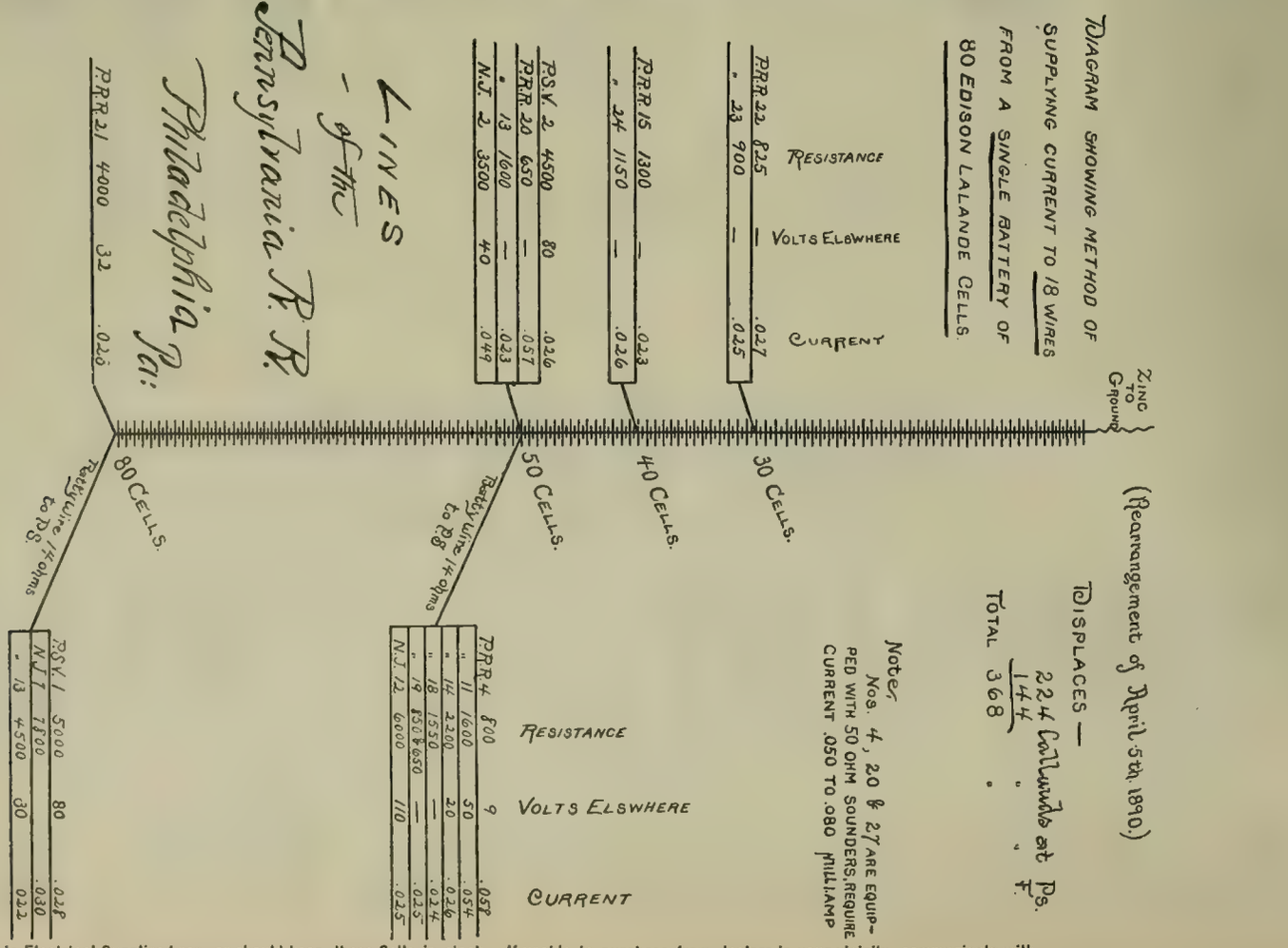
Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

THE EDISON-LALANDE BATTERY.



All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAS. F. KELLY, General Sales Agent, 19 Dey Street, NEW YORK.

GREAT WESTERN ELECTRIC SUPPLY COMPANY.

190 & 192 Fifth Avenue, CHICAGO, ILL.

THE DENVER CONSOLIDATED ELECTRIC COMPANY,

General Office: 1534 Lawrence Street.

DENVER, COLO., June 26, 1890.

MR. GEORGE CUTTER,

Manager.

GREAT WESTERN ELECTRIC SUPPLY CO., 5th Ave., Chicago, Ill.

DEAR SIR:—Samples of *Simplex Wire* have arrived. Have had No. 6 in bucket of water with bucket connected to one side of Brush Dynamo and wire to other side, and nothing but insulation to prevent short-circuiting a potential of *2208 volts*, for *over 50 hours*, and it is as good as ever yet and apparently good for a long time. The *other wire* tested gave out under same test in *1 hour, 40 minutes*, and it is an expensive wire too.

(Signed.) **H. BOTTOMLEY.**

This talks better than the order for 1,000,000 feet which we refused, because the price offered was less than the cost of making a reliable insulation.

We will not Lower the Quality of Simplex Wire.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 10 AMPERES.

ADVANTAGES OF THE CROSBY DRY BATTERY

FOR OPEN CIRCUIT WORK.

THE CROSBY DRY BATTERY is the best Open Circuit Battery in the market. It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing more work than any other. In addition to this, it is the most reliable, most compact, most durable and simplest cell yet discovered. It is so constructed that it is not destroyed or seriously injured by short circuiting, and we are prepared to prove at any time that its power of recuperation is proportionately greater than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks, and all the uses to which Open Circuit Batteries may be put, it has no equal, whether it be compared with Liquid or other Dry Batteries. We guarantee depolarization, absence of offensive crystallization and perfect cleanliness.

The Crosby Battery is the only Dry Battery sold semi-charged. It does not work until wanted.

The preference as between Liquid and Dry Batteries should always be given to the latter, provided the amount of working power required and a constant current can be obtained. No form of Dry Battery has as yet been placed before the public, except the Crosby Dry Battery, which will do the work of Wet Batteries and give a constant supply of Electricity sufficient for reliable Open Circuit work at all times. The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with which their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance, and easily broken and injured. The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids, and, after once being properly connected, requires no attention whatever, while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.

The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for Open Circuit Work. If, however, through an accident, it becomes Short Circuited, it recoups itself. This cannot be said with equal truth of any other Dry Battery known.

The Crosby Dry Batteries are manufactured in different sizes and forms, to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in the Crosby Dry Batteries varies from one to ten amperes, according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

CYLINDRICAL.

SIZE IN INCHES.

	Height.		Diam.
No. 3	7¼	x	2½

RECTANGULAR.

SIZE IN INCHES.

	Height.		Width.		Length.
No. 2	5	x	1¼	x	4½
No. 3	9	x	1¼	x	8

TELEPHONE.

SIZE IN INCHES.

	Height.		Width.		Length.	Price.
Long Distance	7¼	x	2½	x	4¾	$2 00
Telephone	7¼	x	2	x	4¾	1.50

N. B.—OTHER SIZES AND SHAPES TO SUIT PURCHASERS.

[COPY.]

OFFICE OF FLEMMING'S ELECTRO MEDICAL INSTRUMENT MANUFACTORY,
No. 1009 ARCH STREET, PHILADELPHIA, March 8, 1890.

CROSBY ELECTRIC COMPANY, New York.

GENTLEMEN:—The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29, when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan. 30; 7:30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing. Very respectfully,

(Signed) OTTO FLEMMING.

THE CROSBY ELECTRIC CO.,

JudgeBuilding, Fifth Avenue and Sixteenth Street, NEW YORK.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

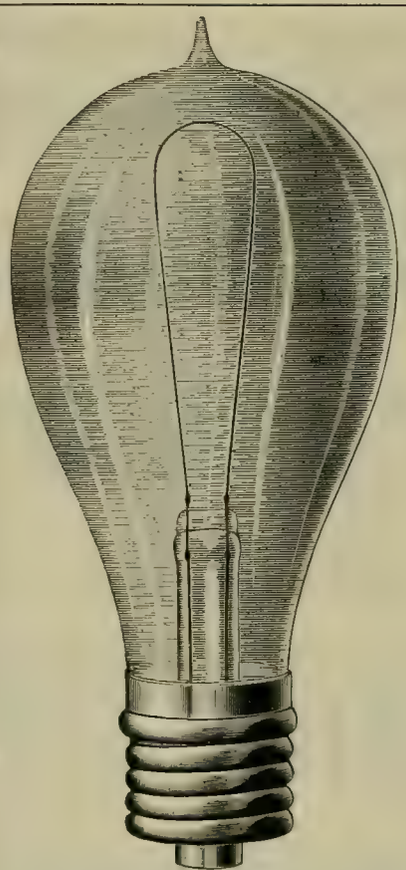
SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

UNITED
EDISON MANUFACTURING CO.,
16 & 18 BROAD ST., NEW YORK.
EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.

No. 2.
No. 2 is the Thomson-Houston.



The Edison Incandescent Lamp.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No. 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

SEND FOR CIRCULARS AND PRICES.

UNITED EDISON MANUFACTURING CO.,

Main District Offices:

Eastern District, 16 & 18 Broad St., New York City. Mountain District, 730 17th St., Denver, Colo.
Central District, Rialto Building, Chicago, Ill. Pacific District, Chronicle Bldg., S. Francisco, Cal.
Canadian District, Toronto, Canada.

THE BEST SOLID RUBBER CORE WIRE ON THE MARKET.

In order to meet the demand for an **ABSOLUTELY RELIABLE, YET LOW-PRICED** solid rubber core-wire, The Edison Machine Works have produced a new line of this class of goods made up in all sizes, from No. 0000 to No. 20. It is the equal in quality, finish and durability of their other well-known wires. Once tried, it will always be used in preference to any other.

IT IS THE NE PLUS ULTRA.

FOR PRICES, SAMPLES, AND OTHER INFORMATION, ADDRESS

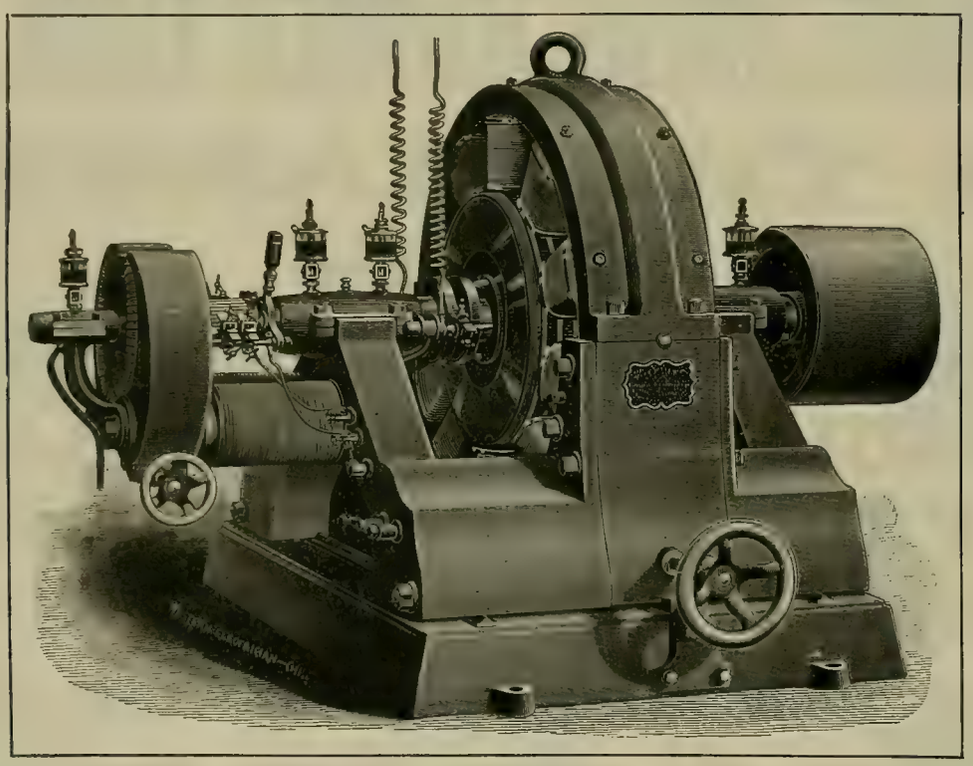
THE EDISON MACHINE WORKS,

JAS. F. KELLY, Gen. Sales Agent, 19 Dey Street, NEW YORK.

THE BEST OF ALL

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts.,
Seattle, Washington.
THOMAS WOLFE, Southwestern Agent,
Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.,
141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.,
1517 Larimer St., Denver, Colo.

CHAS. M. BLANCHARD, Agent,
Girard Building, Philadelphia, Pa.
L. N. COX, Agent,
16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent,
Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts.,
531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

BOTTOM-LESS

TO THE PUBLIC: We have recently received among other large orders one for **1,000,000** ft. of No. 14 A. W. G. B'd Okonite Wire. This particular order was placed with us solely on the merits of Okonite insulation, and after the company ordering had tried all the low-priced imitations. An advertisement appeared in the last week's issue of several electrical papers in the form of a letter which undertakes to give the result of an alleged test. In connection with the letter referred to we beg to call attention to the following, which explains itself:

"COPY."

THE DENVER CONSOLIDATED ELECTRIC COMPANY,

SYSTEMS: Brush Arc. Westinghouse Alternating. Edison Municipal.

GENERAL OFFICE,

C. H. SMITH, President.
E. W. ROLLINS, Vice-President.
W. W. BORST, Manager.
M. D. LAW, Supt. and Electrician.

Please address all Communications to 1534 Lawrence Street.

1534 LAWRENCE STREET,

(DICTATED)

DENVER, COLO., July 12, 1890.

CENTRAL ELECTRIC CO., 116-118 Franklin St., Chicago, Ill.

GENTLEMEN:—We beg to acknowledge the receipt of your communication of the 10th inst. in regard to an advertisement, the same purporting to be a copy of a letter written on our letter head and signed by H. Bottomley.

We beg to state that this has been done **without the authority or knowledge of this company, and should not have any weight or be considered at all.** We knew nothing of such a letter having been issued, **and Mr. Bottomley has surely no authority** to give such letters, and it will not occur again.

Very respectfully,

THE DENVER CONSOLIDATED ELECTRIC COMPANY,
By C. H. SMITH, President.

WE WILL NOT MISREPRESENT OR TRY TO CONCEAL FACTS.

CENTRAL ELECTRIC CO.,

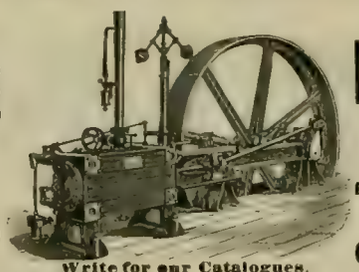
116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable System.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.
Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.
CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

E-D-I S-O-N
Miniature Incandescent
ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,
Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,
And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

COLUMBIA
Incandescent Lamp Co.,
1912--1914 Olive Street, St. Louis, Mo.,
MANUFACTURERS OF
INCANDESCENT LAMPS.
Lamps Made to Fit any Socket.
Send us a trial order. Satisfaction Guaranteed.

JUST COMPLETED

THE LARGEST AND BEST EQUIPPED

INCANDESCENT LAMP FACTORY

IN THE WORLD.

Sawyer-Man Electric Co.,

510-534 W. 23d Street,

NEW YORK.

CINCINNATI HEADQUARTERS
ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.
WEATHERPROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE ·
· FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.
The JONES · BROS · ELECTRIC · CO. 28 30 & 32 WEST COURT ST.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

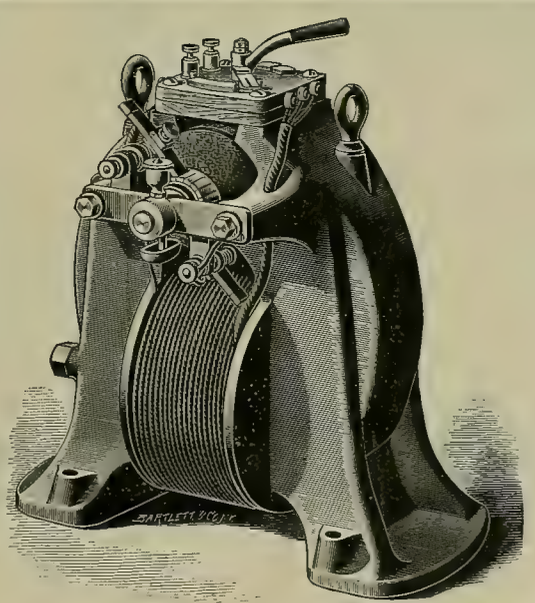
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

WANTED!

Immediately, in good order second-hand Vandepoele generators and motors; very cheap.

CHRISTOPHER P. REILLY,
343 E. Forty-first St., New York City.

WANTED

A Superintendent for arc and incandescent construction work; a man who has had experience in installing isolated plants, and is familiar with Edison apparatus. A permanent position for the right man; must be thoroughly steady and reliable. State age and experience. Address,

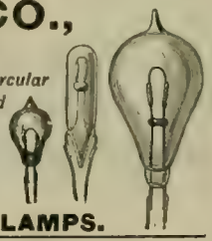
'CONSTRUCTION,'
Care of WESTERN ELECTRICIAN.

THE E. S. GREELEY & CO.,

GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.

ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.



MINIATURE INCANDESCENT LAMPS.

HAZAZER & STANLEY,

ELECTRICAL
HOUSE FURNISHINGS,
32 & 34 Frankfort Street,
NEW YORK.

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.

MICA

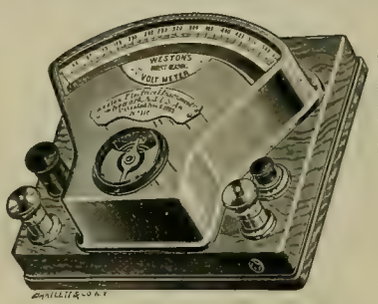
ALL SIZES AND QUALITIES
For Electrical Purposes.
EUGENE MUNSELL & CO.,
218 Water St., New York.

PURDUE SCHOOL —OF— ELECTRICITY.

New laboratory, fitted with best appliances, dynamos, storage batteries, and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue. **Purdue University,**
LA FAYETTE, IND.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS
WESTON ELECTRICAL INSTRUMENT CO.,
Office and Factory, 114 William Street, Newark, N. J.

IT KNOCKS THEM ALL!

BISHOP RUBBER COVERED WIRES.
BALATA INSULATED DROP CORD.

Prof. Henry Morton says: "These wires showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas."

THE "BISHOP" Always Leads the Procession.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, - 341 ROOKERY BUILDING, CHICAGO.

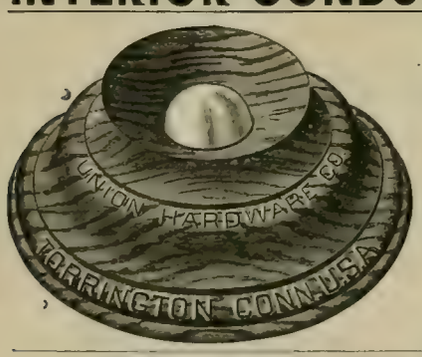
INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address
INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.
Edw. H. Johnson, President.



—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

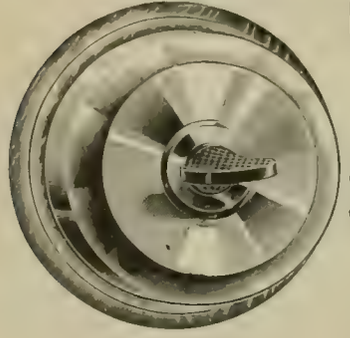
Charles Munson Belting Co.

MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.
28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH



FOR INCANDESCENT WORK

Recognized as the best, simplest and most durable circuit breaker in existence.

H. T. PAISTE,
12th and Market Sts.,
Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

—THE—
Celebrated P. AND B.
ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,
59 Maiden Lane, - NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, JULY 19, 1890. No. 3

Electric Welding in a Carriage Factory.

From the time when Prof. Elihu Thomson conceived the idea of putting to practical use the thought suggested by his now historical lecture experiment, the art of electric welding has been in the process of gradual development. That metals could be brought to a welding heat by the passage through them of an electric current had long been known, but it seems as though it had been left to this one man to turn to account the knowledge of this phenomenon, and demonstrate in a most thorough and practical manner to what an extensive use the simple effect might be put. For the past year Prof. Thomson has been at work perfecting various types of welding machines, and to-day there are in use welders which do their work so efficiently that it may be doubted whether a much greater improvement may be looked for, beyond, perhaps, the perfection of a few minor details.

During the period which has been devoted to experiment and the development of the perfected machines, a great deal has been written concerning the process, and a number of illustrations, showing the welders as they are turned out from the factory, have appeared. Considerable data, too, have been given as to the practical operation of plants which have been installed by the Thomson Electric Welding company, which is exploiting the machines. Up to the present time, however, but comparatively few of the electrical fraternity have had an opportunity personally to inspect an electric welding plant in practical service.

With the object of giving its readers some idea of what such a plant consists and how the process is carried out by the electrically uninitiated factory hand, the WESTERN ELECTRICIAN, through the courtesy of D. M. Parry, of the Parry Manufacturing company, Indianapolis, and H. A. Royce, general manager of the Thomson Electric Welding company, is enabled to present a number of views illustrating the welding plant in the factory of the former company at Indianapolis.

The illustrations were made directly from photographs of the machinery. Fig. 3 shows the 60,000-watt generator. This dynamo develops a current of about 200 amperes at 300 volts. This is transformed in the welder to a little over one volt with, of course, an immensely increased volume. When operated at its full capacity, the generator requires about 100-horse power, and with this power applied at the pulley the current produced will weld an equivalent of 9 square inches of steel or iron. Seven or eight welding machines can be supplied from this one dynamo. Fig. 1 is a view of the welding apparatus proper in place in the factory, with the blacksmith at work. This machine is a buggy tire welder. Fig. 2 is the rear view of an axle welder. Three of the former machines are in service together with two axle welders, and another machine is shortly to be installed. The tires welded are of $1\frac{1}{4}$" x 3-16" iron.

FIG. 1. ELECTRIC WELDING IN A CARRIAGE FACTORY.

The axle machines are used to upset axles $1\frac{1}{4}$" in diameter, and smaller sizes. The five welders in operation in the factory of the Parry company are fed from the one constant potential dynamo, already referred to. To weld the buggy tires about 15-horse power is required, and the axles take about 22-horse power. In regard to the practical operation of the machines, Mr. Parry thinks, after an experience of nearly twelve months, that the process is a great success. He writes as follows: "We use ordinary blacksmiths for the purpose, and have found no trouble either in getting quantity or good work. We have operatives who will make as high as 935 welds in a day of ten hours We find no difficulty at all in keeping the machines in good running condition. As to the amount of expense in keeping them in running order, I would say, so far we have not had any, and we cannot see but that the machines are in as good condition to-day as when we started them. We had no difficulty in making welds more perfectly and economically than we have ever been able to obtain by any other method. We have successfully welded malleable iron to steel and malleable iron to wrought iron, but we can see no economy or money saved in our work by welding malleable to steel."

Chicago's Projected Electric Road.

There seems to be some difficulty over the electric road in course of construction in Chicago. It will be remembered that the Cicero & Proviso Street Railroad company obtained a franchise from the Cicero town board, April 27, 1889, to construct an electric railway. One provision was that the company build within eighteen months a track on Lake street from Crawford avenue to Harlem avenue. The company now asks for an extension of time, and the matter was referred to the corporation counsel for a copy of the original ordinance. The trouble seems to be that the company neglected to take the preparatory steps until the last moment, and

did not award the contract for equipment until the time was nearly up.

In the council Tuesday night a petition for an extension of time was presented by the projectors of the electric road on the south side from Eighty-ninth street and the Strand to Stony Island avenue. The request brought out a sharp discussion. It was objected that too many extensions were asked by companies holding valuable franchises. The old board of trustees of Hyde Park had granted the franchise on condition that the road be completed in a year. The company asked an extension of 90 days in which to complete the provision of the franchise. It was suggested that the matter be referred to the committee on streets and alleys. One alderman wanted the request granted and another expressed the belief that the company had forfeited its franchise. In view of the fact that the council has granted similar extensions of time to other companies it is probable it will grant the petition in this case.

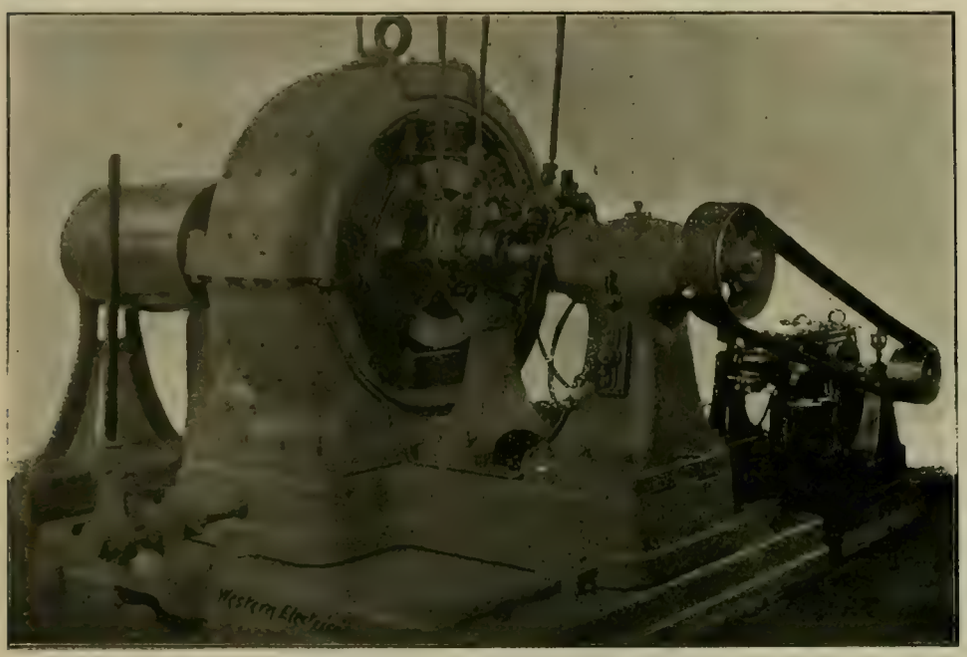


FIG. 3. ELECTRIC WELDING IN A CARRIAGE FACTORY.

Weems' Rapid Transit System.

David G. Weems of Baltimore, whose electric railway experiments at Laurel, Md. have been watched with such marked interest, is now in Chicago. It will be remembered that on his two-mile experimental track, with his projectile-shaped locomotive and car, a speed of about two miles a minute has been attained. The series of experiments carried on at Laurel have convinced Mr. Weems that the system is now so far developed that it can be applied on a larger and practical scale. In speaking of the plans of the company Mr. Weems said to a representative of the WESTERN ELECTRICIAN:

"We have made many changes since the experiments were instituted at Laurel; so many, in fact, that it may be said that the system is now radically different. We propose now to construct a road for carrying passengers. The system, as I have said, will be materially different from that at Laurel. We have discarded the elevated structure, as it would cost too much to build a framework which would stand the strain with such a speed as our trains will attain.

"We expect to commence to build a road for passenger traffic in September. Just where it will be is not definitely determined but it will be in the East, and very likely between Baltimore and Philadelphia. We do not require any special construction as far as rails are concerned. We can use the ordinary standard rail. The weight of the train will keep it on the track.

"The first train will consist of a locomotive and two cars. The locomotive will have a capacity of 700-horse power and will weigh 20 tons. The cars will each be 5 tons in weight. The train, according to our plan, is so made up that one car telescopes into another, so that no space is exposed as resistance to the air. The train itself is shaped like a projectile.

"Our plan of equipping a road contemplates the construction of a station for generating current at every 50 miles along the route. We shall use a complete metallic circuit. There are three plans that we have under consideration for taking current from the wire. If these prove undesirable we will go back to the brush contact which we used at Laurel. We never lost contact when we employed that."

Mr. Weems said he was not yet ready to say whether a constant potential or a constant current system would be adopted. In conclusion he said:

"We have gone slowly in this matter for we learned that it did not pay to try to push on very rapidly. We encountered in our experimental roads many obstacles, but we think we have overcome them. We now propose to go in for passenger business. We have a system which can be substituted on any railroad. Experienced railroad men who have investigated the system say traveling will be as safe running at two miles a minute as an ordinary train running at 60 miles an hour. We depend on the weight of the train to keep it on the track and the construction is such that the center of gravity is very near the ground. This fact makes it possible to run at the high speed of a mile in half a minute without danger of derailing."

Mr. Weems was asked incidentally if he had found in his experiments whether the passage of the current from the wheels to the track increased the tractive effect. He replied in the negative, stating that a very extensive series of tests had convinced him that the adhesion of wheels to the rails was not increased. The effect might be noticed in the case of a toy motor but not in an electric locomotive.

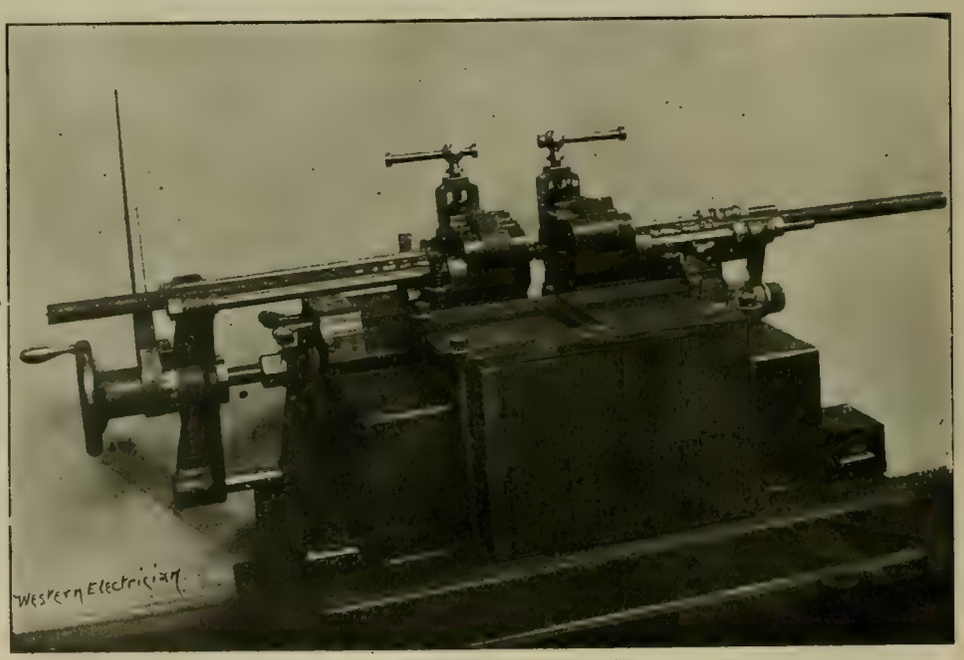


FIG. 2. ELECTRIC WELDING IN A CARRIAGE FACTORY.

Opposed the Edison Company's Plans.

An ineffectual attempt to secure an injunction was made last week by property owners on Wabash avenue, Chicago, who object to the erection of an electric lighting station in the vicinity of their homes. The Chicago Edison company has begun excavating between 26th and 27th streets on Wabash avenue, and the plaintiffs, Jacob and Paulina Weil, Nellie Updyke, Herman and Babette Lehman, Simon and Sadie Pfoelzer, I. Hallock, Mrs. C. W. Chaffee, Anthony and Adelaide Lichtenstein, Emanuel and Rebecca Nusbaum, and James J. Gore, who own houses in the locality, object to further proceedings. All these dwelling houses, it is alleged, were erected with the belief that Wabash avenue would remain a residence street, away from the noise and smoke of factories of all kinds. It is charged that the furnaces will produce volumes of smoke, which will greatly damage the surrounding property, while the noise of the engines and dynamos will unfit the neighborhood for residence purposes and will greatly injure the property owners. The injunction has not been issued, but the property owners say they will press the matter as soon as the advanced stage of the company's work shows that there is any immediate danger.

The Largest Isolated Plant.

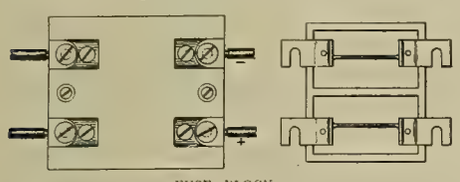
The WESTERN ELECTRICIAN recently took occasion to correct the New York newspapers when the latter claimed that the 3,000 light plant at the Metropolitan Museum of Art was "the largest isolated plant" in the country. The *Pacific Lumberman* recalls the incident and says:

The Madison Square Gardens in New York were lighted with 3,000 16-candle power incandescent lamps, and the New York papers rejoiced over having the largest isolated electric lighting plant in the country, until the Chicago papers exultingly pointed out isolated plants as big in Chicago stockyards. So the Madison Square Garden plant has been increased to 6,000 lights, and now Chicago will have to take a back seat.

New York is still hopelessly in the rear. It will have to double the capacity of that plant before it can rank with Chicago's largest isolated plant the Auditorium which has 12,000 lights.

Fuse Block.

A glance at the cuts presented herewith will enable a practical reader to understand the feature of this fuse block. The base piece and the cap are both of porcelain, shaped as shown. The cap is provided with contact arms, which are united electrically by the fuses. The fuses are inserted in the cap when it is removed from the face of the base-piece. The advantage of thus being able to slide the fuses, so to speak, into place in a live circuit, and at the same time have the hand protected in case of a "blow,"



FUSE BLOCK.

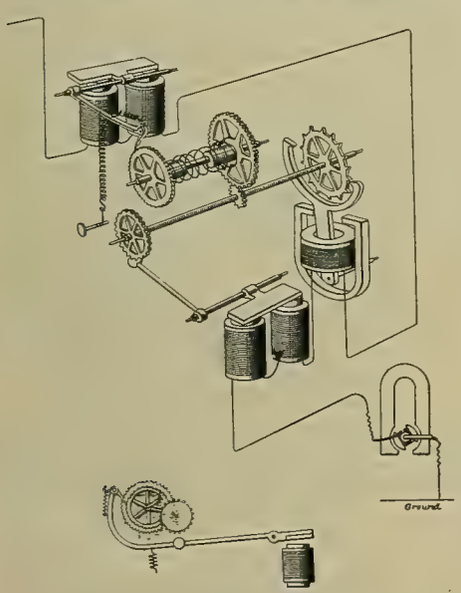
will be appreciated. This device has been patented by J. L. Kimball and H. C. Wirt of Boston.

Electric Winding Mechanism for Printing Telegraph Receiver.

The cut presented herewith illustrates diagrammatically an improvement in printing telegraph instruments, recently invented by George B. Scott of Lakewood, N. J. The invention is more in the line of an improvement in the mechanism for propelling the type wheel shaft than in any change in the construction of the receiver proper. The object of the invention is to propel the type-wheel shaft by power derived from the impulses sent over the line in the ordinary working of the instrument.

Referring to the cut, the type-wheel shaft is represented as carrying the scape-wheel. The type-wheel itself is at the left, on the end of the shaft. The printing lever is shown below the type-wheel. This lever brings the tape against the printing wheel and is operated by the electro-magnet just below it. This magnet becomes energized only when the current is allowed to flow continuously in one direction for an appreciable length of time.

Above the shaft carrying the type-wheel is shown the electric winding mechanism by which



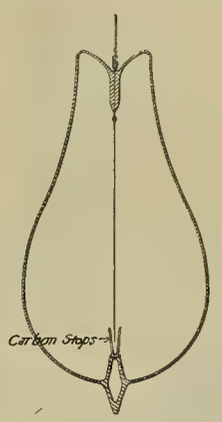
ELECTRIC WINDING MECHANISM FOR PRINTING TELEGRAPH RECEIVER.

the type-wheel is revolved. This is controlled by the same alternating current which oscillates the escapement armature by means of the polarizing device shown beneath the scape-wheel. The operation of the winding mechanism is as follows:

The escapement armature is oscillated by rapid reversals of the current on the line. The same alternating current acts upon the armature of the upper electro-magnet and by means of the arrangement shown the downward pull of the spring brings a pawl into engagement with the ratchet-wheel, thus winding up the spiral spring with sufficient tension and frequency to impart to the gearing all the power required to operate the type-wheel shaft. By this construction the necessity of winding the propelling mechanism of the printer at stated intervals is avoided. In the lower left hand corner is shown a modified form of the type-wheel actuating mechanism, which the inventor proposes to use.

Preventing Vibration in Incandescent Lamp Filaments.

Where incandescent lamps are subjected to great and constant jarring, as is the case when they are used in railway cars, elevators, etc., the life of the carbon is, as a rule, considerably shortened. In order to prevent this excessive vibration, a method has been employed in which the loop end of the filament is steadied between metallic posts set into the glass bulb, as shown in the cut. When, however, this arrangement is used, frequent contact between the filament and these metallic posts soon weakens the former, removing, as it does, small particles at a time, and the life of the filament is materially reduced. It has also been found that the filaments by their frequent contact with metallic posts form grooves in the latter by melting away the material. In experiments made with the view of producing stops which will effectually accomplish the desired result, and at the same



PREVENTING VIBRATION IN INCANDESCENT LAMP FILAMENTS.

time insure the full life of the filament, George R. Lean of Boston, has found that the stop or stops must be made of material which will not melt and that is non-combustible; and also that a stop composed of the same material of which the filament is made is best suited for the purpose. He, therefore, provides stops of carbon, they being secured to the apex of the bulb, and located adjacent to each other to receive between them the filament. When the air is exhausted from the bulb, a small short tube of glass is fitted in the hole at the end. The outer end of this tube is afterward sealed. To secure the stops in place, the inner end of this tube is closed, and the stops are secured in the closed end.

Cheap Electric Power in Mining.

The article on "Natural Sources of Power in the Rocky Mountains," in the WESTERN ELECTRICIAN, June 28th, has attracted considerable attention, and has been widely discussed in mining circles, especially. The *Manufacturers' Record* commenting on the topic says: "There are many places in the Southern mountains to which the practical suggestions given by Frank C. Loring in the current issue of the WESTERN ELECTRICIAN are of value. Mr. Loring is engaged in mining in Northern Idaho, where considerable interest is manifested in the possibilities of electricity as a mining power. He is well acquainted with operatives in all the Montana district, from the Canadian border to California, and seems to have made economy of power in this business a special study."

After quoting liberally from the article and commenting on special points, the *Record* continues: "All the foregoing might with the same truth have been written of the Southern Appalachian mining districts It is less costly to pick up the waste water-power of those mountain streams and to transmit it a few miles by wire to the mines than it is to cart the fuel to the engines that run the varied machinery now enployed in mining, or to carry the ore long distances to the stamps. The nearer to the mouth of the mines all operations are concentrated, the greater the economy and the consequent profits."

The San Antonio, Tex., Gas company has, it is reported, purchased the electric plant of the San Antonio Electric Light & Power company, is remodeling the same and putting in new machinery. A 45-arc light isolated plant has been installed by E. F. Gloze and will be enlarged at once.

Flexible Coupling of an Armature Shaft to the Core.

The accompanying cut illustrates a form of motor armature, which was designed with the view of facilitating the operation of starting. The armature is a cylindrical one, whose core is made up of a series of thin plates, held together by bolts. Its coils are wound upon the core in the usual manner. The commutator and connections are not illustrated in the cut. The core-plates are placed on a hollow hub or cylinder, and the armature shaft passes through the cen-

FIG. 2. FLEXIBLE COUPLING OF AN ARMATURE SHAFT TO THE CORE.

ter of this cylinder, and loosely through the end plates of the core. Within the armature the shaft is threaded, as shown, and upon it is placed a nut, on each side of which is placed a spiral spring. This nut has lugs entering internal slots in the cylinder.

The operation of the device is as follows: When current is applied, as, for instance, in the case of a constant potential motor, and the armature body begins to revolve, it turns the nut, so that it is screwed along the shaft in one direction or the other, according to the direction of revolution. The nut continues to travel along the shaft, compressing the spring which opposes it until the pressure becomes so great as to bring the nut against the screw-thread with sufficient force to turn the shaft. Thus at the moment of starting there is no load on the armature, and it is allowed to make several revolutions, and therefore to develop speed and counter electromotive force, before the full load is placed upon it. The distance which the nut will travel on the shaft will depend on the amount of load on the shaft to be started. When current is cut off from the armature, the spring will force the nut back along the screw-thread to its central position. With a generator the operation is substantially the same. The shaft being started by the application of power, the nut moves along until it engages therewith

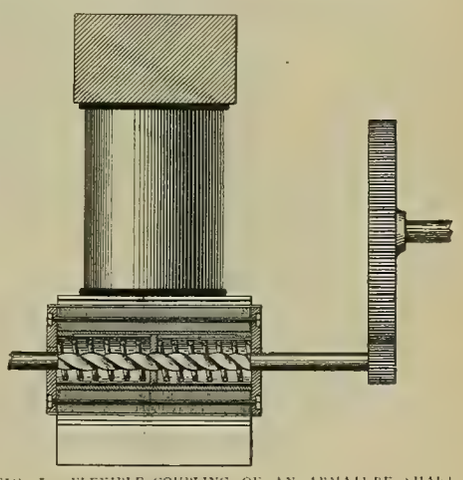


FIG. 1. FLEXIBLE COUPLING OF AN ARMATURE SHAFT TO THE CORE.

with sufficient friction to turn the armature. The generator is thus started gradually.

Edward H. Johnson, president of the Interior Conduit & Insulation company, New York, is the inventor of this method of coupling.

Dangers from Steam Heating.

The dangers of operating steam-heating pipes in roadways has been thoroughly impressed on the people of New York city, and the Chicago city council would do well to profit by the experience so dearly bought in the metropolis. The recent subway explosions in New York led to an exhaustive examination of the conditions under which they occurred. This developed the fact that the direct cause of the catastrophe was the abnormal heat caused by the pipes of the steam heating company. The Board of Health received reports by Dr. Edson and Chemist Martin on the effects of the high temperature maintained in the New York Steam company's pipes. Dr. Edson and Mr. Martin say that they have thoroughly examined the subways on Broadway below Reade street and on Wall street and had

taken the temperature in all of them. Wherever the steam Heating company's pipes were contiguous to the manholes the temperature was abnormally high. The normal temperature in the subways is between 70 and 76 degrees. In very many cases it was found to be away above 100 degrees.

The board debated the question and prepared a report to the mayor. In this they announce their determination to compel the steam company either to change its present system or to remove its pipes at four different points within the districts investigated. At each of these points the heat from the steam pipes had raised the temperature in the manholes to more than 100 degrees. In the bank vaults along Broadway and Wall street the air was so oppressive that it made the investigators violently ill. This should serve as a warning to Chicagoans.

Some Points About Alternating Currents.

Prof. H. S. Carhart writes in regard to his article, which appeared in the last issue of the WESTERN ELECTRICIAN: "Quite an important typographical error occurred in my article on Some Points About Alternating Currents, under the statement about the 'maximum current.' Instead of 'by a quantity $R^2 + L^2 p^2$,' it should read 'by a quantity $\sqrt{R^2 + L^2 p^2}$.' It perhaps might better have been written—'by the square root of the quantity $R^2 + L^2 p^2$.'"

Latticed Iron Poles for Overhead Electric Railway Work.

The accompanying cut illustrates a latticed iron pole, made by the Wisconsin Bridge & Iron company, and now on exhibition at the salesrooms of the Electric Merchandise company, Chicago. These poles, it is stated, have proved most satisfactory on a large number of the leading electric roads. When set at the proper rake, the lacing comes firmly into place as the span wire is tightened, and the poles will then stand a direct strain of 3,000 pounds before permanent deflection. They are strong and ornamental in appearance, and hold the trolley wire up in the very best shape. The poles are finished when desired with ratchet and pole-top for holding feed wires, etc. The Milwaukee Electric Railway company has over 500 of these poles in use. Fig. 4 is an arch adapted for drawbridge overhead work. This is also handled by the Electric Merchandise company, Chicago.

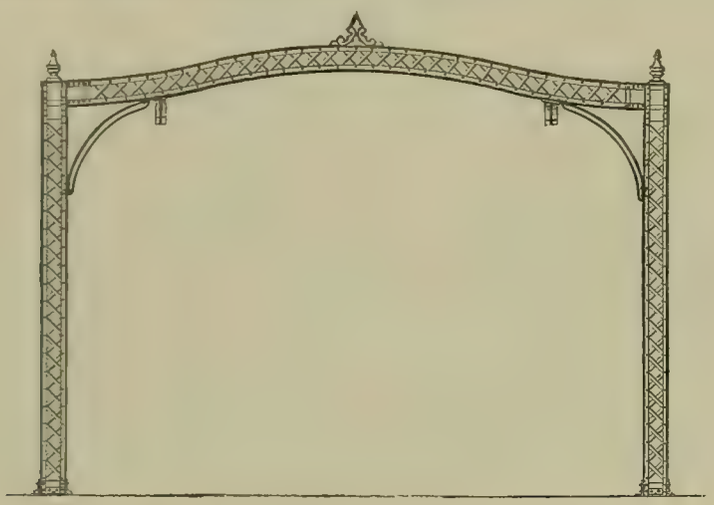
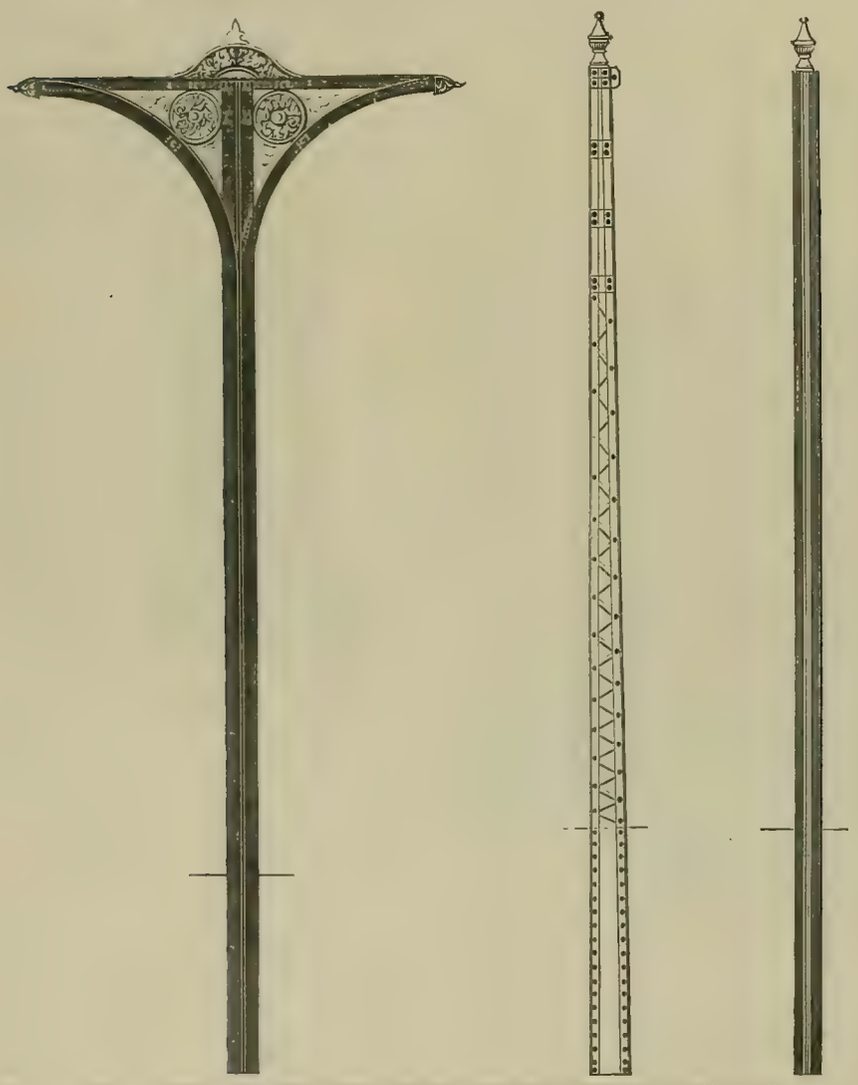


FIG. 4. LATTICED IRON POLES FOR OVERHEAD ELECTRIC RAILWAY WORK.



FIGS. 1, 2 AND 3. LATTICED IRON POLES FOR OVERHEAD ELECTRIC RAILWAY WORK.

Comparison of Two European Secondary Batteries.

BY DR. PAUL SCHOOP.

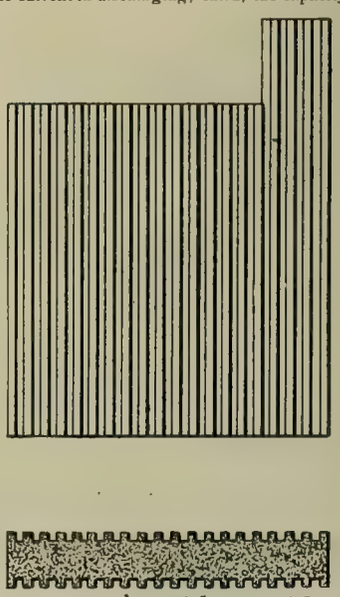
The statement has lately appeared in the German papers that the Tudor accumulator was superior to any storage battery now manufactured. This accumulator, it may be remarked, is to be tried on an extensive scale in Berlin, as already stated in the WESTERN ELECTRICIAN; it is to be used in the sub-stations in the distribution system of the General Electric company of that city. The writer two years ago had occasion to test this cell, and the results of that examination may be interesting to the electricians of this country. It may also be of interest to compare the battery with the accumulator made by the Oerlikon Works of Switzerland, of which considerable has been written of late. The Tudor accumulator was tested at the government laboratory at Hamburg, to the director of which, Dr. A. Voller, the writer was indebted for the use of the delicate apparatus needed in the work.

Six Tudor cells were tested, each having three positive and four negative plates which were connected very roughly with copper wire and placed in glass vessels of the required size. The positive as well as the negative plates were made of pure lead. In constructing the cell vertical channels for retaining the paste are sunken in the plates made apparently by a die. A cross-section of the plate is shown in Fig. 1. The channels are filled with paste, a mixture of litharge or red lead and dilute sulphuric acid, which is applied, it should be stated, after the plates have been formed according to the old Plante process. It is claimed that the paste adheres to the surface of the plate better than if put on as ordinarily when a smooth metallic surface is presented. After the pasting the final forming of the plates terminates the making of the Tudor accumulator. Both the positive and negative plates are identical in construction.

The dimensions of the cells tested were as follows: Height, 220 mm ; width, 105 mm., and thickness, 10 mm. Thirty-seven of the small vertical channels, 3.3 mm. in depth and 1.6 mm. in width, held the active material. The distance between the plates was from 10 to 11 mm. The weight of the three positive plates was 6.10 kilos; that of the four negative plates, 8.30 kilos; that of the sulphuric acid (1.175 specific gravity), 4.16 kilos, and that of the glass containing vessel, 2.35 kilos; making the total weight of each cell 20.91 kilos (56 lbs.). The capacity of the cell was claimed to be 50 ampere-hours. The maximum current for charging was 5 amperes, and the maximum discharging current 6.5 amperes.

It was desired by the comparison of cells to obtain data as follows:

First, the density of current in charging; second, the density of current in discharging; third, the capacity of the



COMPARISON OF TWO EUROPEAN SECONDARY BATTERIES—TUDOR CELL.

cell; and fourth, the efficiency of the cell when the maximum current was used. The density of current may be defined as the quantity expressed in amperes passing the surface of 100 square centimeters.

The surface of one plate was $(10.5 \times 22)\ 2 + (22 \times 2) + 10.5 \times 2 = 462 + 65 = 577$ sq. cm. but the true surface which is of course larger on account of the channels is $527 + (0.3 \times 22 \times 38)\ 2 = 527 + 501 = 1028$ sq. cm. The true surface therefore is practically double that of plates of same linear dimensions without the indentations. The surface of the three positive plates was $1028 \times 3 = 3084$ sq. cm. The density of the charging current is therefore

$\frac{5.00}{30.84} = 0.16$ amperes, and the density of the discharging current is therefore $\frac{8.50}{30.84} = 0.27$ ampere. The "capacity of the plates" is a somewhat inexact expression inasmuch as it assumes that the capacity of both positive and negative plates is equal, and this is not entirely accurate. The positive plates, for example, may be able to perform service even after the negative plates are exhausted and vice-versa. Still this is a theoretical rather than a practical point and capacity may be defined as the amount of electrical energy stored up by each kilogramme of the weight of the cell.

The figures of the tests of charging and discharging are given in the following tables.

CHARGING OF TUDOR ACCUMULATOR.

TIME.	CURRENT.	TENSION.	ENERGY.
9:30 a. m. charging commenced.	5.00 amperes.	2.13 volts	10 65
9:45 a. m.	5 00 "	2.23 "	11.15
2:30 p. m.	5.10 "	2.22 "	11.32
5:30 p.m charging continued	5.00 "	2.17 "	10.85
9:40 a m. ch'g res'd after 16 hs rest	5.05 "	2.06 "	10.40
10:40 a m.	4.86 "	2.32 "	11.28
3:15 p. m.	5.15 "	2.28 "	11.74
5:55 p. m.	5 15 "	2.44 "	12.56

First charge 40 ampere-hours, second 40.8; total 80.8 ampere-hours.
First charge 88 watt-hours, second 95; total 183 watt-hours.

DISCHARGING OF TUDOR ACCUMULATOR.

TIME.	CURRENT.	TENSION.	ENERGY.
9:45 a. m.	6.4 amperes.	2.12 volts.	13.51
11:50 a. m.	6.7 "	2 08 "	13.94
2:45 p. m.	6.54 "	2 03 "	13.28
4:30 p. m.	6.49 "	1 99 "	12.90
5. p. m.	6.47 "	1.96 "	12.68
5:30 p. m.	6.21 "	1.91 "	11 86
6. p. m.	6.04 "	1.86 "	11 23
6:30 p. m.	5.66 "	1.70 "	9.62

Ampere-hours, 56.75. watt-hours, 114.

Capacity, $\frac{56.75}{20.91} = 2.7$ ampere-hours.

Capacity, $\frac{114}{20.91} = 5.5$ watt-hours.

Efficiency, $\frac{114}{183} = 62$ per cent.

The capacity as well as the efficiency of the accumulator varies greatly in accordance with circumstances. The capacity depends first, upon the physical, chemical and electrical condition of the active material; second, upon the concentration, the temperature and the pressure of the electrolyte; third, upon the rate at which the current is discharged or the time of discharging; fourth, upon the rate at which the accumulator is charged or the time of charging; fifth, upon the rise of the tension allowed for in the charging; sixth, upon the fall of tension, allowed for in the discharging. It is obvious that the efficiency also depends upon the same conditions. In regard to this Tudor cell it should be stated that though it has been tested several times and has been charged and discharged before the test of which the figures are given, the active material was in all probability not in the best possible condition. It is also true that a certain amount of current was escaping as shown by gas bubbles during the charging. But it may be stated that such is often the case in the practical use of secondary batteries, and I give the figures as a contrast to the ordinary tests which are usually conducted under the most favorable conditions. Two prominent electricians have also tested the Tudor cell, Voller of Hamburg and Kohlrausch of Hanover. Their results are given in the following table:

	CAPACITY.	EFFICIENCY.	RESISTANCE.
Voller.	2.03 amperes.	80 per cent.	0.020 ohm.
Kohlrausch.	2 30 "	82.4 "	0 020 "
Schoop.	2 70 "	62 "	

The capacity as stated to be 2.3 ampere-hours, and the efficiency as 80 per cent., are in all probability the most accurate figures. These cells are said by the makers to have been fully six years in practical use. This is doubtless true, but the statement conveys no particular idea unless we know the amount of work which has been performed by them daily within this period.

THE OERLIKON CELL.

A year ago a test was made of four cells of the Oerlikon accumulator at Zurich. Each cell consisted of 15 plates which were placed in an ebonite cell. The plates were of the pasted type. The connection of the plates differs somewhat from that usually employed. Each plate has two legs which are connected with two strips. The positives are connected by two trips extending along the top of the plates and the negatives are joined in parallel by means of two strips lying on the bottom of the containing vessel. By this arrangement the current must pass over the whole surface of the plates and an equal distribution of the charging or discharging current is thereby secured. As a matter of fact it has been observed that when the current enters and leaves the upper edge of the plates that portion is sooner saturated or charged, and free gases are developed at those points, although the lower part may be still absorbing the current. The two sections of the plates are separated by means of two channeled ebonite strips, which are also placed on the bottom of the cell.

The dimensions of the Oerlikon cell are as follows: seven positive plates, height, 140 mm.; width, 140 mm.; thickness, 5 mm ; weight of seven plates' connections included 5.6 kilo; eight negative plates weight, 140 mm.; width, 140 mm.; thickness, 5 mm.; weight of eigh plates' connections included, 6.4 kilos; Ebonite vessel with cover, 1 kilo; dilute sulphuric acid (1. .180 sp gr.), 7 kilo s; total weight of cell, 20 kilos (53.5 lbs).

The plate is cast in the form of a grip and the true surface has exactly 1½ times that of a plane surface of the same dimensions. Its true surface is as follows: (14 × 14) 2 + (14 × 0.5) 4 = 392 + 28 = 420 sq. cm. The true surface of the seven positive plates is 2940 sq. cm.

The manufacturers give 15 amperes as the maximum quantity of the charging current, and 10 amperes as the maximum discharging current. The current density in discharging is $\frac{10}{29.40} = 0.34$ amperes per 100 sq. cms., and that of charging is $\frac{15}{29.40} = 0.51$ amperes per 100 sq. cm.

The capacity is stated to be 120 hours when the cell is charged and discharged at the maximum.

After the cells, which were tested, had been charged and discharged several times, the results given in the following tables were obtained:

CHARGING OF OERLIKON ACCUMULATOR.

TIME.	CURRENT.	TENSION.	ENERGY.
8 A. M.	16 amperes.	7.78 volts.	124.5 watts.
8:10 A. M.	16 "	8.05 "	128.8 "
11 A. M.	16 "	8.20 "	131.2 "
1 P. M.	16 "	8.33 "	133 "
3 P. M.	15 "	8.41 "	126.2 "
6 P. M.	15 "	8.60 "	133.5 "

Ampere-hours, 157; watt-hours, 1,310; one cell, 157 ampere-hours, and 327 watt-hours.

DISCHARGING OF OERLIKON ACCUMULATOR.
(After 18 hours' rest).

TIME.	CURRENT.	TENSION.	ENERGY.
7:40	10 amperes.	7.70 volts.	77 watts
10	10 "	7.60 "	76 "
3	10 "	7.50 "	75 "
4	10 "	7.45 "	74 5 "
5	10 "	7 43 "	74.3 "
6	10 "	7.32 "	73.2 "
7	10 "	7.30 "	73 "
Interrupted.			
8:30	10 "	7.40 "	74 "
Discharging resumed after rest of 14 hours.			
9:30	10 "	7 27 "	72 7 "
10:30	10 "	7.12 "	71.2 "
11:30	10 "	6.60 "	66 "

Ampere-hours, 140; watt-hours, 1,050; one cell 140 ampere-hours 262.5 watt-hours.

Efficiency $\frac{262.5}{322} = 80$ per cent. Capacity $\frac{140}{20} = 7$ ampere hours.

The figures given for the tension are probably 5 per cent. too low, as the voltmeter which was used was not very exact. This fact, however, does not destroy the accuracy of the test so far as the efficiency and capacity in ampere-hours are concerned. The capacity was $\frac{262.5}{20} = 13.1$ watt-hours (per kilo weight of cell). The remarks made concerning the Tudor cell, in regard to efficiency and capacity, are also applicable to the tests made with the Oerlikon battery, as will be seen from the following results obtained by Prof. Weber, of Zurich.

Resistance varying from 0.002 to 0.005 ohms' efficiency in ampere-hours from 89.2 per cent. to 95.9 per cent. efficiency; in watt-hours, 79.5 per cent. to 83.9 per cent.; current density in charging, 0.62 ampere to 0.52 ampere; current density in discharging, 0.51 to 0.47 ampere; capacity, 125.8 to 130 ampere-hours; capacity, 249 to 263 watt-hours.

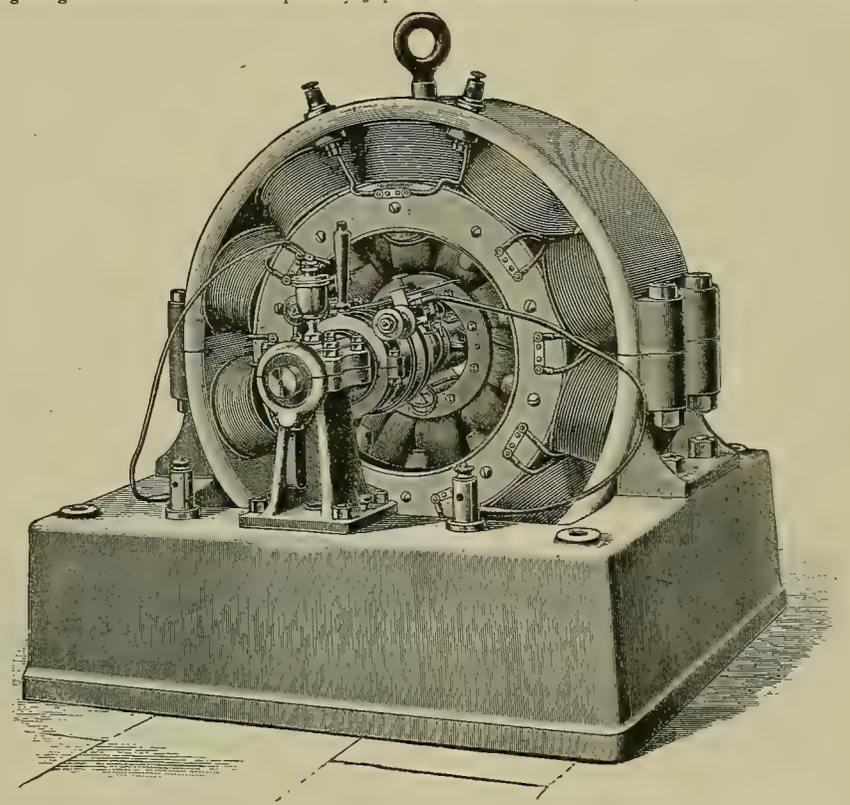
The figures of Prof. Weber are accurate, much more so than those given in the table prepared by the writer. If the data are compared with those given for the Tudor cell, the conclusion seems to be that the Oerlikon accumulator has far more efficiency, as the figures show three times more current density, three times larger capacity and three times stronger current, while the weight of the two cells is practically the same. If the figures are accurate, it would seem to follow that the price of the Tudor cell would have to be only one third that of the Oerlikon cell, in order that in actual practice the same economy could be obtained. For street car propulsion, the Tudor cell, it would seem, could not compete with that made by the Oerlikon works. It may be stated, however, that a greater life is claimed for the Tudor cell than for any other pasted accumulator. The truth of this claim, however, can only be demonstrated by watching results for a number of years.

Adaptability of the Electric Motor.

An illustration of the adaptability of the electric motor to all kinds of work, and its peculiar efficiency in times of emergency, was presented at Toronto recently, when the steam plant in a factory was disabled, and it was necessary to shut down the works. It was expected that the fifty odd hands employed would have to lie off for three or four days until repairs were effected. An electric motor, however, happened to be on the third flat of the building, and the experiment was tried of driving all the machinery by it. The attempt was perfectly successful, and the 5-horse motor did the work of the 17 horse engine. How opportune and valuable the substitution was may be gathered from the fact that the turn out of envelopes alone in the factory is 900,000 per day. The machinery actually driven by the motor included fifteen envelope machines, three cutting presses, eight glueing machines, two box-covering machines, two scorers, three curters, one embossing press, one corner-cutting and five ruling machines. The connections included 800 feet of shafting. The work of the motor was so satisfactory that it is said that electricity will be adopted as the motive power in the factory.

English Alternator at the Edinburgh Exhibition.

The "Tyne" alternating current dynamo, illustrated in the cut, is now in operation at the Edinburgh Exhibition. The machine is exhibited by Ernest Scott & Co., of Newcastle on-Tyne, England. This dynamo is designed to give an output of 1,000 volts, and a current of from 10 to 15 amperes when running at a speed of 1,200 revolutions per minute. It will be observed that the machine is fitted with 10 field magnets, arranged radially round the frame and looking inwards. These magnets are separately excited by a constant current dynamo. The armature is wound with ten bobbins. The armature core is built up of rectangular iron wire, insulated by thin paper, the wire being primarily wound upon a gun-metal hub. By this method of constructing the armature, it is claimed, most perfect ventilation is secured. The bearings of the machine consist of cast-iron pedestals accurately bored and fitted with adjustable caps; the bearings proper are lined with anti-friction metal. The alternator is running on Ernest Scott & Co.'s stand in the exhibition and is feeding through transformers 150 16-candle power 100-volt lamps.



ENGLISH ALTERNATOR AT THE EDINBURGH EXPOSITION.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building, - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Electric Welding in a Carriage Factory, Illustrated	29, 30
Chicago Projected Electric Roads	29, 30
Weems' Rapid Transit System	30
Opposed to the Edison Company's Plans	30
Largest Isolated Plant	30
Fuse Block, Illustrated	31
Electric Winding Mechanism for Printing Telegraph Receiver, Illustrated	31
Preventing Vibration in Incandescent Lamp Filaments, Illustrated	31
Cheap Electric Power in Mining	31
Flexible Coupling of an Armature Shaft to the Core, Illustrated	31, 32
Dangers from Steam Heating	31, 32
Some Points About Alternating Currents	32
Latticed Iron Poles for Overhead Electric Railway Work, Illustrated	32
Comparison of Two European Secondary Batteries, by Dr. Paul Schoop, Illustrated	32, 33
Adaptability of the Electric Motor	33
English Alternator at the Edinburgh Exhibition, Illustrated	33
Editorial	34
Two Storage Battery Street Car Systems, Illustrated	35
Does Earthing the Secondary Circuit of a Transformer Protect the Consumer? by Sydney F. Walker	35, 36
Combined Pulsometer Dynamo and Westinghouse Engine, Illustrated	35, 36
Electric Omnibus	36
The Westinghouse Electric Company	36, 37
DEPARTMENTS.	
Correspondence	37, 38
The Electric Light	39
The Electric Motor	39
The Telephone	39, 40
The Telegraph	40
Electrical Patents	40

IT will be noticed in the Kansas City letter that an organized attack on overhead wires is proposed in that city. It is stated that the ordinance requiring the removal of the wires is to be modeled upon the measure which caused so much destruction of property in New York city. Judging by the amount of dissatisfaction that the latter measure caused, it would scarcely seem to be a safe model to follow. Not only electrical companies, but the city authorities and the citizens generally found fault with its practical workings.

IN another column is presented a descriptive article, which cannot fail to be of interest to the majority of our readers. Ever since Elihu Thomson first began those experiments which have brought the art of electric welding to its present state of perfection, the daily press and various technical journals have given extensive descriptions of the process. The apparatus, as it appears when completed in the factory, has also been illustrated, but up to the present time few have had an opportunity to witness the practical every-day application of the welders as they are operated by the blacksmith in the shop. With the object of giving its readers reliable information on the subject, and a faithful representation of electric welding machinery in practical operation in a factory, the WESTERN ELECTRICIAN publishes in this issue a series of views, reproduced from photographs, of the welding plant, which has been in daily use for a year at the works of a company in Indianapolis. Accounts of the performance of electrical apparatus when tested in the factory often differ from those which might be given after an extended service in charge of the average workman. In view of this fact, the opinion of Mr. Parry as to the success of the process is most valuable, not only to the exploiters of the welding machinery, but also to manufacturers contemplating introducing the process into their own establishments.

IN another column is published an interview with D. G. Weems, with whose high speed electric motor experiments most of the readers of the WESTERN ELECTRICIAN are familiar. Mr. Weems now proposes to make a test of his projectile-shaped train on a practical scale. He states that he will carry passengers on his electric road at a speed of two miles a minute. A complete metallic current will be employed, and current will be supplied by stations along the route. It will be noticed that Mr. Weems states in regard to the much-discussed question of the effect of the passage of the current from the wheels to the rails, that his experience has convinced him that traction is not increased thereby.

HENRY VILLARD, it is reported, has intimated his belief that we are on the eve of a most important discovery—one that will revolutionize the world. It is claimed that Mr. Villard has had his attention drawn to an important discovery, which is nothing less than the solution of the problem of producing electricity direct from coal. If, indeed, such a discovery has been made, a revolution is at hand. So many similar claims have been made that the public has begun to associate this idea with Keeley's motor claims. The former, however, has the advantage of engaging the greatest scientists and highest inventive genius of the age.

IT has recently been stated that a company of men and women who are disciples of Bellamy, have decided, "after many conferences and discussions," to enter politics as an organization, nominate a full municipal ticket, and "organize upon a solid footing the New York wing of the coming party of emancipation." The metropolitan advocates of the doctrines taught in "Looking Backward" are supposed to number about 3,000. They would have the city assume the direction of and provide "all public necessities," which would mean that the municipal government would control the business of the entire community, and the only employment obtainable would be under this great money-making corporation. Thus the city would assume possession of the electric lighting and power business, telegraph, telephone and all other industrial branches. The government would be supreme, the people its servants, or rather slaves, for there would be nothing to excite ambition or stimulate enterprise in such a community; on the contrary a bare existence would be all that could be expected. The New York contingent will engage in a crusade against the present order of things, and it is understood the electrical interests will receive much attention at the hands of their orators. They will have an opportunity to engage in this warfare if they can secure 300 voters to nominate a ticket. It will not cost them anything and may afford them much entertainment. There is very little danger though that the principles of Bellamy will ever receive the support or serious consideration of a large body of American voters.

IT is universally agreed that the electrical section of the World's Fair will constitute its most interesting and significant department. It is not surprising, therefore, that the electrical fraternity has already begun to take interest in the appointment of an electrician to take charge of the section. One petition, at least, is already in circulation in Chicago. This address to the authorities of the World's Fair requests them to select for the position Prof. John P. Barrett, city electrician of Chicago. The paper has already been quite generally signed. Prof. Barrett is in many respects well qualified to discharge the multifarious duties connected with the office. He is thoroughly practical, accustomed to handle work on a large scale, and his experience covers almost every department in the electrical field. He has distinguished himself particularly as an executive officer, and if he should be selected to organize and to assume the direction of the electrical section, the work would be well done. The friends of Prof. Elisha Gray, who resides in a suburb of Chicago, have suggested that he would make an admirable head for the electrical section. Prof. W. A. Anthony, of Manchester, Conn., president of the American Institute of Electrical Engineers, and formerly of Cornell University, has also been spoken of, although the fact that he is not a resident of Chicago might be urged as an argument against his appointment. Neither Prof. Gray nor Prof. Anthony is perhaps as well qualified as Prof. Barrett to organize the electrical department, considering it practically as an enormous electrical plant, as their experience has not been in that direction; still as their reputation as electricians is world-wide, the name of either would inspire the greatest confidence among all those at home and abroad, who intend to contribute exhibits to the electrical section. A selection of any of the three gentlemen named would be an admirable choice. Prof. Barrett at the present time is decidedly in the lead, for systematic work has already been commenced by his friends. In addition to the petition in Chicago, papers requesting his appointment are, we understand, being circulated in New York, Philadelphia, St. Louis and Pittsburg.

THE most distressing accident that has occurred in Chicago in many months caused the death of a score or more persons last week. The fatalities were due to an explosion in the steamer Tioga which had on board a cargo of oil. A gang of stevedores was engaged in unloading the vessel when the oil vapor ignited, and many of the workmen were either killed instantly or burned to death in the fierce fire which broke out in the steamer. It is generally agreed that the oil vapor was ignited by lighted lanterns carried by the men. It has been suggested, and with a great deal of force, that the fearful catastrophe could have been averted had the owners of the vessel used incandescent lamps for lighting the boat instead of allowing the stevedores to carry into the hold ordinary lanterns. Certainly a temporary installation could have been made which would have rendered the work of the men almost entirely safe. The danger attending the use of the lantern however did not seem to be appreciated. On the night following the explosion while a wrecking crew was at work a second explosion arising from the same cause occurred. Two men were seriously injured. Steamers carrying oil are continually coming into the river and ordinarily workmen are employed to unload them at night. There is no reason therefore why the disaster of last week should not be repeated with even more terrible consequences unless some effectual means for averting such catastrophes is adopted. The use of an incandescent system would reduce the danger to a minimum, but apart from considerations of safety the employment of electric light we should think would prove economical to vessel owners. The fact that the work of discharging a cargo can be completed in comparatively short space of time when good light is available is a great argument in favor of an electric light plant. This matter was referred to by M. B. Leonard in his excellent paper on "Electric Lighting in Railroad Service" which appeared in the last number of the WESTERN ELECTRICIAN. He cites a case in which the use of an electric light plant had so facilitated the work of unloading steamers that its purchase was found to be a highly profitable investment. The Chicago river is fairly well lighted by arc lamps on its banks, still their rays do not reach many points at which boats are unloaded. Perhaps a portable electric light plant which vessel owners could rent for a night or two might prove quite a money-making piece of property.

Two Storage Battery Street Car Systems.

Mention has been made from time to time for two years of experiments with the River & Rail storage battery in street car work. A new car has just been finished which embodies the results of the experiments, and its operation is claimed to be highly satisfactory. The River & Rail battery plates are illustrated in Figs. 1 and 2. No active material is used in their construction, and the method of forming them is based on the Plante principle. The positive plate, Fig. 1, is composed of a number of sheets of lead foil pressed together between thin plates of lead and then perforated with many small holes, about twenty-four to the square inch, after which all is securely fastened by lead rivets about an inch apart. The fluid part is an acid solution of zinc sulphate.

The negative plates are of zinc about one-eighth of an inch thick, and perforated with large holes, and they rest on a plate of copper

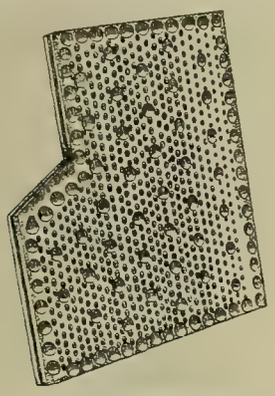


FIG. 1. TWO STORAGE BATTERY STREET CAR SYSTEMS.

perforated to correspond. Fig. 2 shows both the zinc and copper plates, which are arranged in the cell like shelves, one above the other. The copper plate acts only as a conductor, and the zinc plate, according to the company's claim, does not waste away, the chemical changes restoring it to its original condition. When placed in circuit the lead foil becomes an oxide and the oxide of lead thus formed by the action of the current is stated to be of a peculiarly crystalline and conductive nature, and to be better for the work required of it than the oxide which is mechanically applied in the grid plates. It is furthermore permanently retained, the company states, owing to the construction of the plate, and experience has shown that there is no dislodgement either from jarring or rapid discharge. By

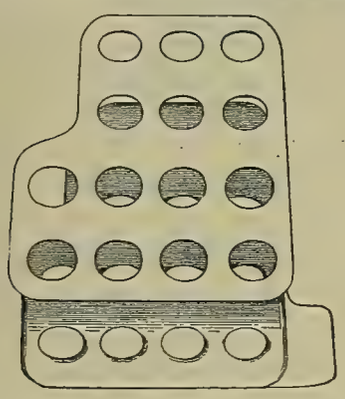


FIG. 2. TWO STORAGE BATTERY STREET CAR SYSTEMS.

the use of zinc a higher e. m. f. per cell is said to be obtained than when lead is employed.

The form of street car motor used by the company is represented in Fig. 3. It is compact, and weighs about 900 pounds. The armature is stationary, and the fields and brushes revolve.

In Fig. 4 is given a view of the driving mechanism.

In Figs. 5 and 6 are shown the storage battery plates used in the McLaughlin system of street car propulsion. A car equipped with McLaughlin battery has been operated on the People's railway in Philadelphia for several months.

The McLaughlin car can scarcely be said to represent a distinctive system in an entirety, as it does not cover the motors, those at present on the car being regular Sprague motors. Its novelty lies in the batteries, and a friction clutch within a gear wheel by which the motor, running continuously, may be clutched, or released at will. It will be seen by the cut that each electrode consists of two thin parallel plates of lead held a distance apart by a series of lead tubes extending between and through the plates,

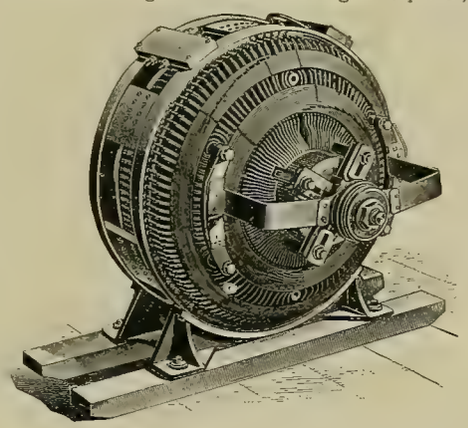


FIG. 3 TWO STORAGE BATTERY STREET CAR SYSTEMS.

so that there is a clear passage for the electrolytic fluid all around the tubes and between the plates. These tubes are, moreover, perforated with numerous small holes, and are filled each with a cylinder of active material of a peculiar composition having the consistency of a brick, which, when the battery is being charged, swells, portions of the cylinders protruding through the holes in the tubes.

It is claimed that none of the active material within the tubes can ever break off and accumulate at the bottom of the jar to short-circuit the battery, and to be lost for useful purposes. The makers claim that the rigidity of the electrode, owing to its peculiar mechanical construction, is so great that bending or warping under the action of the current is practically impossible. The cuts are reproduced from the *Street Railway Journal.*

Does Earthing the Secondary Circuit of a Transformer Protect the Consumer?[1]

By Sydney F. Walker.

In the writer's opinion it does not. In fact, if the arguments which follow are correct, it would even appear that the earth connection, so far from being a protection, is, under certain conditions, a source of danger; and the object of the present article is to remove what is believed to be an erroneous impression on the subject.

The weak point of the high tension transformer system is, of course, the possibility of a connection being made between the high tension primary and the low tension

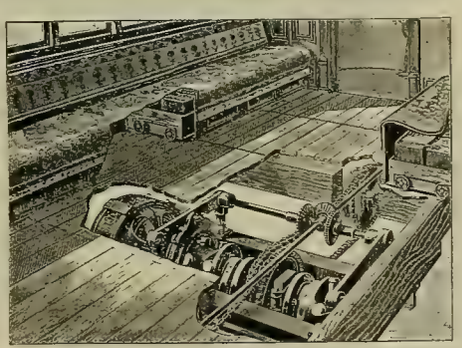


FIG. 4. TWO STORAGE BATTERY STREET CAR SYSTEMS.

secondary circuits, leading to danger from fire and probable danger from shock. To prevent this, fuses are inserted in both primary mains on their way to the transformer, and in both secondary mains immediately on the consumer's side of the transformer. If these fuses act, either the primary or the secondary, well and good, but it has been justly urged fuses sometimes fail. It is necessary that they shall be of such strength that any ordinary variation in the e. m f. of supply shall not destroy them. It would be intolerable if all the lights in an establishment were extinguished, for instance, if a number of lamps were suddenly turned out in the district. And if the fuses are not to require rather frequent attention, they must have a margin of strength over and above this also, to provide for oxidation, the brittleness created by the passage of the current, and other contingencies.

[1] London Electrical Engineer.

Then the other factors come in. The fuses may be in a position where the surrounding atmosphere is sometimes hot and sometimes cold; and at the moment when they are required they may be surrounded by cold air, perhaps in a keen, biting draught from an east wind, and they do not act.

Further, the transformers now in use are apparently well made and highly insulated, because their manufacture is in the hands of a few well-known firms who are able to obtain a price that will pay for good insulation and plenty of it. But the time will come when competition will be keen if transformers are much used, and then will come the question, how can money be saved in construction? If the manufacturer has before him the fact that a defect in the insulation of the transformer may lead to the loss of human life, he will in most cases see that it is perfect, so far as he knows how. But if this fear is removed, if there is the feeling that the earth connection will put all right in the last resort if the fuses should fail; then there may be a temptation to cut the insulation as fine as possible so long as it passes the supply or insurance company's test, and not to remake an apparatus when a workman has made a slip.

It is in these very cases, as will be shown later on, that

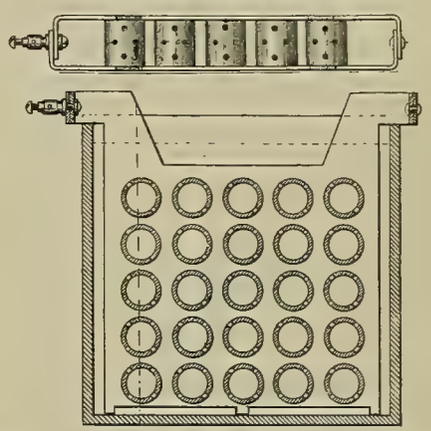


FIG. 5. TWO STORAGE BATTERY STREET CAR SYSTEMS.

the earth connection produces danger instead of making up for structural defects.

Consider the two phases of the danger separately: first, the danger from overheating the wires within the house, and secondly, the danger to life. In order that there may be overheating in the consumer's wires, it is necessary that some portion of these wires, or of the secondary coils of the transformer, should form a part of a circuit in which the primary e. m. f. is included. This is not possible with only one connection between the primary and secondary circuits, unless the latter is connected to earth. If there is only one connection between the two circuits and no connection to earth anywhere, either on the primary or secondary circuits, no harm is done, as there is no path for the primary current except its own legitimate one. But there is always a connection to earth on the primary circuit, though it may be of high resistance: because, if no other connection exists, there is one through the dynamo itself; as it has been found impossible, so far, to insulate the coils

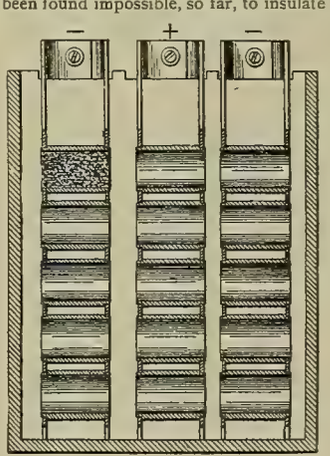


FIG. 6. TWO STORAGE BATTERY STREET CAR SYSTEMS.

of the dynamo from the framework of the machine, and therefore from earth, to any high degree for high tension currents. Therefore one connection between primary and secondary produces danger of fire if there be an earth connection on the side of the secondary, and it will be evident that the danger will be inversely proportionate to the joint resistance of the connection between the primary and secondary circuits the earth's connections of primary and secondary, and that of the path by earth itself; and the more any one of these is lowered, the greater chance is there of danger, provided the main primary fuse does not act. Two points in connection with this matter should be considered, however. First, it is by no means easy to obtain a good earth connection either for the secondary circuit or for any screen that may be interposed between the primary and secondary coils of the transformer. It must be remembered that for *earth* to be effectual, its resistance must bear some proportion to that of the rest of the circuit. What is good earth for a telephone line may be very bad earth for an electric light system. It must be remem-

bered too, that the resistance of the earth circuit consists, not only of that of the connections to it, external to itself, but of the path through the earth's crust, and very often this latter is very high As telephone engineers know to their cost, earth connections are often very troublesome, even for the small currents they use, owing to their high resistance in comparison with that of the telephone lines; and even allowing for the greater sensitiveness of telephone apparatus, and the greater liability to trouble from that cause, it is evident that the chances of obtaining an earth circuit for electric light currents that will really be of any value, must be a work of considerable difficulty. A total earth resistance, for instance, of 10 ohms would be nothing out of the way in a telephone or telegraph circuit, especially on long lines; but such a resistance upon an electric light circuit would be enormous; and yet the same appliances have to answer in each case.

It is possible, of course, to arrange a so-called earth circuit that will answer. In fact, electric light circuits using earth as a return are established facts; but *earth* in these cases does not mean earth in the ordinary sense of the term. It is not the *ground* of our American friends. It is a mass of metal—such as the skin of a ship, plus the water it floats in; or a lot of iron rails or pipes, carefully jointed with copper wires, and with all doubtful places bridged over. This is an uninsulated metallic return, not the *earth* that is to be provided in connection with transformer systems of supply.

And, secondly, it should be remembered that the creation of a path for the current to earth on the consumer's side of the transformer tends to break down the insulation between the primary and secondary wires, the very thing which it is so important should be maintained as high as possible, and the time occupied in breaking down the insulation will be directly in proportion, other things being the same, to the resistance of the earth circuit. The lower this is the more rapid must be the deterioration. It is well known, of course, that the passage of a current through insulating material alters the nature of the latter, tending to lower its resistance, and in the end breaks it down altogether at some favorable point, say by sparking across.

The higher the initial resistance the smaller the current strength that passes, and the greater the length of time that will elapse before the resistance of the insulation will be appreciably deteriorated; but it must be the initial resistance of the whole circuit in which the insulation is included.

Earthing the screen, which in some transformers is placed between the primary and secondary, protects the insulation between the secondary and the screen from this deteriorating influence, providing there is no connection to earth on the secondary circuit itself, and is, therefore, an additional protection against fire. But here comes in the question once more, what is earth? In most cases there will be a connection, though of high resistance, between the secondary and ground, and, of course, between ground and whatever is used for the earth connection to the screen, so that a small current will be passing through the insulation of the primary circuit as well, tending to break it down as the other.

Next, consider the more important question of danger to life from shock. It is stated that if the fuses fail to cut off the consumer from the high tension primary circuit, still the earth connection will protect him should there be a connection between primary and secondary. In order that the consumer may be protected, the e. m. f. between the metallic portion of his circuit which he is able to touch, say, some part of the lamp fitting, and the ground he stands on, must be reduced below the dangerous point, say, to 200 volts. Unless this is done, the earth connection does not protect him. He is in one derived circuit between the supply wires and ground; the protecting earth connection is another; and the current passing through the body, when it forms a branch circuit between the supply wires and ground, will only be affected by the connection to earth, if the latter is able to provide a path of such low resistance for the primary current, that the current which passes along the primary wire reduces the e. m. f. beyond the contact between primary and secondary to 200 volts, or less, in accordance with Ohm's law.

Of course, long before such a current did pass, the primary fuses should have melted; but supposing they did not, and it is this supposition the earth connection is to provide for.

Now, consider what probability there is of the earth connection providing such a path for the primary current

Take the primary e. m. f. at 2,000 volts, and the limiting e. m. f. for the safety of the consumer at 200 volts, we have 1,800 volts to dispose of; what current and what earth resistance will effect this? Take the resistance of one primary main from the dynamo to the transformer where the contact exists, and including that of the contact at 1 ohm. In order that the e. m. f. may be reduced to 200 volts at the point of contact, the current passing C must

$$\text{equal } \frac{E}{R} = \frac{1,800}{1} = 1,800 \text{ amperes.}$$

But this current must pass in the whole circuit, including the dynamo itself, the contact to earth, whatever it may be, on the primary circuit; the primary main before referred to, the contact between it and the secondary, or with the screen between primary and secondary; the connection to earth, and the path by earth back to the dynamo. In order that the voltage at or beyond the point of contact may be only 200 volts, the resistance of all these must be inappreciable. Take the primary voltage at the dynamo as 2,000 volts, as before. Then R, the resistance that must rule in order that 1,800 amperes may pass,

$$\text{must equal} \frac{E}{C} = \frac{2,000}{1,800} = 1.$$

But we have already taken the joint resistance of the primary main and the fault at 1 ohm; therefore the resistance of the rest of this circuit must be only ·1 ohm, which, as every electrical engineer knows who has experience with earth circuits, is an absolute impossibility.

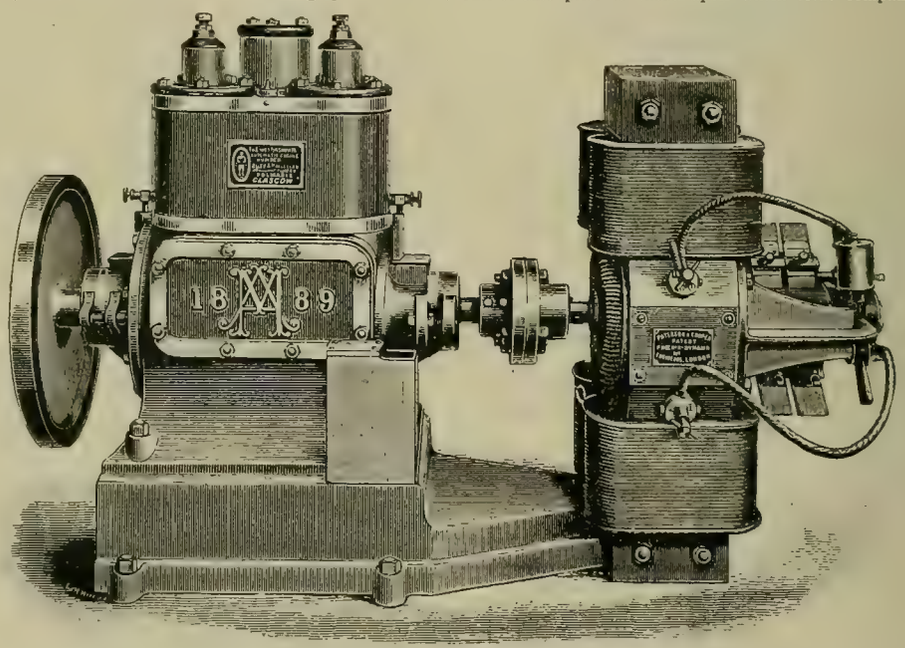
It may be objected that the resistance of the primary main would be less than the figure that has been given, but a glance at the formula will show that this only increases the difficulty. On the other hand, the resistance of the primary main, plus that of the contact, might be greater than 1 ohm, and therein lies safety as far as it is to be obtained; since the higher this resistance the smaller the current required to reduce the e. m. f. to a safe voltage, and the greater the margin for resistance of the earth circuit. With 2 ohms for resistance the earth may have 2 instead of 1, with 4 ohms it may be 4, and so on.

The fact that other transformers are being supplied from the same primary mains will hardly affect the issue, as the current passing in all the transformers is necessarily, from the nature of the system of distribution, very small in comparison with that required to reduce the voltage to the safe limit.

Further, it will be noted that in those cases where the insulation between the primary and secondary wires of the transformer is weak the current passing through it will be stronger than where the insulation is high, and will therefore deteriorate more rapidly.

Combined Phœnix Dynamo and Westinghouse Engine.

The combined Phœnix dynamo and Westinghouse engine, says the London *Electrical Review*, has been constructed for lighting, by the Timmis system, the trains of the Central Argentine railway. The dynamo, made by Paterson & Cooper, is of the double magnet type, shunt-wound with four magnetizing coils. The cast iron bedplate, on which the engine sits, is prolonged to form a support for the wrought iron vertical magnet bars, which are 8 inches wide by 3½ inches thick. This bed also forms the bottom yoke, a block of cast iron being placed between the bars at the top to furnish the top one. A gun-metal bracket ties the bars together in the center, and also forms the outer bearing. At 600 revolutions per minute the machine gives 85 amperes at a difference of potentials of 52 volts. The engine, made by Alley & Maclellan, of Glasgow, is a "Westinghouse Special," having cylinders 4½ inches diameter, and a stroke of 4 inches The steam is derived from a locomotive boiler at a pressure of 120-140 lbs. per square inch.



COMBINED PHŒNIX DYNAMO AND WESTINGHOUSE ENGINE.

Electrical Omnibus.

The following from an English electrical journal would seem to indicate that our English cousins are not only talking but doing: "As an appropriate conclusion to the trip of the lord mayor to the Electrical Exhibition at Edinburgh, he was met at Euston on his return by the electrical omnibus owned by the Ward Electrical Car company, limited, of 38 Gracechurch street. The omnibus, which was driven by Radcliffe Ward, the managing director, conveyed his lordship and the town clerk to the Mansion House in a most satisfactory manner, and very quickly, showing itself to be under most perfect control. As we have already stated, the company have in hand a complete line of omnibuses, to run from Charing Cross to King's Cross, with which it is intended to demonstrate commercially the economy, humanity, and cleanliness of electricity over horses, and the facility for locomotion in towns without the aid of tramway lines."

The Westinghouse Electric Company.

A meeting of the stockholders of the Westinghouse Electric company took place on July 8, at the offices of the company in Pittsburg. At this meeting the formal transfer of the stock of the Westinghouse Electric company to the Westinghouse Electric & Manufacturing company was made. A proposition was laid before the stockholders for an increase of the capital stock of the company from $5,000,000 to $10,000,000. A resolution having been passed to this effect the matter was put to a vote, which lasted an hour. At the termination of this period nearly 80,000 shares had been voting and every one had been cast in favor of the increase.

George Westinghouse, Jr., made the following statement to the meeting:

GENTLEMEN—This company has now acquired the outstanding shares of the Westinghouse Electric company, and by an action of a meeting of the stockholders of that company, held July 7, 1890, has succeeded to its property and business. That company began the manufacture and sale of continuous current apparatus for incandescent lighting in 1886, which apparatus, however, could be commercially successful only for isolated lighting and central stations within moderate limits. Its capital was fixed at $5,000,000, with the expectation that that amount would meet the requirements of the business. For the purpose of supplying apparatus for the distribution of electric light and power from central stations over large areas, it took up the alternating current system in 1886, up to which time none of the companies engaged in the business in the United States had considered that system commercially practicable, and it thus entered a field entirely its own. To protect its business and successfully defend itself in any litigation that might be forced upon it by its competitors, the company found it desirable to fortify its patent position, and to that end acquired the control of the Consolidated Electric Lighting company and the United States Electric Lighting company, both of New York. The Consolidated company was the successor of the Electro-Dynamic Light company of New York, the first company organized in the United States for the manufacture and sale of electric incandescent lamps, and the owner of a large number of patents of date prior to those upon which rival companies were depending. The company purchased nearly one-half of the capital stock of the Consolidated company, and subsequently leased it at a rental equal to 6 per cent. per annum on its capital of $2,500,000. The United States company was organized in 1878, a few weeks after the Electro-Dynamic company, and was the successor of the oldest company in the United States for the manufacture of electric power apparatus, and also owned a large number of early patents covering every necessary detail of lighting and power plants. The company purchased $700,000 of a total of $1,500,000 capital stock of the United States company, and leased its patents and business at a rental which will ultimately equal 6 per cent. per annum on its capital stock. In addition to their patents these two companies had large and flourishing businesses and manufacturing plants, which were also acquired by the leases.

These purchases have greatly increased the standing and influence of the company, which now owns and controls 632 patents relating to electric lighting and power, and has now pending over 200 applications for patents for inventions necessary or desirable to the manufacture and operation of the latest improved forms of apparatus.

The success of the company is best illustrated by the report for 1889, already submitted, during which year the sale of the company and its leased companies amounted to $4,362,115 22, yielding a net profit of $729,307.37, after paying very heavy extraordinary charges incident to a new business of this character.

No branch of the electric business yields such large profits as the railway business, and the company has already entered this field. It has assured to itself the necessary patent protection to enable it to carry on the manufacture and sale of such appliances, and during the last three years has given close attention to the details of this class of

apparatus; but it has refrained from selling the same until it could supply its customers with efficient and reliable equipments. The experience of users with the defective apparatus heretofore rushed out by other companies fully justifies the wisdom of the company's action in this respect. To-day the company is in receipt of orders and inquiries from all parts of the country, and has actually completed contracts for the equipment of 17 railways, aggregating $300,000, these orders having been received during the last 60 days. The volume of business offering to the company in this line indicates that its total output from July 1 of this year to July 1, 1891, may be doubled by the provision of adequate capital for carrying on this increased business, and with more than a corresponding increase in the returns. To enable the management to reap the greatest profit, the company should be placed in a position by its stockholders to do its business on a cash basis, and it should have available sufficient capital to take advantage of all profitable business offered to it.

The necessity for a large capital for a general electric business has been shown by the action of its two competitors—the Thomson-Houston company having authority to issue $15,000,000, of which $11,500,000 have already been sold, while the Edison General company has an issued capital of $12,000,000, which, according to its report to the listing committee of the New York Stock Exchange, is still insufficient to carry on an extended business. The board of directors are of the opinion that a total increase in the capital stock of not less than $5,000,000 should now be authorized in order to provide for the future requirements of the company, $3,000,000 of which may be issued by the directors from time to time, as in their judgment may be deemed best, and the issue of the remaining $2,000,000 to be subject to the approval of a special meeting of the stockholders called for that purpose.

It is proposed to issue forthwith to each stockholder of record on this date an assignable right to subscribe on or before August 1, 1890, for one-half share of stock for each share now standing in his name on the books of the company at $40 per share, this price being determined by a distribution or an allowance from the surplus earnings. Of this price one-quarter will be payable on August 1, one-quarter September 1, one-quarter October 1, and one-quarter November 1. George Westinghouse, Jr., has agreed to take $1,250,000 of stock on the terms above indicated. If each of the other stockholders will subscribe to the number of shares to which he is entitled, the company will be enabled to provide for a large increase in its business. The board believes it to be to the pecuniary interest of each stockholder to subscribe for his amount of stock, and thereby aid in increasing the earning capacity of the company, which will have the immediate effect of enhancing the value of the shares already outstanding, and of the shares which in this manner will be secured at a reduced rate.

The board believed that great profit would accrue to the company by securing foreign patents on the more important of the inventions exploited by it in this country. This policy resulted in an order from the Metropolitan Electric Supply company, limited, of London, for a central station of 10 000 lights capacity, which has since been increased to 25,000. A company known as the Westinghouse Electric company, limited, has been organized in London to operate these patents, and this company has received in payment for the patents and the money expended in the development of that business £301,000 of the stock of that company, which is the controlling interest. The English company has recently received orders for other plants, and is in negotiations for others of a very extensive character, with every prospect of success. Indeed, the business abroad bids fair to reach proportions equal to if not greater than those of the parent company, and to be a source of great profit to it. The majority of the board of the Westinghouse Electric company, limited, are also members of the board of the Westinghouse Brake company, limited, of London, and the business is being conducted on the same lines which rendered the latter company so successful. It operations are under the supervision and direction of H. S. Byllesby, the vice-president of this company, who is its managing director, and is now in England giving it his personal attention.

The following is a statement showing the financial condition of the company on June 1 of this year:

ASSETS.

Cash		$ 74,503.58
Accounts receivable		1,341,535.56
Due from leased companies for cash advanced		539,591.33
Material in stock at cost		516,029.25
Material purchased for Newark factory		338,837.11
Real estate and buildings		401,854 75
Machinery, tools and fixtures		344,301.57
Stock in United States Electric Lighting, Consolidated and other companies, bought		1,597,664.18
Stocks and bonds received in settlement of accounts and for franchises		322,967.60
Stock of Westinghouse Electric company, Limited		1,449,462.40
Charters, franchises, etc.		83,751.16
		$ 7,010,498 49
Patents—Some 632 patents, covering the alternating current system, arc and incandescent, Tesla motor, and other lines of manufacture of this company		1,111,312.09
Total		$11,121,810.58

LIABILITIES.

Bills payable secured by collateral	$1,228,500.00	
Bills payable, outstanding for merchandise	317,911.43	
Bills payable for sundries	116,666.66	
Accounts payable	358,841.01	
Bills payable given in purchase of shares of United States Electric Lighting Company, payable $37,500 quarterly	575,000.00	
Bills payable, given in purchase of Newark storeroom stock, payable in monthly installments of about $15,000 each	324,269.48	
Cash advanced by Mr. George Westinghouse, Jr.	1,241,705.42	
	$4,161 694 00	
Capital stock	$4,998,150.00	$9,159,844.00
Surplus		$1,961,966.58

CORRESPONDENCE.

New York Notes.

NEW YORK, July 12.—Interested corporations are forced to admit that the faulty construction of the pipes, sewers and conduits under the streets of New York has made it imperative to begin a systematic overhauling. Extensive changes must be made, if indeed the entire system is not replaced. Public health and safety demand these changes, and the health board has taken the question up and started at the root of the present trouble. The steam heating system in vogue here has ruined the underground conduits, sewers gas and water mains, and made it unsafe to frequent the neighborhood. The expert's examination demonstrated the fact that the temperature ranges from 140 to 162 degrees in the manholes near the heating company's pipes, while the ordinary temperature is only 71 to 76 degrees. Croton water pipes show a temperature of 120 degrees in many places, and in one instance the startling temperature of 200 degrees was registered in an excavation 14 feet from any steam main. This condition of affairs makes it next to impossible to operate the water system, the gas system or the electric system with any kind of certainty. Explosions are imminent at all times, and public health is in absolute danger. In consideration of these facts the sanitary department has served orders on the steam heating company to shut off the steam and discontinue the use of its mains between 165 and 184 Broadway, between 233 and 259 Broadway, in front of the *Herald* building, and between 11 and 71 Wall street.

The Steam Heating company has asked permission to present arguments in its own behalf before the Board of Health, and the request has been granted, Tuesday next being the time fixed for the hearing.

The report that the tearing down of overhead wires in the city has ceased and the institution of a litigation in the Supreme court at the instance of the North American Underground Telegraph & Electric company against the Consolidated Telegraph & Electrical Subway company, the Metropolitan Telephone & Telegraph company, and the New York Underground Telegraph company, to recover damages to the extent of $2,500,000, in violation of contract, is bringing to notice some statements of a surprising nature which charge the Western Union Telegraph company and the Bell Telephone company with conspiracy, in order to maintain the overhead system of wires and defeat the act of 1884, providing for conduits. It is claimed by the complainants that these companies suffered a faulty subway to be constructed, when they were bound by agreement to furnish the Johnstone conduit. The charges are highly sensational. Here is an extract from the complaint:

"That the said corporations (the Western Union and Bell Telephone) had vast and almost incalculable amounts of capital invested in the construction and maintenance of the system of wires usually termed 'overhead wires,' and as this plaintiff believes and so charges, the said corporation, and each and every one of them, were opposed to any and every system and law which would compel them to sacrifice such capital and remove such wires and conduct their system by any other means save those which during many years they had maintained overhead.

"That it became a necessary and popular demand for the safety of life and the protection of property in the estimation of the general people, as expressed through their legislative representatives, that such electric wires (telephonic, telegraphic and electric light, and of whatsoever description the same might be) should thereafter be removed from overhead conditions and constructed and operated beneath the surface of the ground.

"That the legislation aforesaid, being designed to control the construction and operation of such electric systems of communication underground, the acts of the legislature of the state of New York were, as aforesaid, especially leveled and directed against the corporations hereinbefore mentioned and referred to, as well as other corporations operating electric conductors overhead.

"The plaintiff further alleges that by reason of the objects of such legislation and the consequences to such corporations, as aforesaid, said corporations were induced to become the controlling and ruling elements in the general administration and conduct of the affairs of the said defendants, the Consolidated Telegraph & Electrical Subway company, and thereafter, to accomplish such purpose in the name of their said creature thereinbefore referred to as the Metropolitan Telephone and Telegraph company) they did proceed to acquire control and direction of the affairs of the said defendant, the Consolidated Telegraph & Electrical Subway company, for the purpose of defeating the objects of the said act of June 14, 1884, and all acts subsidiary to and amendatory thereof."

Edward Lauterbach, counsel for the defense, said after a casual examination of the papers: "We gave up that system of conduits because we found a better conduit. We act under the advice of the electrical experts of the city. Our contract with the North American company permits us to use their system at our pleasure. We were at liberty to stop using it when we saw fit to do so, and we are free to resume it if necessary. As to the idea that the Western Union company does not want the subway system to be successful, that is not worthy of serious consideration. The Western Union company has most of its wires on the elevated railroad structure and is not bothered much with the subway question, although I think it approves subways. In truth, the underground system is generally approved now, because after the plant is once established it is cheaper than the overhead method."

A lively fire at 141 Chambers street gave the firemen close work amid the thick web of telephone and telegraph wires over the roof of the building ablaze. The insulation burned off, the wires sagged down and tumbled upon the adjoining buildings in close proximity to an overhead electric lighting wire, which fortunately was guarded by a lineman to avoid any accident from contact which might occur with the falling wires.

Jersey City choppers brought down two immense poles this week which have for a long time served a double purpose, one for electric light, telephone, telegraph wires exclusively, while the other held up the only Republican banner ever raised in the old horseshoe district.

It is reported that the celluloid manufacturers will form a trust with $6,000,000 capital. This combination will tend to raise the price of celluloid articles, and its use in electrical mechanism will be somewhat affected.

Congratulations were exchanged by cable between Mayor Grant of this city and the chief executive officers of the cities of Hamilton and St. George, Bermuda, as soon as the new cable was completed. These were the first messages transmitted.

E. H. Johnson, president of the Interior Conduit & Insulation company, had a thrilling experience at his country residence, Greenwich, Thursday morning. Accompanied by his wife he had driven to the station behind a spirited team, and as the train pulled up to the station, he was leaving his wife, who was seated in the carriage, when the horses ran away. The carriage was overturned, throwing Mrs. Johnson and the coachman to the ground. Both were seriously injured, but fortunately not dangerously.

Referee Howland has filed his report in the famous copper case, giving the plaintiff judgment for $150,000. The Oxford Copper company brought suit against the French Copper Trust for damages for alleged breach of contract. The French corporation, it is alleged, agreed to deliver to the Oxford Copper company every month from March, 1889, to March, 1891, copper in the form of ore, bar or pigs to the minimum amount of 1,500,000 bars a month. The defendants, it is alleged, failed to fulfill their contract.

W. H. T.

Pittsburg, Pa.

PITTSBURG, Pa., July 12.—The trial of the new double deck car was made in this city on July 4th by the Pleasant Valley Electric company, and from all appearances it was a great success. The car has a double truck of four wheels each and a flexible coupling supplies the electric power to each set of wheels. The car is about thirty-six feet long and seats sixty people inside and twenty-eight outside.

In Lima, O., a man attempted to commit suicide a few days ago by trying to catch hold of the electric light wires. His wife however caught him in the act and crying for help, the man was prevented from accomplishing his desired end. The man's name was given as Alfred Ray.

The management of the Second Avenue Railway company entertained its employes a few days ago by giving them a grand banquet. This was done in appreciation of the fact that the men had worked fifteen hours on July 4th instead of nine the regular day's work. The company carried on that day over 10,000 passengers in its cars and not a single accident occurred.

Louisville, Ky.

LOUISVILLE, July 12.—There is another syndicate sensation here to the effect that an English corporation is after the Louisville Gas company. The latter has just bought out the Louisville Electric Light company, as stated, and is building an immense electric light plant at Sixth and Green streets. If there is anything in the deal, the English syndicate will control the sale of electric light as well as gas in this city.

Now that Judge Toney has dissolved the injunction of W. J. Tapp and the Louisville Bagging Manufacturing company against the Central Passenger Railway company, the latter is pushing the Green street electric line down Walnut street to the Eclipse Base-Ball park, and the line will be completed before many days. It only requires that the wires be strung and the return ground wires be put in along the rails a part of the way, as all the posts are up and the rest of the work is finished. As soon as the work can be commenced, the rest of the city lines will be turned into electric lines.

L.

Kansas City, Mo.

KANSAS CITY, July 12.—A resolution was adopted by the council at its last meeting providing that the board of public works should make a contract for lighting the city by electricity, gas or gasoline, as it may deem for the best.

Capt. Cannon took occasion to say that the present contracts for lighting were go-as-you-please contracts in everything except the price, especially for electric lights. This matter could be investigated by the board acting with Counselor Yeager. It could then be determined whether the city really had any valid lighting contracts or not. It was necessary for the council to know at once what rights and power the city had in the premises.

At the next meeting of the board of public works Secretary Kay was instructed to ascertain what contracts there were. He has been searching industriously among the dusty and time-worn archives of the city for contracts or agreements with the various lighting concerns. The fact that there are no formal contracts in existence has just begun to dawn upon the board, but it is the opinion of all members that the ordinances of the city in all matters of this kind are as binding as contracts and will make perfectly reliable foundations for any legal action that it may be necessary to take. The ordinances regulating the location of electric lamps from time to time are the same, it is claimed, as the original ordinance.

W. H. Robinette of Kansas City has completed a floating water power device designed to utilize the force of the river currents. His idea is to transmit electrically the power from the current to the shore.

At the last meeting of the board of public works the subject of fire alarms was under discussion. Since the extension of the city limits the necessity of placing a number of telephones in the annexed district for the use of the fire department and the public in receiving and sending fire alarm signals has been urged. Heretofore when the fire department has been provided with telephones the Missouri & Kansas Telephone company has furnished, without cost to the city, the wire to connect the telephone with its headquarters in this city. In order to equip a sufficient number of additional telephones to meet present needs about eight miles of wire will be needed. At the present time the telephone company is not disposed to supply the wire. Hence, the gentlemen composing the board are undecided whether they will continue to supply telephones to the fire department or will look around and see if they cannot find some system of fire alarm that is more modern.

Councilman Hoffman of the lower house has submitted to City Counselor Yeager the outlines of an ordinance which will be introduced at the next meeting of the lower house of the common council, providing Counselor Yeager finds it conflicts with no provisions of the city charter. Mr. Hoffman's ordinance proposes to inaugurate war upon the present system of overhead electric wires. It will provide that all electric light, telegraph, telephone or other wires must be placed underground. It will be drawn upon a plan similar to the one adopted by New York City in its fight against the overhead wires. The ordinance will be rather lengthy. It will provide for the change within two years of all the wires within the city. No special system will be recommended but the different telegraph and telephone companies will be required to adopt only the best-known methods. There are probably over 500 miles of overhead electric wires in the city. Mr. Hoffman's ordinance compelling them to be put underground within the space of two years will be the first organized attack by the council upon the present system of overhead wires. The ordinance will meet with strong opposition from the telegraph companies, but the telephone company is said to favor it because the underground system, it is said, will cost it less than the present one. When the ordinance is considered in committee a hot light against it is looked for.

At the meeting of the city council of Kansas City, Kan., last week an ordinance amending the franchise of the West Side Electric Railway company was passed. As amended the route of this road will begin at Fifth street and Minnesota avenue and run north on Fifth street to State avenue, east on State avenue to Third street, north on Third street to Greeley avenue, west on Greeley avenue to Quindora boulevard, and west on the boulevard to the western city limits. This change will meet with more favor than did the original route, and especially is Fifth street to be benefited. The company will soon begin the construction of the new line.

The directors of the Gate City Electric company have voted to increase the capital stock of the company from $10,000 to $30,000.

The Edison Electric Light & Power company of this city has increased its capital stock from $100,000 to $150,000.

The double track laid from the terminus of the Armourdale electric line of the Metropolitan system is now completed, and the operation of the line simply awaits the stringing of the wires. This line is now double track from the end of the Twelfth street cable at the stock yards to the smelter at Argentine, a distance of seven and one-half miles. The power plant will now be doubled, and a 125-horse power engine and two 80-horse power dynamos will be placed in the power house at Ninth and Wyoming streets. The car service will not be increased for awhile.

Kansas City capital and enterprise have just fitted up Augusta, Ga., with ten miles of electric railways. The capitalists at the head of the enterprise are S. M. Jarvis and R. R. Conklin of the Jarvis Conklin Trust company, while D. B. Dyer, a former Kansas Cityan is in immediate charge of the road as president. W. B. Knight, of Kansas City, is chief engineer, and his assistant, Will Southron, is in charge of the work. The road is 15 miles in extent and the cars were started in just four months from the time ground was first broken. Several Kansas City gentlemen, who were at Augusta to see the road opened to the public, say the people of Augusta regarded the quick and effective work as something almost phenomenal. The enterprise is altogether a Kansas City one, the road being built by Kansas City capital, under Kansas City management and by Kansas City builders.

The city council of Kansas City, Kas., has passed a resolution instructing the city counselor to appear before Judge Miller of the district court and get from him an opinion as to the exact rights of the Kansas City Electric Light company. The matter was the result of the attempt of this company, which is a Missouri concern, to put wires into a house on Central avenue.

The electric light plant of the new Kansas City steamer, A. L. Mason, attracted considerable attention upon its arrival here last week. The headlight and two side lights are furnished with current. The headlight is so arranged that the pilot can turn it and concentrate its rays on any point. Both the Kansas City boats now under construction will have the same light facilities. The plant was furnished by the Fort Wayne Jenney Electric company. The headlight is of 10,000-candle power and each of the side lights 5,000-candle power. P.

Nashville, Tenn.

NASHVILLE, July 12.—The first effort to introduce the electric light in this city was made several years ago when electric lighting was in its infancy. The pioneer company was known as the Brush Electric company. It became popular through its superiority over former methods of illumination and it laid the foundation for a fuller development. This company was succeeded by the Nashville Electric Light & Power company, which greatly extended the territory covered by the original company. The contract between the city and the latter company expiring by limitation Jan. 1 last and a new company, composed mostly of local capitalists and called the Capitol Electric company, which had been organized, secured under certain conditions and restrictions the exclusive privilege of public lighting and some other franchises for a limited term of years. The Capitol Electric company went vigorously to work as a separate and independent organization until a few months ago, when it secured by purchase all plants, outfits, rights, privileges and fixtures of its predecessors, and at present it enjoys a monopoly of all franchises hitherto granted and holds the exclusive contract for public lighting for three years. The Capitol Electric company is controlled by a board of five directors, of whom the three first named below are the chief officers: T. A. Atchison, president; J. H. Ambrose, vice-president; Adolf Dahlgren, treasurer; Dr. Wm. Morrow, W. L. Darnley.

The existing plant consists of two power stations conveniently located and aggregating 850-horse power, and 90 miles of circuit. The machinery is mostly of the Thomson-Houston system, although there are a few Brush machines in use. A Westinghouse alternating arc dynamo has already been put in on trial.

The Capitol Electric company covers the city from Tenth street on the East side to the Vanderbilt University on the West end, a distance of about 3½ miles from east to west, and for an equal distance from north to south, and transversely across the city in all directions. The wires of the old companies have been removed and replaced by new Grimshaw and Simplex wires.

There are now in use 250 arc lights for the city and about 200 for commercial use. More than a month ago a city ordinance was passed authorizing the placing of 100 additional arc lamps on the streets. The poles have been erected, but owing to a delay in shipping the wire the work is not yet done. This delay has been the cause of vigorous protests. The company, however, give assurance that the delay will not be protracted.

In addition to the arc lights there are now in use about 3,500 incandescent lights, and the number is increasing weekly.

The company will start a day circuit to operate stationary motors for driving small machinery. This is an entirely new thing here and from the contracts already made and applications presented it bids fair to prove a practical and and financial success.

Taken altogether the electric lighting system of this city compares very favorably with that of any other city of equal population.

The destruction of a portion of the pumping machinery of the Nashville waterworks on the evening of June 21 caused a partial water famine, and nearly all the steam power plants were stopped for several hours last Friday for want of water to supply their boilers. More than 40 electric cars loaded with passengers were suddenly stopped without warning in all parts of the city. There were a few mules and mule cars on the Northeast Nashville line which were put into use and when they arrived in the city with their little bells jingling they were greeted with laughter.

The work of laying track for the Nashville Electric Railway and Power company has been resumed after a temporary suspension by injunction served by the United Electric company. The line will be pushed to completion as rapidly as possible. No further litigation is apprehended.

An enterprising machinist named Frank Sheperd has secured a twenty years contract with the corporation of Dyersburg, a live country town in West Tennessee, near the Mississippi river, for lighting the town by electricity. He has had the business houses illuminated for three weeks and last week he turned the current on the street lamps. His little plant works well. B.

Des Moines, Ia.

DES MOINES, July 12.—The Des Moines Electric Street Railway company is expending an immense amount of money this year building new track and relaying the old. The amount of track has been increased from less than 20 miles last fall to more than 40 miles at the present time, and a large force of men is constantly employed in track laying. The system is now by far the most complete of any system in the state. The people of the city appreciate the public spirit that has led to the expenditure of $1,000,000 in the completion of this model system, and show their appreciation in a liberal patronage. There is, as a consequence, no more paying investment in the state that this one is proving itself to be. At least so say those in a position to know. Arrangements are about completed for the erection of two additional power houses, one upon each side of the river, an enlargement made necessary by the great extension of the line. The company has also purchased a large plot of ground centrally located, and will erect thereon car house and repair shops.

C. K. Harding of the little city of Atlantic, in the western part of the state, has invented a conduit system for electric railways. He uses a tight conduit in which the main wire may be thoroughly insulated. The inventor claims for his invention many advantages not possessed by any other system. A working model has been on exhibition in Atlantic for some days, and many visitors from surrounding cities have witnessed its workings. A stock company with a capital of $600,000 has been organized to push the invention.

The Edison Electric Light company has just completed and moved into a fine new power house in this city, located upon the bank of the Des Moines river. The old quarters of the company became too small to accommodate it, and the new building erected especially for its use is large and splendidly arranged. The new location is also a central one, and enables the company to reach its patrons with less expense.

A strike among the young lady operatives at the telephone exchange in this city has caused considerable trouble and inconvenience during the past ten days. Five of the oldest operators quit work on the Fourth. Their places have been filled and business is transacted as usual.

F. M. C.

Cleveland, O.

CLEVELAND, July 12.—During the recent hurricane one of the Brush iron electric light masts was blown down and completely demolished, causing little damage to property, however. The tower was valued at $5,000. It will not be replaced, and there is a probability of the others being taken down.

The new Arcade building, of which Chas. F. Brush of the Brush Electric company, is president, is open for business. The electrical equipments were furnished by the Brush company, and Cleveland Electrical Manufacturing company.

The new Hollender hotel has been furnished with 2,500 Edison lights.

The Time Electric company is exploiting its public and private annunciator systems, recently perfected.

Canal Dover had a jollification on the Fourth, dedicating the new electric road between that place and New Philadelphia.

Manager J. C. O'Neil of the Supply & Manufacturing company, is building up an extensive business. He has recently ventured into railway supplies.

The Sprague company recently furnished 30 car equipments and six 80,000 watt generators to the East Cleveland Railroad company. Twenty of the motors are for the new Garden street line.

H. F. Fletcher of the F. & F. company, who was seriously injured by the bursting of a cannon on the Fourth, is reported out of danger. C.

THE ELECTRIC LIGHT.

Ennis, Tex., has decided to erect an electric light plant for illuminating the streets.

The Fort Payne (Ala.) Electric Light & Power company will shortly enlarge its plant.

A $10,000 stock company will be organized to erect the electric light plant at Brenham, Tex.

A franchise has been granted by Henrietta, Tex., for the establishment of an electric light system.

The announcement is made that the authorities of Trenton, Tenn., will install an electric light plant.

The Matthews Cotton Mills company of Selma, Ala., is considering the question of installing an electric plant.

A company has been formed at Greensboro, N. C., to develop electric light and power plants. It is capitalized for $1,000,000.

The Austin & Gravis County Rapid Transit company of Austin, Tex., will construct a street railway and erect an electric plant to operate it.

The Crew (Va.) Land & Improvement company was incorporated recently with a capital stock of $150,000. The company will erect electric light plants

The Milledgeville (Ga.) Electric Light company will enlarge its power plant by the introduction of a 70-horse power boiler and 60-horse power engine.

George A. Redman, superintendent of the Brush Electric Light company at Rochester, N. Y., reports largely increased business both in arc lighting and motors.

The Satilla Manufacturing company has purchased the electric light plant at Waycross, Ga., and has already begun improvements. The company will add a 700 light incandescent dynamo and a 130-horse power boiler and engine.

More patent litigation is promised over the recent decisions of Judge Gresham in the Brush suits. The California Electric Light company has begun an action in the United States Circuit court at San Francisco against the Electric Improvement company to restrain the latter from using the American Wood arc lamps, which it is claimed infringe on the Brush patents.

The contract for the East Seattle Electric Light & Power company's station on Mercer Island, has been awarded and will be completed August 10. The station will be 40x60 feet in size, with a tower ten feet square and fifty feet high. The Thomson-Houston system of arc and incandescent lighting will be used, and an Edison generator for the motor line of railway. The building and machinery will cost when completed about $12,000.

L. N. Cox, Washington agent of the National Electric Manufacturing company of Eau Claire, Wis., recently installed in the Hotel Normandie, in Washington, a 1,000 light plant. The plant has given great satisfaction. Mr. Cox has just closed contracts for electric light plants at Nelson, N. C., and Rock Hill, S. C. The plant in the former place will illuminate the Mervon cotton mills, and that in the latter town will be used for lighting streets, business houses and residences.

The Brush Electric Light company of Baltimore, Md., having again been awarded the contract for lighting the city in spite of the strongest opposition on the part of other local companies, is now obliged to increase the capacity of its central station apparatus A contract for alternating current machinery for 3,000 lights was made with the Westinghouse Electric company a few days ago. This makes the Baltimore plant one of the largest alternating current central stations in the country.

The specifications for city lighting contracts for San Francisco have been drawn by the supervisors providing for not less than 5,100 or more than 5,600 lamps, which are to be lighted half an hour before sunset. The specifications for electric lighting call for twenty-one masts, one hundred and fifty feet high, each having a 16,000-candle power light, and one hundred and two masts forty feet high, each with a 20,000-candle power light. The lights are to be located as at present, and the contract will be for two years.

The Chicago Edison company has closed a contract with the Webster Manufacturing company of Chicago for a 250 light incandescent plant. Six arc lamps will be run on the incandescent circuit in this plant. The company is wiring the upper floors of the Rand-McNally building for 900 lights, and will put in two 500-light machines. The ground floor and the offices of the Chicago, Milwaukee & St. Paul Railroad company, which occupy the second and third floors, are supplied from the Chicago Edison company's station on Adams street. The Lakeside restaurant is supplied with 60 incandescent lights by the Chicago Edison company, and the same company last week installed a 30-light arc plant of the Sperry type. The Consumers' Pure Ice company has awarded a contract to the Chicago Edison company for a 100-light incandescent plant, and a 6-light arc machine of the Sperry type.

It is evident that the beauties and blessings of the electric light are not fully appreciated in all parts of this country. An "editorial" in an Iowa paper referring to the installing of a plant for lighting the streets, says: "If it's going to be hard on the cows, and make them climb on sidewalks to reach over fences, and get on their knees to eat under them, and stretch their poor necks over fences after shrubs all night, we'd best give it up and keep the town dark enough for them to be still long enough to rest. Is there a town over the broad earth where cows run loose under electric lights? If so, let's hear how the beasts do. Can they sleep? A town with electric lights and cows running loose in it would be a spectacle for gods and men, resembling a savage clothed in a silk hat, but the idea that they would never rest because it would be light enough to ravage all night we take to be just a device of pestilent kickers."

Electric lights will play an important part in the decorations of the Sioux City corn palace for 1890. A special plant will be installed on the grounds. All the buildings, etc., will be illuminated by electric lights and the effect of the decorations will be heightened by the profuse scattering of lights throughout the buildings. For instance, in the central building there will be an open space, 78 feet across, without a post to interfere with the interior decoration. This will be covered by an artistically painted sky at a height of 65 feet. It will be studded with stars made of incandescent lamps and the effect promises to be quite startling. The building will be so designed that the interior will be entirely novel in its construction, giving an idea of fairyland. There will be grottoes, beautiful and original ideas worked out in corn and showing the wealth of the great agricultural Northwest, as well as the ingenuity and artistic taste of its people. One of the features of the palace will be an immense waterfall, forty feet in height, lighted by myriads of incandescent lights, ending in a large lake containing many kinds of fish. The falls will be located at the extreme northeastern corner of the palace, and will be the first thing to greet the eye of the spectator upon entering the main portals. At no time will the light of day enter the palace. A special electric plant of 250-horse power will supply power for the dynamos which will be placed on the grounds. More than 3,000 incandescent lights and 50 arc lamps will be used in and around the palace.

THE ELECTRIC MOTOR.

The Elgin electric railway commenced operations on July 1.

Mobile, Ala., has closed a contract with the Gamewell company for the introduction of the fire alarm system throughout the city.

The Mt. Auburn Electric Line company has purchased the Mt. Auburn Incline plane. At a meeting of the directors of the road, President Littell presiding, it was decided to extend the line now building on out to Wyoming. It is completed beyond St. Bernard, and in six weeks will reach Carthage.

The Moberly, Mo., city council granted a franchise last week to the Western Engineering company of Kansas City, to build a street railway in Moberly, to be operated by electric power. The routes cover all the available streets of the city, and the franchise is for twenty years. Work will be commenced within four months.

The Yakima, Wash., Street Railway & Power company has been formed, capital stock $100,000. The company will establish electric light, power and railway service at North Yakima, and it will begin building three miles of track at once for its first electric street railway. Poles are being placed and wires strung for electric lights which will be in operation in August.

In an editorial note the New York *Sun* says: "Mr Villard the other day expressed very positively the opinion that great discoveries in electricity are at hand. In fact, he expressed this idea as absolutely as if the discoveries were already known to him. In five years, he said, there will not be a steam locomotive on any railway in the United States; and every kind of machinery will be driven by electricity."

A San Antonio correspondent writes: The San Antonio Street Railway company is equipping 12 miles of its lines with the Sprague overhead system. New cars and a power station are to be furnished. Several small plants of Edison incandescent are going up in San Antonio. The West End Street Railway company, of the same city, is putting in one car. The Thomson-Houston system has been adopted. The gas and electric light companies have been purchased by H. D. Kampenapen and are being rebuilt and enlarged. A supply house is in contemplation.

The directors of the Oakland & Berkeley Rapid Transit company have awarded the contract for the equipment of its lines to the Sprague company of New York. Eight cars and five miles of track will be operated at first. The expectation of the directors is to have the cars running between Oakland and Berkeley by November 1st. The track is now laid on Grove street to Fortieth street. A turn will be made at Forty-seventh street. Cars will make the complete trip from Oakland to Berkeley every ten minutes, and inside the limits of the city of Oakland cars will run every five minutes.

A dispatch from Alexandria, La., says: A street railway company was organized here, with Col. E. B. Wheelock as president, and Charles W. Green, treasurer, both capitalists of New Orleans, and officers and contractors on the Texas & Pacific Railway; R. W. Bringhurst, secretary, and Theus N. Miles, vice-president. At a meeting of the city council last evening the exclusive right for the term of fifty years was granted on all except four streets. Work will commence inside of a month, and at least two miles of track will be run over inside of four months. The road will be operated by electricity, and an electric light station will be built.

The first electric street car motor of the manufacture of the Westinghouse Electric company has now been in operation on the Pleasant Valley electric railway line in Allegheny City, Pa., for some time, and the success of the machine is beyond question. The great strength of the apparatus and the excellent workmanship are very apparent. The Westinghouse Electric company has already secured orders for the equipment of seventeen street railways, aggregating a business of $300,000, although the company has only been soliciting orders during the months of May and June. From the very moment it became known that the Westinghouse company had determined to manufacture street railway apparatus, orders and communications have been received from all parts of the country.

In view of the fact that there will be no horses to step on a balance plate and open the switches for the new electric street cars, many inventors have been devising schemes to obviate the necessity of the driver or engineer leaving his car to arrange the rails. One of these devices was exhibited last week to New York and Brooklyn street car magnates of long experience and they expressed themselves satisfied that the problem had been solved. Philip B. Downing, of Boston, is the inventor. The device consists of a double knob above and seesaw connecting rod beneath the roadbed and an easily worked brake attached to the car. Supposing the driver wished to open the switch. He turns the handle of his spiral brake, which, descending to the right level, presses down the knob on the roadbed and the switch opens. An extension from the rear wheel touches the knob as it passes and the switch swings back to its original place.

The storage battery car exhibited recently at Providence, R. I., was given a trial trip last week, and it gave excellent results according to the local papers. The car is of the same pattern as those on Fourth avenue, New York, and is very comfortable. Power is applied by two Thomson-Houston motors, and the car floor is one step above the platform. There are two iron folding gates at each end of the car. The car is lighted by six 16-candle incandescent lamps, and weighs seven tons with all its appurtenances. It was manufactured for the United Electric Traction company, formerly the Julien company, by the John Stephenson company. The motors are 10-horse power each, and are wound for 250 volts. Underneath the seats on each side of the car there are six trays of cells and nine cells in each tray, making 54 cells on each side, and 108 in the car. By what is called the elevator system, the cells may all be removed from the car on the outside and another set be substituted in the space of one minute.

The Rochester, N. Y., Street Railway company is pushing its work of substituting electricity for animal power, and a correspondent in that city says the work is beginning to show. There are fifty miles of railroad track in the system and the greater part of it will have to be relaid. The rail used is manufactured by the Johnstown, Pa., steel rail company and recommended by the state railroad commission as least likely to interfere with general traffic on the street. Twenty-five miles of this rail have already been ordered and very largely delivered, consignments of rail arriving by nearly every train. It is estimated that the material and labor involved in relaying the tract will cost the company at least $[illegible]00,000. It is also estimated that 450,000 pounds of copper will be required for wiring the system. The new cars are being rushed through the shops and 100 will be ready when the system is opened. The new power house now in course of construction will be in the New York Central Railroad track just west of the river. It will have a frontage on Mill and Center streets, extending back to the race, and in excellent position to handle coal, etc. The site cost $20,000, the building $60,000, and the equipment nearly $200,000. The power house will be of brick, two stories in height. Its smoke stack will be 150 feet high. Besides the power plant there will be located in the building a complete machine shop in which will be lathes, planes and all the machinery necessary for a fully equipped iron-working machine shop. It will be the policy of the company to do its own repairing. The power plant to be put in at the present time will consist of four Heine boilers having a total capacity of 16,000-horse power; seven Ball condensing triple expansion engines; three of 300-horse power, three of 120-horse power and one of 60-horse power. The engines and boilers are being constructed by the Ball Engine company, of Erie. For the present use of the company there will be nine Brush dynamos of 120 horse power each, but the power house is built upon plans which anticipate the extension of the plant to nearly double its present capacity. It is estimated that the improvements, etc., will cost $[illegible],000,000.

THE TELEPHONE.

Long distance telephony has introduced or rather made possible a new form of amusement which is attaining popularity in eastern cities. This new fad is a telephone concert in which half a dozen cities are interested. Thus at Buffalo, Rochester and other cities in New York, last week, select audiences were entertained by selections presented at Troy and Poughkeepsie by noted vocalists and instrumental music from New York.

According to the Rochester (N. Y.) *Herald* quite a number of the local telephone subscribers gathered at the Powers hotel recently to test the long distance telephone, having been invited by the local officials of the American Telegraph & Telephone company. Connection was made with New York and a phonograph in the Lenox Lyceum was plainly heard. The gentlemen present also had the pleasure of talking with people in Boston and Philadelphia. The test was a very satisfactory one.

THE TELEGRAPH,

The members of the New York Stock Exchange are now furnished by the Western Union Telegraph company with self winding clocks, with bell attachments, which strike at 12 noon and 2:15 p. m., delivery hour, exactly in accord with the standard time from the United States Observatory at Washington. These clocks never get out of order and require no regulating. They are not sold, but are rented for a small monthly charge.

The establishment of a cable line between Halifax and the Bermudas makes the latter far more valuable to Great Britain as a stopping point and station for provisions. That government has accordingly pledged a subsidy. The cable will do much toward developing the islands and it will give the world an opportunity to learn something of the daily happenings in that part of the globe. This cable will soon be extended to Jamaica and Nassau.

It is reported that every telegraph wire on the Union Pacific railway near Sydney, Neb., was cut July 10, and all communication with the West and Pacific coast by this, the main route of the Western Union Telegraph company, was completely severed from daylight until late in the afternoon. A lot of cowboys who had been working on a round-up near Sydney visited that town at night, and, when they had exhausted all the pleasures of the metropolis of Cheyenne county, at daylight they mounted their ponies and proceeded a few miles west of the town, where they set up a target against a telegraph pole. They spent some time in hitting it from various distances, but, the mark proving too easy for their skill, they turned their attention to the insulators and wires, and only desisted when they had knocked off all the insulators and cut every wire with their bullets. The Western Union Telegraph company sent linemen to the scene but it took them all day to repair the damage.

Miscellaneous Notes.

The third international fair and exposition will be held at San Antonio, Tex., from September 30th to October 11th. It is stated that electrical companies, desiring to make exhibits, will be furnished space and power free.

The Universal Electric Construction company has been formed in Chicago for the manufacture and sale of electrical machinery; capital stock, $500,000; incorporators, Charles M. Peal, Edwin Brainard and Frederick H. Wood.

The Hardy High Speed Engine company has been organized at Chicago to manufacture and deal in steam engines and other machinery; capital stock, $100,000; incorporators, Mark P. Leonard, Malcolm N. Owen and Lewis J. Blossom.

The real plaintiff in the conspiracy and damage suit brought by the North American Underground Telegraph & Electric company against the big telegraph and telephone corporations of the country is William H. Johnstone. Mr. Johnstone had a patent conduit which he invented and developed in Philadelphia and brought three or four years ago to the metropolis to introduce to the business world. The North American Underground company now owns the Johnstone patents, and Johnstone owns enough of the company's stock to make him its leading spirit. He is an active, aggressive man, and believes he will make out a strong case against the Western Union and Bell Telephone people, who, he says, conspire to ruin his conduits so they can point to the underground system as a failure and refuse in towns and cities throughout the country to obey municipal ordinances requiring the burial of the wires.—*New York World.*

Personal Mention.

M. M. M. Slattery was in Chicago last week

Harry A. Kinney of Omaha was in Chicago this week.

J. F. Porter, of the St. Louis Electrical Supply company, was in Chicago last week.

W. S. Heger has been appointed manager for the Sprague company in California, Nevada and Arizona.

Ben M. Hammond, who represents the Sprague & Edison company in San Antonio, Tex., was in Chicago last week.

Alex. H. Lewis, who has had charge of the Chicago office of the C & C. Motor company, has resigned his position to accept a position with the General Edison company. Mr. Lewis' headquarters will be in Chicago.

George B. Shaw, general manager of the National Electric Manufacturing company, Eau Claire, Wis., was chosen supreme chancellor of the Knights of Pythias at the Milwaukee convention July 10th. He has the distinction of being the youngest man ever chosen to fill that position, being only thirty-six years of age. He is looked upon as the representative of the young men of the order.

Business Mention.

The Bergmann Electric & Gas Fixture company of New York has issued a circular calling attention to the "Universal" electric light fixture switch which it is manufacturing. This company deals in all kinds of electrical fixtures and devices.

The new factory of the India Rubber & Gutta-Percha Insulating company will start about September 1, with increased facilities. The new plant is at Yonkers, N. Y. The interior wiring of two of the largest buildings in the city of New York, the Madison Square Garden and the Metropolitan Museum of Art is of the Habirshaw brand, while the government cruisers, the Philadelphia, the Newark, and the San Francisco, are all fitted with the same wire.

The Consolidated Electric Storage company, New York, report a rather fine business under its new regime—1,780 accumulators were sold during the month of June, while already in July the orders are more than keeping pace with the record.

J. N. Beckley, secretary of the Rochester, N. Y., Railway company, in a letter to the Peckham Street-Car Wheel & Axle company of 239 Broadway, New York, says: "After a thorough investigation by our engineers into the merits of your patent interchangeable wheels, motor axle, and cantalever trucks, our company has awarded you the contract for 100 trucks equipped with said wheels and axles."

It is well known that the effective life of incandescent lamps giving a certain efficiency has been much increased in the last twelve years. Indeed some manufacturers now claim a life for their lamps which was not long ago thought to be impossible. Such a long life must be obtained at the cost of some energy supplied to the lamps above that which a short lived lamp of the same candle power would consume. Lamps are now on the market ranging from about 3.1 to about 5.3 watts per candle power, the life varying inversely as the energy. This would seem to leave quite a range, so that the most economical lamp to use in each case can be found from the cost of current and the cost of the lamps. Messrs. Howells, Preece and others have worked out formula for doing this. In practice, the consumer wants long lived lamps, yet his taste for a white light does not permit a very high watt lamp. The current supplier likes to please the consumer, and also to be saving of his coal pile. So he may pick the lamps either for the energy to be consumed by them or for their represented life. One of the factors will be only approximately known. As the lamps made by different firms will vary, many station managers find it well to make tests of various lamps rather than rely on the manufacturers' statements. The ordinary station instruments readily give the energy required by the lamps, but the life is not as easily kept track of. Labeling lamps of various makes and using them side by side can give only the comparative life of the different ones. As the actual life in hours is not found, the results are not of much value. They will simply prove the high watt lamp to last longer, but will give nothing from which to compute which is the most economical lamp for the given prices of current and coal. Station managers have felt their need of timing the lamps as well as measuring the current which they take, but have found no instrument on the market to make this easy for them. Their want is now met by Pattee's lamp hour recorder, which was illustrated and described in the WESTERN ELECTRICIAN two weeks ago. This instrument is practically a time-counter, and by noting its readings at the beginning and the end of the life of a lamp, that life is found in hours directly. As the apparatus is as simple as a clock, it ought to commend itself to station managers as an aid to them in reducing their business to more systematic refinement. When placed back of a gang-switch, it will at the same time replace a meter, killing two birds at one stroke. Any instrument which helps the station manager to get at the exact truth and to find the volts and amperes of the lamp which pays best all around is to be welcomed. The more so, if it is at once a time recorder, which will give a basis for fair charges. An instrument like the above would seem to do this, and some gain for the station men using it, is to be looked for. The lamp recorder is sold by the Great Western Electric Supply Co., 190-192 Fifth Ave., Chicago.

Electrical Patents.

Issued July 8, 1890.

431,542. Water Conveyer. George W. Bailey, Brooklyn, N. Y.

431,551. Electric Ceiling Block. Waldo C. Bryant, Bridgeport, Conn.

431,559. Magneto Electric Machine. Arthur E. Colgate, New York, N. Y.

431,564. Apparatus for Cutting Electrical Conduit Pipes. Sylvester P Denison, Brooklyn, N. Y.

431,565. System of Defending Harbors by Submarine Torpedoes. Alexander G. Donnelly, New York, N. Y.

431,578. Means for Moving and Guiding, Turning, Engraving, or Planing Tools. George M. Guerrant, New York, N Y.

431,597. Electric Signaling Apparatus. Geoffrey B. Lehy, Medford, Mass.

431,598. Signaling Apparatus. Geoffrey B. Lehy, Medford, Mass.

431,617. Apparatus for Preparing Electric Accumulator Plates. Charles F. Pollak, Paris, France.

431,618. Regulator for Dynamo Electric Machines. Gustavus A Polson, New York, N. Y.

The method consists in causing the lines of force emanating from a pole piece to cut both sides of the coils of wire on the armature, thus setting up in said coils opposing electro-motive forces.

431,633. Conduit for Electric Railways. Joseph H. Wehrle, Newark, N. J.

431,634. Electric Railway. Joseph H. Wehrle, Newark, N. J.

431,649. Electric Motor Apparatus. Stanley C. C. Currie, Philadelphia, Pa.

431,651. Private Line Telegraphy. Patrick B Delany, South Orange, N. J.

431,671. Signaling Apparatus. James H. McCartney, Rochester, N. Y.

431,681. Incandescent Lamp Socket. James J. Wood, Brooklyn, N. Y.

431,684. Trolley Pole Supporting Mechanism. John M. Andersen, Boston, Mass.

The last claim reads:

"10. In a trolley pole supporting mechanism, the combination, with a supporting base, of a sliding carriage, a pivoted trolley pole carrier connected to the sliding carriage to move the same, and means to act on the carriage in opposition to the movement of the said carriage produced by the movement of the trolley pole."

431,711. Electric Railway. Sidney H. Short, Cleveland, Ohio.

431,718. Thermal Cut-out. Lorenzo B. Favor, Bridgeport, Conn

431,720. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

431,721. Means for Attaching and Detaching Electric Lamp Bulbs. Solomon J. Jacobs, New York, N. Y.

431,742. Galvanic Battery. Charles R. Goodwin, Paris, France.

431,743. Composition for Porous Carbon Structures. Charles R. Goodwin, Paris, France

The composition consists of hard carbon, fibrous carbon, and a carbonized agglomerant, the fibrous carbon forming a highly porous structure throughout the composition.

431,776. Incandescent Lamp. George R. Lean, Boston, Mass.

431,777. Electric Device for Slaughtering Animals. Jacob D. Miller and James A. Dollemyre, Gunnison, Colo.

The object of the invention is to construct an effective device by which the slaughtering of animals may be accomplished by means of an electric current.

The invention consists in the combination, with a suitable pen provided with a metallic floor divided into two sections, of an electric generator, and an electrode for applying the current to the animal.

431,780. Subway for Electric Cables. Walter L. Parsley, Wilmington, N. C.

Claim 1 reads as follows:

"A nest of conduits composed of frame timbers having longitudinal conduit channels and one or more central timbers, each having longitudinal quarter circular conduit channels and a longitudinal semicircular or half conduit channel, all the timbers being laid together to form longitudinal openings or conduits."

431,784. Printing Telegraph. George B. Scott, Lakewood, N. J.

431 793. Automatic Telegraphy. Frank Anderson, Peekskill, N. Y.

The method consists in causing the transmitted impulses to effect an audible receiver simultaneously with the automatic receiver, the individual elements of the audible record being intelligible to the receiving operator.

431,794. Automatic Telegraph. Frank Anderson, Peekskill, N. Y.

431,810. Aural Attachment for Telephone Receivers. Edwin C. Hess, Montreal, Canada.

431,812. Dynamo. Edward H. Johnson, New York, N. Y.

431,823. Electric Railway Motor. Frank J. Sprague, New York, N. Y.

Claim 1 reads:

"A wheeled truck provided with springs for supporting a car-body and carrying an electric motor flexibly supported upon it, said motor being centered upon an axle of the truck with which its armature shaft is mechanically connected."

431,879. Apparatus for Electrical Conversion. Edward N. Dickerson, Jr., New York, N. Y.

431,883. Automatic Coin Controlled Phonograph. Leon F. Douglass, Grand Island, Neb.

431,885. Boiler Alarm. Daniel Focer, Cape May, N. J.

431,955. Metallic Pole for Electric Wires, etc. Joseph F. Schnieder, and David K. Carson, St. Louis, Mo.

431,962 Transfer Connecting Apparatus for Multiple Switch-boards Enos M Barton, Chicago, Ill.

The invention consists in a transfer switching apparatus, with which the different telephone lines are connected immediately after passing through the switch on the last board and so arranged that any line may be readily transferred from the connection with one board to a corresponding connection with another board, thus facilitating the classification or distribution of the busy lines among the operators. The invention is applicable to metallic circuit systems, single or grounded circuit systems, and to mixed systems of multiple switch boards, and the switching apparatus at the different switch-boards may be of the single cord type or of the more usual double cord type.

431,968. Process of Forming Porous Pots for Voltaic Batteries Charles R. Goodwin, Paris, France.

This process is carried out by mixing any proper agglomerant finely divided hard carbon with particulate organic matter capable of such carbonization as not to sensibly diminish the volume of the particles forming the paste with suitable pressure, and then firing so as to convert said organic matter into charcoal within the pores or spaces of the mass.

431,973. Hanger for Trolley Wires. John T. Herty, Boston, Mass.

431,977. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

631,978. Electro-Therapeutic Appliance. Abram W. Jackson, New York, N. Y.

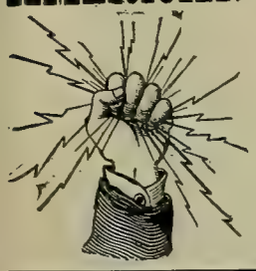
431,979. Automatic Fire Alarm. Henry E. Jacobs, Milwaukee, Wis

431,987. Printing Telegraph. Andrew T. McCoy, Boston, Mass.

432,003. Passenger Recorder. Augustus Torrey, Detroit.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

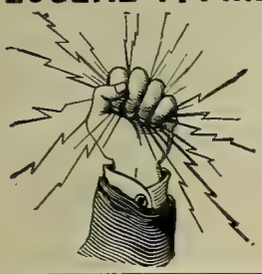
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS: W. H. SALISBURY & CO., Chicago, Ill. / A. H. GARDINER CO., Milwaukee, Wis. / TODD & STANLEY CO., St. Louis, Mo. / ENGLISH, MORSE & CO., Kansas City, Mo. / E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

WANTED.

2 DRUM ARMATURE WINDERS.
2 INCANDESCENT WIRE MEN
2 MACHINISTS.

Address **Royal Electric Co.,** PEORIA, ILL.

THE TURNER BRASS WORKS
MAKE ANYTHING IN BRASS
4 LASALLE AVE CHICAGO.

FRANK T. BROWN, Late
PRINCIPAL EXAMINER ELECTRICITY,
U. S. PATENT OFFICE, NOW OF
Butterworth, Hall, Brown & Smith,
Patent Attorneys,
25-26 HONORE BUILDING, - - CHICAGO.
Two complete sets of U. S. Electrical Patents.

NOW IS THE TIME TO BUY

AYRTON & PERRY'S

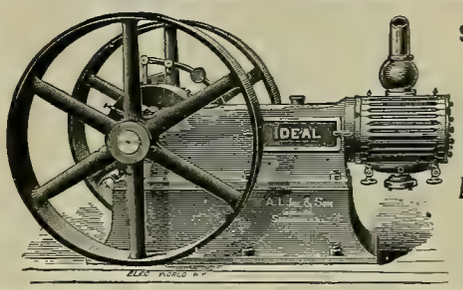
Celebrated Spring Ammeters & Voltmeters.

No permanent magnets. Scale divisions equal throughout. Portable. Direct Reading.

We have received large consignments from the makers, and are prepared to fill orders for all ranges AT ONCE.

QUEEN & CO., PHILADELPHIA.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers

SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

OKONITE
TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,
For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

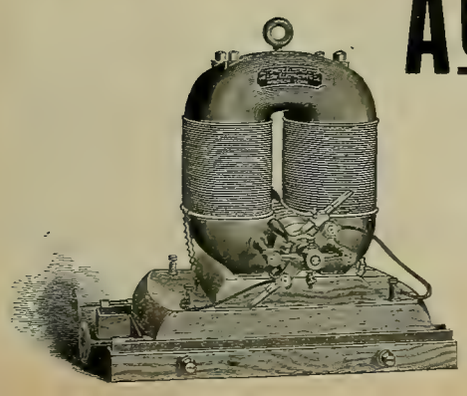
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

C., M. & ST. P. R. R.

The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

THE MONON ROUTE

Affords choice of Four (4) Fast Trains each way, commencing June 1, 1890,

EVERY DAY AND SUNDAY, TOO

In Pullman's Patent Perfected Safety Vestibuled Buffet Sleepers and Chair Cars between

CHICAGO and the OHIO RIVER.

These are all solid Pullman trains of latest design and improvements, consisting of Elegant Day Coaches, Chair Cars, Composite Cars, Dining Cars and the very finest of Buffet Sleeping Cars, equipped with Pullman's Perfected Safety Vestibules.

Trains from Cincinnati and the Southeast, and from Louisville and the South, arrive at Chicago in ample time to connect with the morning and evening fast trains for Milwaukee, Minneapolis, St. Paul, Omaha and all points in the Northwest.

Morning and evening connections made both at Louisville and Cincinnati with the Fast Express Trains of connecting lines for Memphis, Knoxville, New Orleans, Jacksonville and all points South.

At Indianapolis connections are made with all diverging lines.

Special Features: Steam Heat, Electric Light, Perfected Safety Vestibules.

For rates, through and local schedules, address any Ticket Agent of the Monon Route.

Wm. F. Black, General Manager.
W. H. McDoel, Traffic Manager.
James Barker, General Passenger Agent.

C., B. & Q. R. R.

—IS THE—

Best Appointed Line

—FOR REACHING THE—

West, Northwest and Southwest.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

ELECTRICAL WOOD.

Telegraph
Telephone
Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,
Room 410, Com'l Bld'g, St. Louis, Mo.

POND ENGINEERING CO.

707 and 709 Market St., St. Louis.
427 "The Rookery," Chicago.
31 Waterworks Building, Kansas City.
319 Ramge Building, Omaha.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

Erected Ready for Service.

SPECIALTIES:—The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, etc.

SEND FOR LATEST CATALOGUES.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

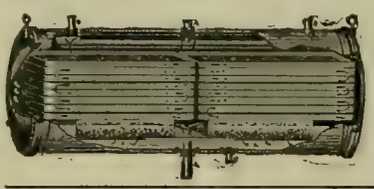
Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. Correspondence Solicited.

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents SCALE in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

The Rae "Horn" Ammeter

A New Measuring Instrument.

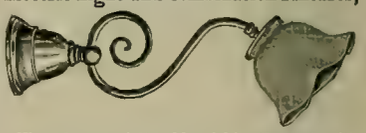
Send for Circular and Price List.

LOCKWOOD INSTRUMENT CO.,
91 Griswold St., - DETROIT, MICH.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

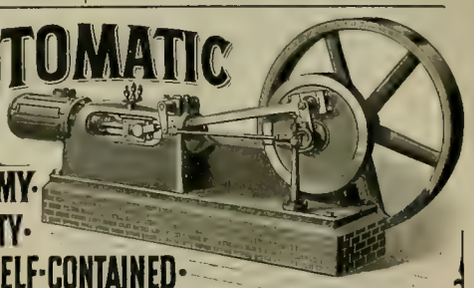
OFFICE AND FACTORY:
85 and 87 FIFTH AVENUE, CHICAGO, ILL.
Send for New Descriptive Circulars.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,
FITCHBURG, MASS.

THE RICE AUTOMATIC



GUARANTEED ECONOMY · REGULATION · DURABILITY · SIMPLICITY · SELF-CONTAINED ·

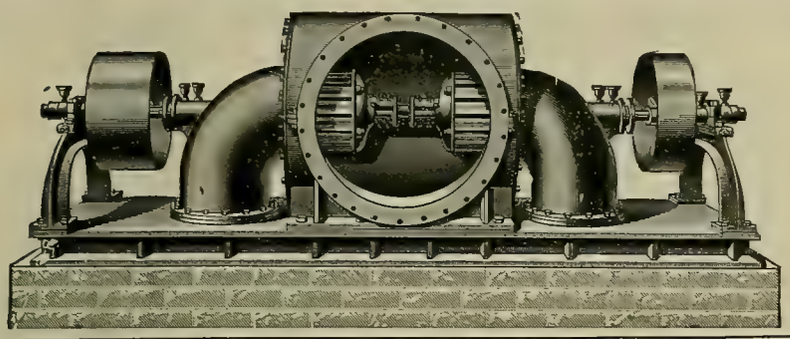
8 TO 300 H.P. PAIR & TANDEM COMPOUNDS · THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO.

1221-1223 Union Ave. KANSAS CITY, MO.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

WILLIAM S. BATES,

PATENT LAWYER,

204 Dearborn Street, CHICAGO.

17 YEARS EXPERIENCE IN THE PATENT OFFICE AND THE COURTS.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

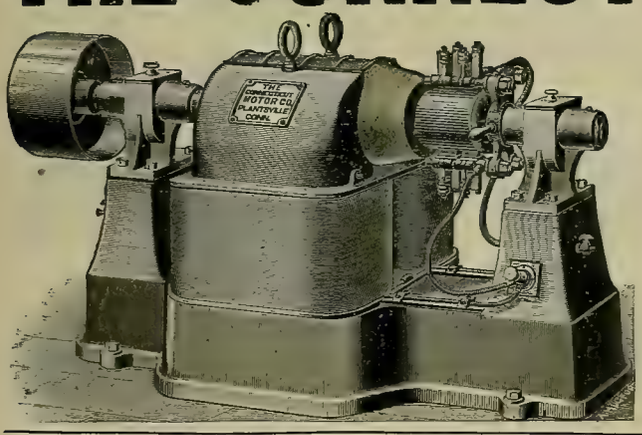
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 N. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

THE SPERRY ELECTRIC CO.,

D. P. PERRY, Vice-President and General Manager,

——MANUFACTURERS OF THE——

SPERRY IMPROVED SYSTEM

——OF——

ARC LIGHTING,

HIGH OR LOW TENSION.

WE GUARANTEE:

1. The new Sperry apparatus free from repairs for twelve months.
2. That the new Sperry improved Dynamos can be coupled in series with perfect safety.
3. That any number of lamps from one to capacity of dynamo can be cut in or out of circuit, singly or in groups, with perfect safety, and without sparking at the brushes.
4. To absorb power in exact proportion to number of lights burning.

WE BELIEVE:

1. The new Automatic Sperry Dynamos and Lamps surpass in efficiency those of any other make.
2. That there is greater economy in operating the new Sperry System than any other.
3. That our automatic regulation has no equal; no rheostat, no wall boxes, no solenoid or dash-pot.
4. That if you will visit our factory we can show you the best arc lighting apparatus in existence.

We invite correspondence with electrical engineers, intending buyers, and interested people everywhere.

THE SPERRY ELECTRIC CO., 195 to 207 South Canal Street, CHICAGO ILL.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for New Catalogue, out August 1st.

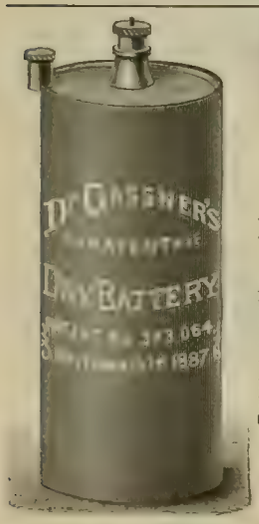
ELECTRICAL BOOKS

OF ALL KINDS.

Send for New and Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO, ILL.



DR. GASSNER'S

DRY BATTERY

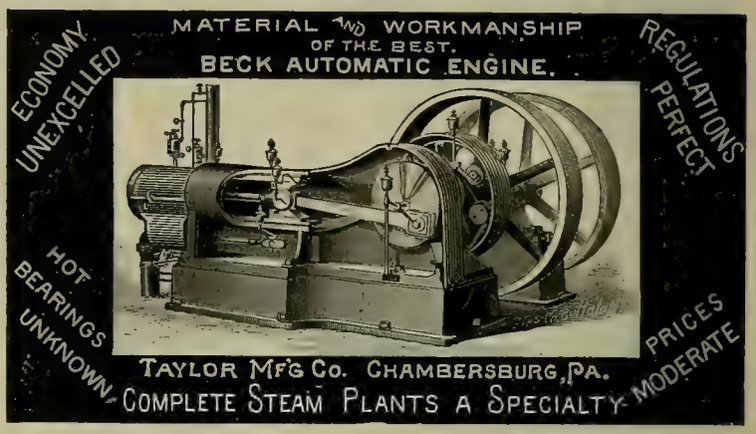
FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3½ in.
17.	"	7½ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1¼ in.
02.	Rectangular,	4½ "	2½ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,

111 Chambers St., New York.



C. H. & D. R. R.

BEST ROUTE

From CINCINNATI to the North and North West.

Binders FOR THE Western Electrician $1.00.

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

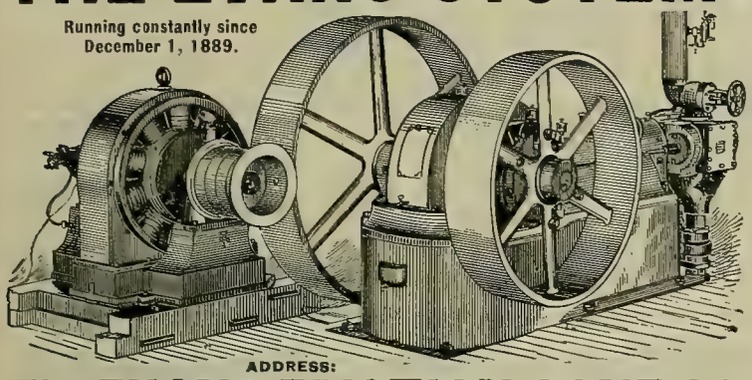
Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago. 111 Water St., Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

Running constantly since December 1, 1889.



UNION ELECTRIC LIGHT CO.,
FRANKLIN, MASS., June 13, 1890.

EVANS FRICTION CO., 85 Water St., Boston, Mass.:

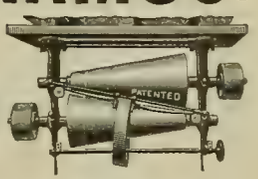
GENTLEMEN:—In reply to your inquiry, we will say that we are more than pleased with your system of driving dynamos. We have it in use on our 500 light alternator, and the severe tests which we have successfully applied to it have convinced us that it is a device of remarkable efficiency and power.

This dynamo had previously given us a great deal of trouble from hot bearings, but since the use of your friction, it has run perfectly cool. The belts prove durable and the power is transmitted with no slip, and a remarkably steady light as the result.

We find that it gives us perfect control of the dynamo, and that a sudden load of the full capacity of the dynamo can be thrown on without any jump, jar or slip. We have tested it in every way and do not hesitate to pronounce it the best system for driving dynamos in existence. Yours truly,

F. W. CROCKER, Superintendent,
Union Electric Light Co., Franklin, Mass.

We guarantee less pressure on the bearings for the same power than with ordinary belting.



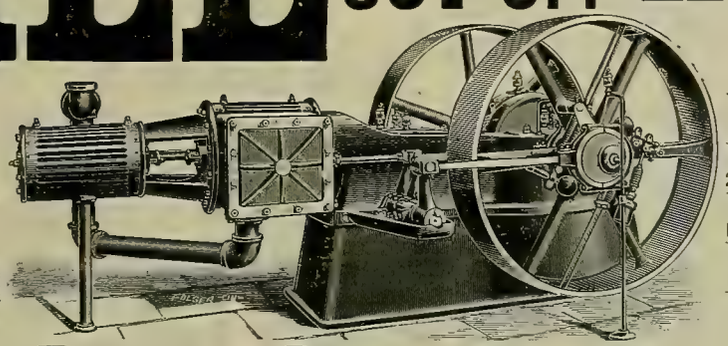
Also manufacturers and patentees of Cone Pulleys (as per cut) which have been in successful operation for over three years, transmitting from one to fifty H. P.

ADDRESS:

The EVANS FRICTION CONE CO., 85 Water St., BOSTON.

BALL AUTOMATIC CUT OFF ENGINE

Standard.
Cross Compound.
Triple Expansion.
Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER,
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Build'g, CHICAGO, ILL.

OMAHA ENGINEERING COMPANY,
Sheeley Building, OMAHA, NEB.

KANSAS CITY ENGINEERING CO.
KANSAS CITY, MO.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS M. WILKINS. E. WARD W LKINS

—TRADING AS—

PARTRICK & CARTER,

Manufacturers of and Dealers In Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO., - San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO., - Seattle, Wash.
WOLFE ELECTRICAL CO., - Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO., - Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

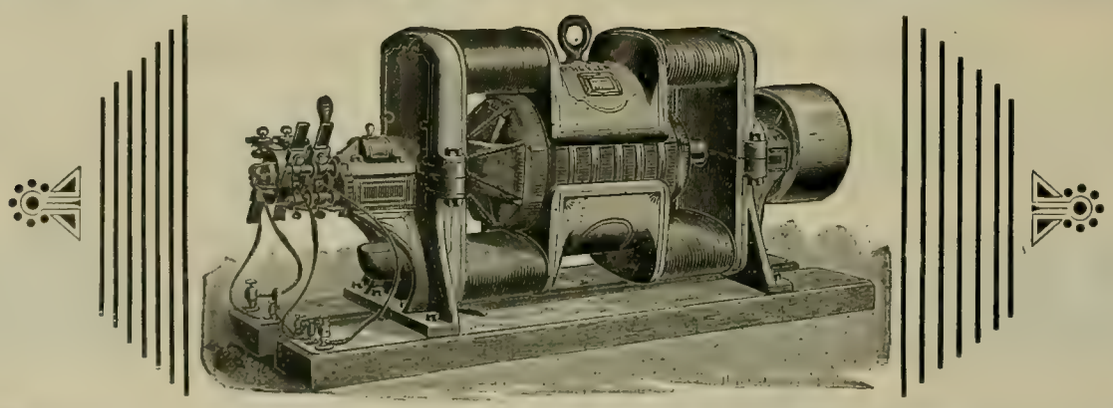
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY,

CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.

THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S

Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

OKONITE
TRADE MARK.
WIRES, CABLES, TAPE and CORD FOR PROMPT SHIPMENT.

HOGGSON'S
IMPROVED
Door Spring.
Has Shield to Protect the Pin.

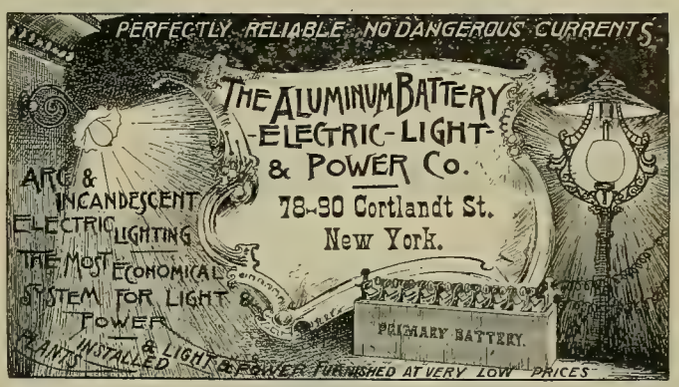
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

WHEN YOU BUY A MOTOR

From **ANY** Manufacturer or Dealer,
State that you WANT IT SUPPLIED WITH the

Whittingham Automatic Switch.

Send for Catalogue.
Automatic Switch Co.,
No. 8 Keyser Building,
BALTIMORE, MD.



GONDA

The Standard Open Circuit Batteries of the World.

AXO

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

TRADE
GONDA
MARK.

THE ONLY
Genuine Leclanche Batteries
Made or Sold in America.

LECLANCHÉ BATTERY CO., 149 West 18th St., NEW YORK.

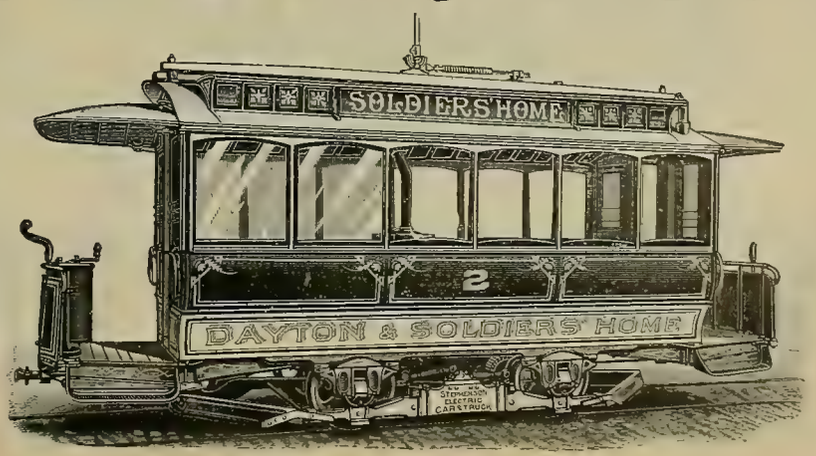
WESTERN ELECTRIC CO.,

We are the Exclusive Western Agents for the sale of
Washburn & Moen's Galvanized Iron Wire, Galvanized Steel Wire, and Hard Drawn Copper Wire.
Prices on Application.

CHICAGO. *NEW YORK.*

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
—FOR—
ELECTRIC MOTORS
CARS ADAPTED TO ALL SYSTEMS.

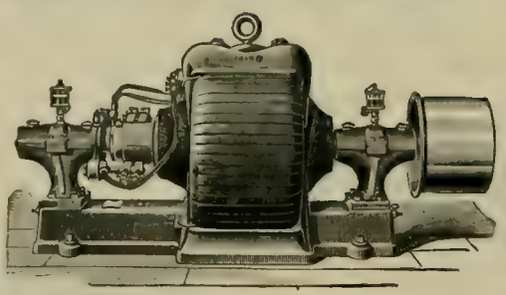


C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 8,000 Motors in actual operation.



FAN OUTFITS.

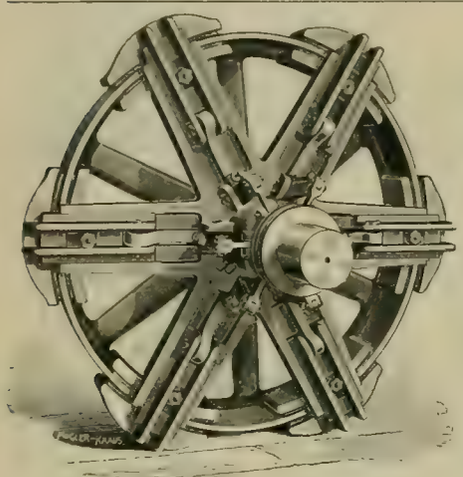
Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.



COPYRIGHTED BY H. W. HILL.

HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

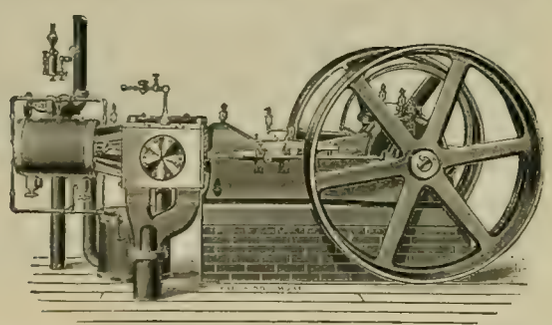
KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

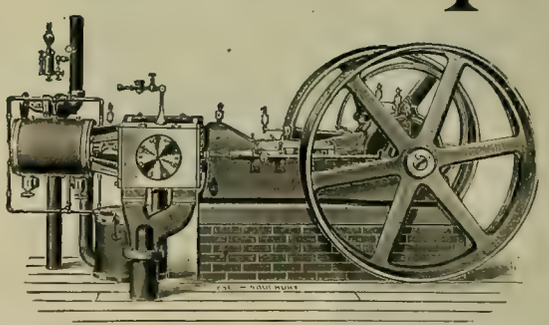
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

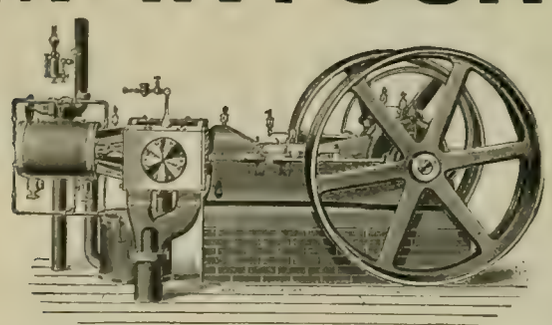
None so Good, None to Equal.



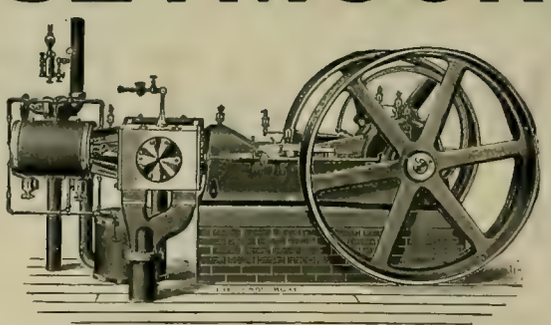
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction. Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices. Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,

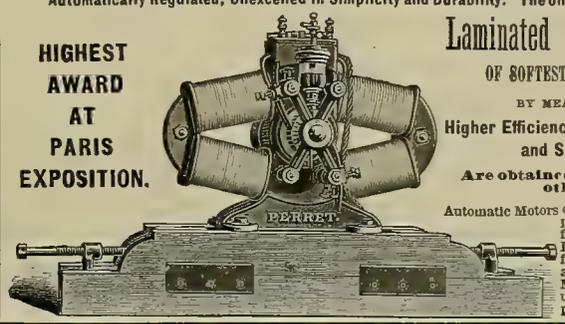
MANUFACTURERS OF

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

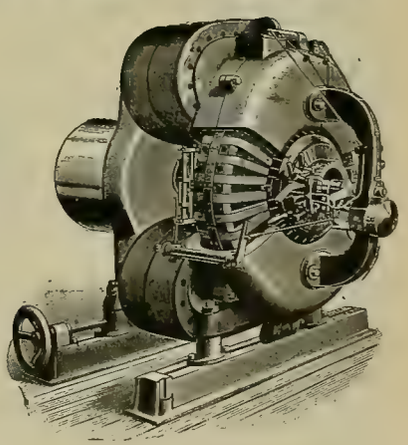
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

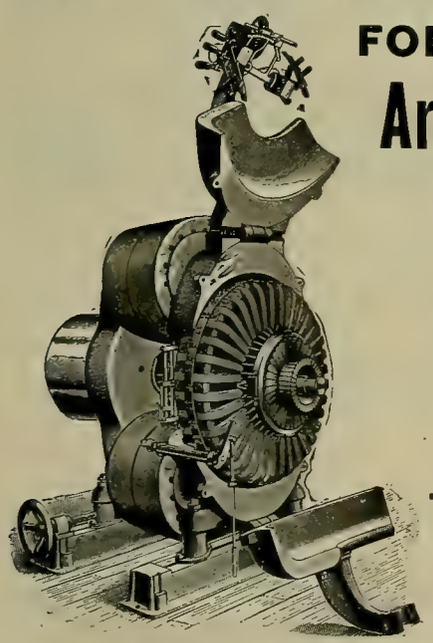
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features:

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st	Edition	2,500 Copies.
" " "	2d	"	2,000 "
" " "	3d	" (Just ready.)	2,000 "
Incandescent Wiring "	1st	"	2,500 "
Incandescent Wiring Hand-Book,	2d	Edition (Just ready.)	2,500 Cop'es.
Bell Hangers' "	1st	"	2,500 "
" " "	2d	"	1,000 "
Total within Eighteen months			15 000 "

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1 00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

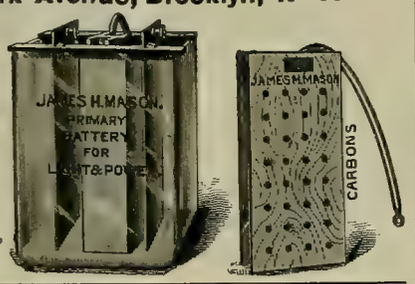
SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

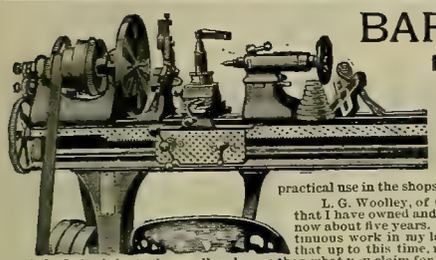
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.
These Batteries are in practical use, and giving perfect satisfaction.





BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

SPRAGUE
ELECTRIC RAILWAY SYSTEM.

More than one hundred different street railways in operation or in course of construction.

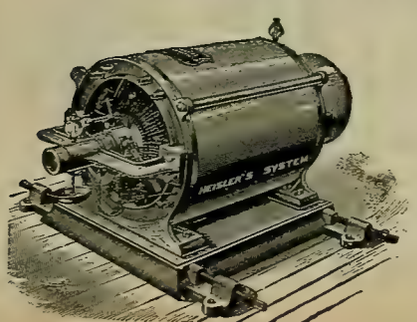
MORE THAN 175
SEPARATE ORDERS
From Street Railways for Electrical Equipments.

The Sprague Electric Railway System has been proved to be the most

DURABLE, RELIABLE, ECONOMICAL, CONVENIENT.

Sprague
ELECTRIC RAILWAY & MOTOR COMPANY,
16 and 18 Broad St., NEW YORK.

THE HEISLER PATENT LONG DISTANCE
INCANDESCENT ELECTRIC LIGHT SYSTEM.
UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,
809-817 South 7th Street, - - - ST. LOUIS, MO.

THE

THOMSON-HOUSTON

ELECTRIC RAILWAY SYSTEM

BY THE VERDICT OF OVER FIFTY RAILWAY COMPANIES HAS BEEN DECLARED

A PRACTICAL AND COMMERCIAL SUCCESS.

Schedule Time Regularly Maintained,
No Destruction of Apparatus,
Slight Cost for Repairs,

—ARE THE DISTINCTIVE FEATURES OF THE—

Thomson-Houston Railway System.

FIFTY ROADS IN OPERATION.
THIRTY ROADS UNDER CONSTRUCTION.
TWENTY CONTRACTS JUST CLOSED,

—MAKING A GRAND TOTAL OF—

ONE HUNDRED ELECTRIC RAILWAY COMPANIES

USING THE THOMSON-HOUSTON SYSTEM.

Illustrated and Descriptive Pamphlets Furnished to Prospective Purchasers.

THOMSON-HOUSTON ELECTRIC CO.,

MAIN OFFICE: 620 ATLANTIC AVE., BOSTON, MASS.

BRANCHES:

148 Michigan Ave, Chicago, Ill. Wall and Lloyd Sts., Atlanta, Ga. 403 and 406 Sibley St., St. Paul, Minn.

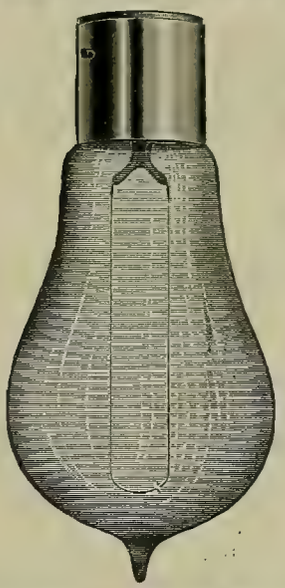
THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,
ALL CANDLE POWERS,
ANY VOLTAGE,
ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT Co., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER Co., Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

GRIMSHAW WHITE CORE

WIRES AND CABLES.

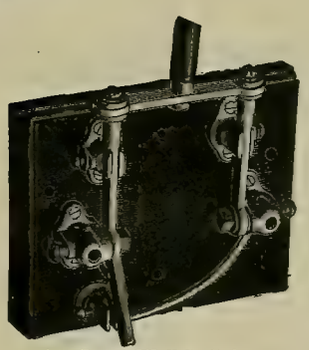
=FOR=

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

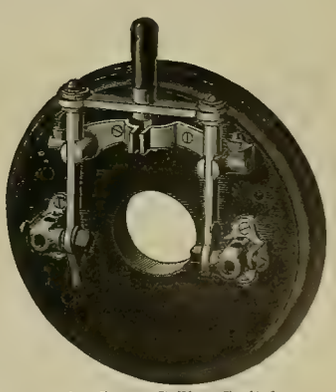
Switch-Board Cables,
Grimshaw White Tape,
Grimshaw Black Tape,
GRIMSHAW SPLICING COMPOUND.

McLennan Switch.

Paiste Switch.



Arc Lamp Wall Switch.



Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.,* CHICAGO, ILL.

THE Electrical Supply Co.,

171 RANDOLPH ST.,

C-H-I-C-A-G-O.

MANUFACTURERS OF

BARE AND INSULATED

WIRES AND CABLES

—AND—

GENERAL ELECTRICAL GOODS.

Catalogues or Quotations upon Application.

NO CHARGE MADE CUSTOMERS FOR EXPERT ADVICE.

A large and well assorted stock of Shield Brand and Habirshaw Wires constantly on hand.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219,208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219,208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

Manufacturers of the

SLATTERY INDUCTION SYSTEM

—OF—

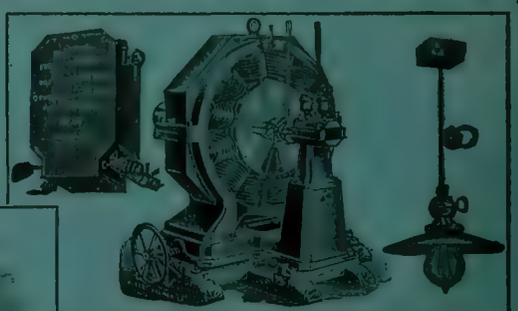
Incandescent Lighting,

—AND THE—

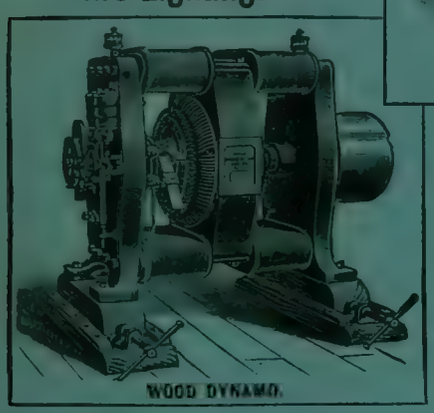
WOOD SYSTEM

—OF—

Arc Lighting.



SLATTERY DYNAMO, LAMP AND CONVERTER.



WOOD DYNAMO.

The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12–16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.

CORRESPONDENCE SOLICITED.

MAIN OFFICE AND WORKS, FORT WAYNE, IND.

NEW YORK OFFICE,
115 Broadway, Boreel Bldg.

SAN FRANCISCO OFFICE,
217 Sansome Street.

CHICAGO OFFICE,
185 Dearborn Street, First Floor,
W. J. BUCKLEY, Manager.

PHILADELPHIA OFFICE,
907 Filbert Street,
C. A. WILBUR, Manager.

PITTSBURGH, PA., 533 Wood Street.

CITY OF MEXICO OFFICE, F. ADAMS, Successor.

BERGMANN & CO.,

ELECTRIC LIGHT, COMBINATION

AND

GAS FIXTURES,

ADAPTED TO ANY SYSTEM OF INCANDESCENT LIGHTING.

ALL APPLIANCES FOR THE EDISON ELECTRIC LIGHT.

Illustrated Catalogues, Designs and Estimates Furnished on Application. Correspondence Solicited.

Office and Works, 292-298 Avenue B, } **NEW YORK** { Show Rooms, 65 Fifth Avenue.

T. W. WILMARTH & CO., 227 State Street, CHICAGO, ILL.

AGENTS FOR OUR FIXTURES IN THE NORTHWEST.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, JULY 26, 1890. No. 4.

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { BAKER, BALCH & CO., Seattle, Wash. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufactures can be found at our Agencies.

THE ACME OF FINE CONSTRUCTION.

OUR WIRES

OUR CABLES

STANDARD UNDERGROUND CABLE CO.,

Westinghouse Building, PITTSBURGH, PA.

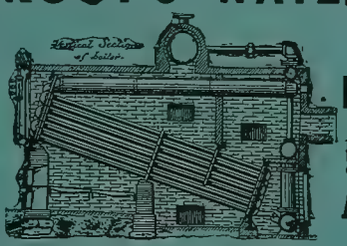
G. L. WILEY, Manager, New York. F. E. DEGENHARDT, Manager, Chicago.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

ELECTRIC PLANT BOILER.



ROOT SECTIONAL SAFETY BOILER.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff Street, New York.

BRANCHES: BOSTON, PHILADELPHIA, NEW ORLEANS, DALLAS and CHICAGO.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Sub erranean Use, Submarine Use

Concealed Wiring in all Locations

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

c b b a

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

THE EDISON MACHINE WORKS,

MANUFACTURERS OF

Weatherproof Wire. Insulated Iron Wire. Magnet Wire. Rubber Covered House Wire.
Annunciator Wire. German Silver Wire. Office Wire. Flexible Brush Holder Cable.
Gas Fixture Wire. Arc Lamp Cords. Tinsel Cords. Flexible Cords.
Telephone, Telegraph and Electric Light Cables.
PARAGON TAPE.

JAMES F. KELLY, General Sales Agent, - 19 Dey Street, NEW YORK.

WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave., Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment.
Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	1,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	791	.....	791
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	285
Waterhouse	232	.....	232
Heisler	.....	500	500
Remington	159	300	459
Sperry	130	.....	130
Excelsior	90	.....	90
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,250
Westinghouse	321	49,467
Edison	.....	13,853
American	1,587	[illegible]
United States	632	6 141
Schuyler	1,066	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	[illegible]
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	160	.....
Excelsior	205	30
Hochhausen	70	..
Weston	138	.....
Fuller	10	.....
Reliance	30	.
National	....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

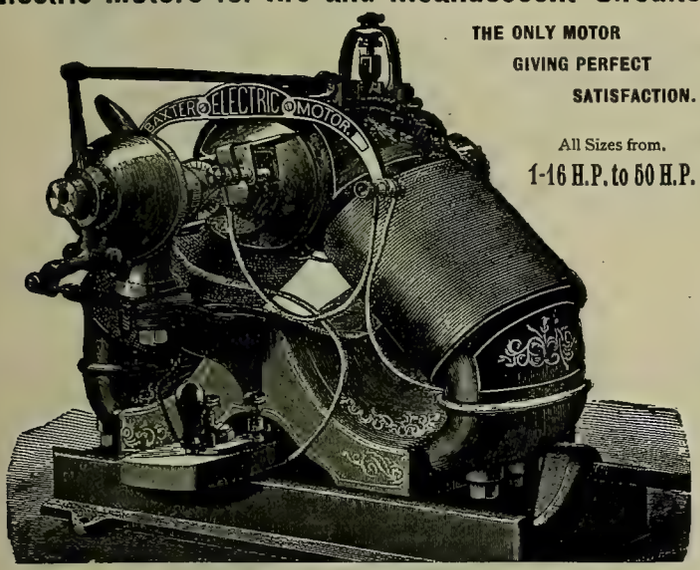
THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890.		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45.055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16.927	8,826	45,055	Lights in use as per clipping, March 20, 1889.	11,084	10,229	8.826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5.843	4,402	36.229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

To Arc and Incandescent
POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,
MANUFACTURERS OF
Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR
GIVING PERFECT
SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——
Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

PHŒNIX GLASS CO
OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF
ELECTRIC LIGHT

GLOBES **SHADES**

BOTH ARC AND INCANDESCENT.
RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.
ADAPTED TO ALL SYSTEMS.

729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

THE HAWKEYE
ELECTRIC MFG. CO.,
DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station
AND
ISOLATED PLANTS,
ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

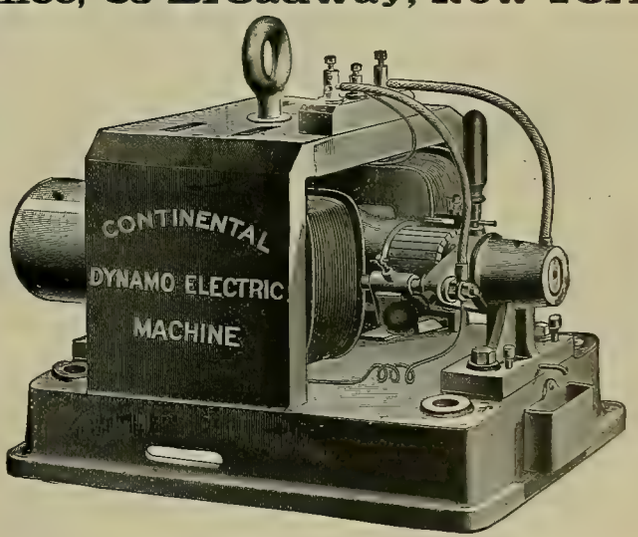
Licensee of the ***Renowned Perkins Incandescent Lamps***, Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

CONTINENTAL DYNAMO CO.
DYNAMOS AND MOTORS,
Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF
Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, Journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

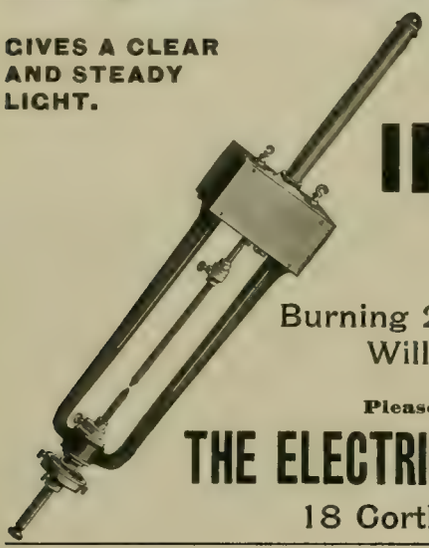
THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

GIVES A CLEAR AND STEADY LIGHT.



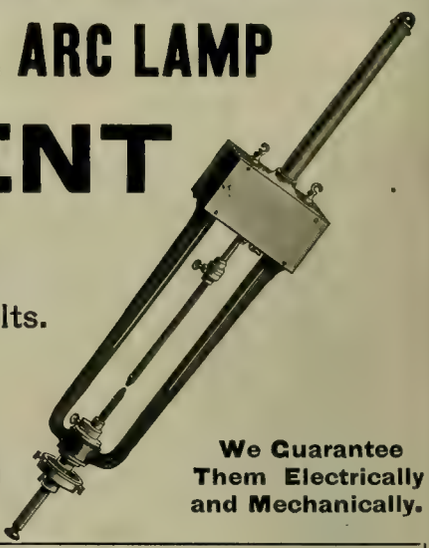
THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.



We Guarantee Them Electrically and Mechanically.

J. H. REID, GENERAL AGENT,
Room 9, Metropolitan Block, CHICAGO.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 10 AMPERES.

ADVANTAGES OF THE CROSBY DRY BATTERY FOR OPEN CIRCUIT WORK.

THE CROSBY DRY BATTERY is the **best Open Circuit Battery in the market.** It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing **more work** than any other. In addition to this, it is the **most reliable, most compact, most durable** and **simplest** cell yet discovered. It is so constructed that it **is not destroyed** or seriously injured by **short circuiting,** and we are prepared to prove at any time that its **power of recuperation** is proportionately greater than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks, and all the uses to which Open Circuit Batteries may be put, **it has no equal,** whether it be compared with **Liquid or other Dry Batteries.** We guarantee **depolarization, abscence of offensive crystallization and perfect cleanliness.**

The Crosby Battery is the only Dry Battery sold **semi-charged. It does not work until wanted.**

The preference **as between Liquid and Dry Batteries** should always be given to the **latter,** provided the amount of working power required and a constant current can be obtained. **No form of Dry Battery** has as yet been placed before the public, **except the Crosby Dry Battery,** which will do the work of Wet Batteries and **give a constant supply of Electricity sufficient for reliable Open Circuit work at all times.** The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with which their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance, and easily broken and injured. **The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids,** and, after once being properly connected, **requires no attention whatever,** while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.

The Crosby Battery is **not affected by temperature;** whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for **Open Circuit Work.** If, however, through an accident, it becomes **Short Circuited, it recoups itself.** This cannot be said with equal truth of any other Dry Battery known.

The Crosby Dry Batteries are manufactured in **different sizes and forms,** to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in **the Crosby Dry Batteries varies from one to ten amperes,** according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

CYLINDRICAL.

SIZE IN INCHES.

	Height.		Diam.
No. 3	7¼	x	2½

RECTANGULAR.

SIZE IN INCHES.

	Height.		Width.		Length.
No. 2	5	x	1½	x	4½
No. 3	9	x	1½	x	8

TELEPHONE.

SIZE IN INCHES.

	Height.		Width.		Length.	Price.
Long Distance	7¼	x	2½	x	4¾	$2 00
Telephone	7½	x	2	x	4¾	1.50

N. B—OTHER SIZES AND SHAPES TO SUIT PURCHASERS.

[COPY.]

CROSBY ELECTRIC COMPANY, New York.

OFFICE OF FLEMMING'S ELECTRO MEDICAL INSTRUMENT MANUFACTORY,
No. 1009 ARCH STREET, PHILADELPHIA, March 8, 1890.

GENTLEMEN: The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan. 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29 when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan 30; 7:30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing.

Very respectfully,
(Signed) OTTO FLEMMING.

THE CROSBY ELECTRIC CO., Judge Building, Fifth Ave. & Sixteenth St., NEW YORK.

GREAT WESTERN ELECTRIC SUPPLY COMPANY.

190 & 192 Fifth Avenue, CHICAGO, ILL.

BOTTOMLESS

PIT TO CATCH THE UNWARY.

Such tests as those at Denver are valuable, and we would not consider it to our credit to try to "conceal" the reports. We make it our first aim to do everything we can to improve and advance the science we love. If **SIMPLEX WIRE** will not stand practical scientific tests, we wish to know it, and will then cease to sell it.

We will not give unusual rates on a large order and charge smaller customers all the more. Our quotations are uniformly as low as the quality of the wire admits.

The now famous order for **1,000,000** feet of wire, was refused by us because a reliable insulated wire cannot be made and sold at such a price.

WE INVITE COMPARATIVE TESTS FROM ALL SIDES.

Do you remember Mr. Harber's Kansas City Measurement?

Average resistance per mile,	P. & B.	1 133 305 Ohms.
	GRIMSHAW,	1 842 210 "
	OKONITE,	2 250 530 "
	SIMPLEX, 3 311 951	"

"THAT IS WHAT TALKS."

The Detroit Electrical Works

ELECTRIC RAILWAY SYSTEM.

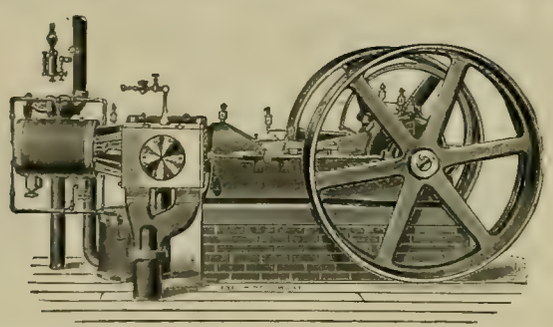
RAE PATENTS.

CHEAPEST.

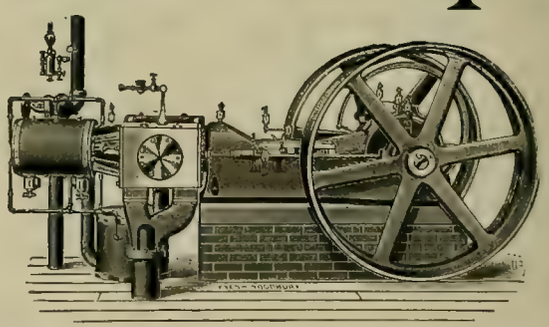
SIMPLEST. BEST.

The Detroit Electrical Works, Detroit, Mich.

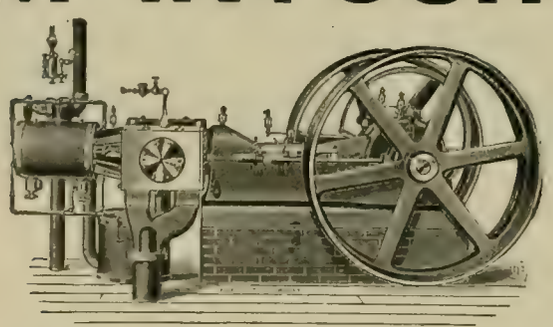
None so Good, None to Equal.



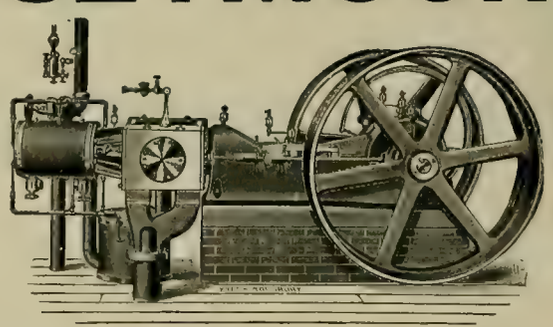
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

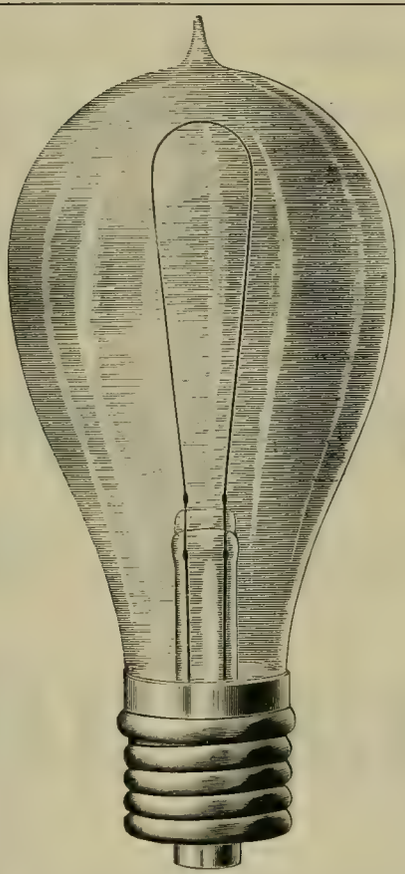
SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

UNITED
EDISON MANUFACTURING CO.,
16 & 18 BROAD ST., NEW YORK.
EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.

No. 2.
No. 2 is the Thomson-Houston.



The Edison Incandescent Lamp.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No. 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

SEND FOR CIRCULARS AND PRICES.

UNITED EDISON MANUFACTURING CO.,

Main District Offices:

Eastern District, 16 & 18 Broad St., New York City. Mountain District, 730 17th St., Denver, Colo.
Central District, Rialto Building, Chicago, Ill. Pacific District, Chronicle Bldg., S. Francisco, Cal.
Canadian District, Toronto, Canada.

THE BEST SOLID RUBBER CORE WIRE ON THE MARKET.

In order to meet the demand for an **ABSOLUTELY RELIABLE, YET LOW-PRICED** solid rubber core-wire, The Edison Machine Works have produced a new line of this class of goods made up in all sizes, from No. 0000 to No. 20. It is the equal in quality, finish and durability of their other well-known wires. Once tried, it will always be used in preference to any other.

IT IS THE NE PLUS ULTRA.

FOR PRICES, SAMPLES, AND OTHER INFORMATION, ADDRESS

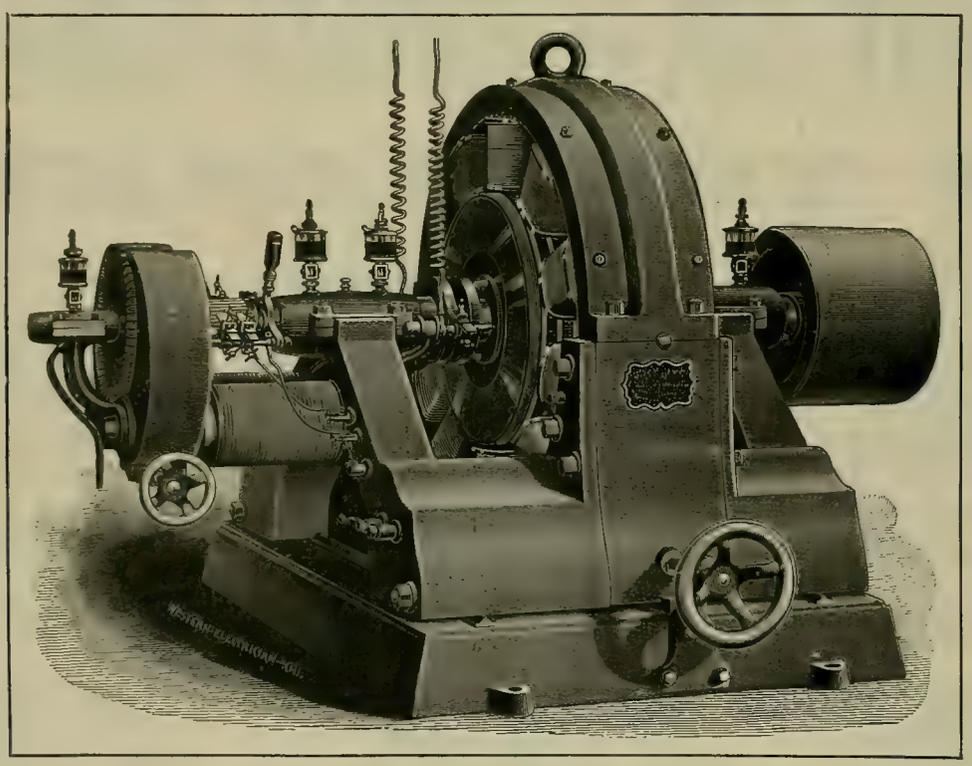
THE EDISON MACHINE WORKS,

JAS. F. KELLY, Gen. Sales Agent, 19 Dey Street, NEW YORK.

THE BEST OF ALL

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts.,
Seattle, Washington.
THOMAS WOLFE, Southwestern Agent,
Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.,
141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.,
1517 Larimer St., Denver, Colo.

CHAS. M. BLANCHARD, Agent,
Girard Building, Philadelphia, Pa.
L. N. COX, Agent,
16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent,
Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts.,
531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

BOTTOM-LESS

TO THE PUBLIC: We have recently received among other large orders one for **1,000,000** ft. of No. 14 A. W. G. B'd Okonite Wire. This particular order was placed with us solely on the merits of Okonite insulation, and after the company ordering had tried all the low-priced imitations. An advertisement appeared in the last week's issue of several electrical papers in the form of a letter which undertakes to give the result of an alleged test. In connection with the letter referred to we beg to call attention to the following, which explains itself:

"COPY."

THE DENVER CONSOLIDATED ELECTRIC COMPANY,

SYSTEMS: Brush Arc. Westinghouse Alternating. Edison Municipal.

GENERAL OFFICE,

C. H. SMITH, President.
E. W. ROLLINS, Vice-President.
W. W. BORST, Manager.
M. D. LAW, Supt. and Electrician.

Please address all Communications to 1534 Lawrence Street.

1534 LAWRENCE STREET,

(DICTATED)

DENVER, COLO., July 12, 1890.

CENTRAL ELECTRIC CO., 116-118 Franklin St., Chicago, Ill.

GENTLEMEN:—We beg to acknowledge the receipt of your communication of the 10th inst. in regard to an advertisement, the same purporting to be a copy of a letter written on our letter head and signed by H. Bottomley.

We beg to state that this has been done **without the authority or knowledge of this company, and should not have any weight or be considered at all.** We knew nothing of such a letter having been issued, **and Mr. Bottomley has surely no authority** to give such letters, and it will not occur again.

Very respectfully,

THE DENVER CONSOLIDATED ELECTRIC COMPANY,
By C. H. SMITH, President.

WE WILL NOT MISREPRESENT OR TRY TO CONCEAL FACTS.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable System.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

COLUMBIA
Incandescent Lamp Co.,
1912--1914 Olive Street, St. Louis, Mo.,
MANUFACTURERS OF
INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

JUST COMPLETED

THE LARGEST AND BEST EQUIPPED
INCANDESCENT LAMP FACTORY
IN THE WORLD.

Sawyer-Man Electric Co.,
510-534 W. 23d Street,
NEW YORK.

ARMATURES REPAIRED and REWOUND
COMMUTATORS TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

THE

WESTINGHOUSE ELECTRIC CO.'S

Alternate Current System of Incandescent Electric Lighting warrants your most careful investigation.

Three years ago half a dozen central station companies running a few thousand lights, had adopted it. To-day it is in use in three hundred towns and cities, and about 600,000 sixteen candle power lamps is the aggregate capacity of the 300 plants.

The first dynamos the Westinghouse Electric Company made are still in operation, but the improvement since that time has been great. Electrically and mechanically perfection has been attained.

The converters of the Westinghouse Electric Company have the highest attainable efficiency, and are from ten to fifteen per cent better in this respect than those of other manufacturers.

No central station can be operated to advantage without the Shallenberger Meter. No gas company, however small, would think of operating a station without meters, and the same reasoning is applicable to all electric light plants. Send for special circular on the Shallenberger Meter.

The Westinghouse Electric Company was the pioneer in the manufacture of alternate current dynamos in America, and all of its apparatus is celebrated in this country and abroad for its durability, efficiency and the satisfaction it has given to purchasers.

The Westinghouse Electric Company has recently utilized the alternating current for Arc lighting. Send for special circular just issued. A simple single carbon lamp runs four nights without renewal of carbons. Dynamos of the following capacities constantly kept in stock, together with a full outfit of detail, apparatus and lamps:

25, 40, 60, 125, 250.

No wall fixtures are required in the Alternating Arc System.

The machine is inherently self-regulating from full load to short circuit.

THE WESTINGHOUSE ELECTRIC CO.,

PITTSBURGH, PENN., U. S. A.

BOSTON, NEW YORK, CHICAGO, ST. LOUIS, CINCINNATI. SAN FRANCISCO. PORTLAND, ORE., CHARLOTTE, N. C., DALLAS, TEXAS.

BURNLEY DRY BATTERY

PATENTED January, 1890.

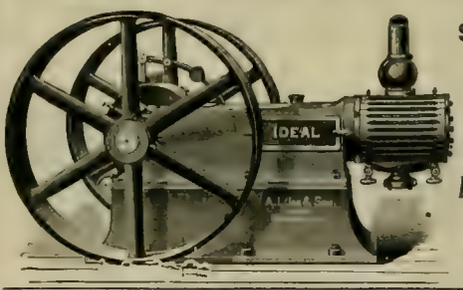
STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:—Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. **76 Cortlandt St., N.Y.**

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,
32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, June 9, 1890.

Messrs. Hazazer & Stanley.

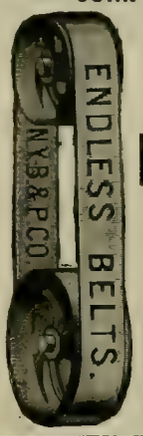
GENTLEMEN:—We have used your Dust Proof Iron Box Bells for the past five years and have always found them to give entire satisfaction and should be happy to recommend them to any one in search of a reliable bell.

Yours respectfully, *McKEERY & PENDERGAST.*
Electrical Contractors,
936 Sixth Avenue, NEW YORK CITY.

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTH, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
ST. LOUIS, 907-911 N. Main St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 131 and 1313 W. 12th St.
RICHMOND, 1306 East Main St.

IT KNOCKS THEM ALL!

BISHOP RUBBER COVERED WIRES.
BALATA INSULATED DROP CORD.

Prof. Henry Morton says: "These wires showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas."

THE "BISHOP"
Always Leads the Procession.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, - 341 ROOKERY BUILDING, CHICAGO.

INTERIOR CONDUIT & INSULATION CO.

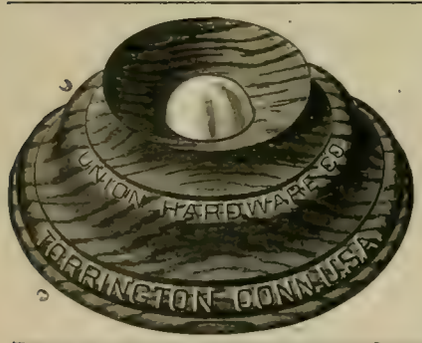
A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.
Edw. H. Johnson, President.



—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co.

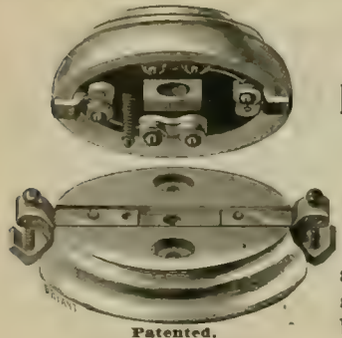
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.



DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

Patented.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.
Kept in Stock and for Sale by all Prominent Supply Houses.

—THE—
Celebrated P. AND B.
ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,
59 Maiden Lane, - NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, JULY 26, 1890. No. 4

Ferranti's Alternating Generators at Deptford, England.

Much has already been written and published concerning the electrical apparatus now being installed at Deptford, England, by S. Z. de Ferranti. The WESTERN ELECTRICIAN, however, has for some time appreciated the fact that although a great deal of matter has been published descriptive of the plant the illustrations which have been presented gave but an inadequate and unsatisfactory idea of Mr. Ferranti's colossal undertaking. With the object, therefore, of placing before its readers illustrations which could be relied upon as absolutely correct in representation of detail, the WESTERN ELECTRICIAN opened correspondence with Mr. Ferranti, and through his courtesy is enabled to present the accompanying views of the interior of the station. It is needless, perhaps, to point out that the pictures are reproduced directly from photographs, and for this reason make illustrations of more than usual interest.

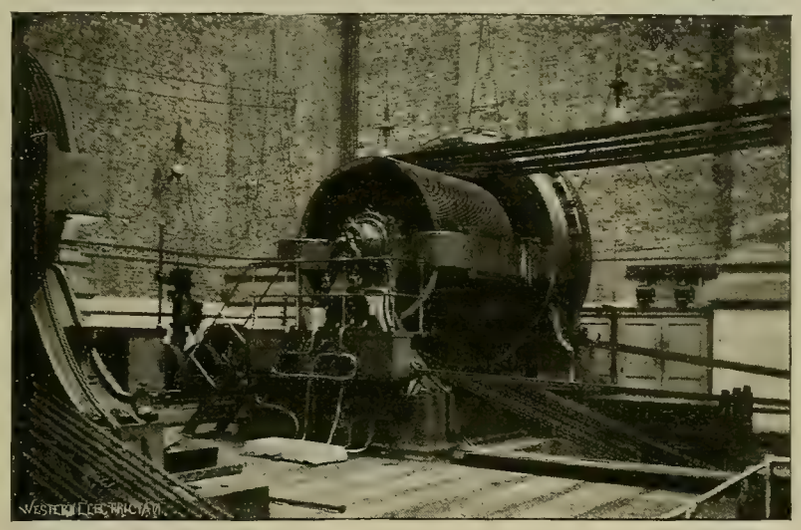
Mr. Ferranti writes: "The photographs show the two 1,250-horse power dynamos erected and the two 1,500-horse power engines for driving them. The whole of the ropes were not put on at the time the photographs were taken, but I may say that each machine is driven by 40 5-inch ropes. The diameter of the armature is 14 feet 6 inches."

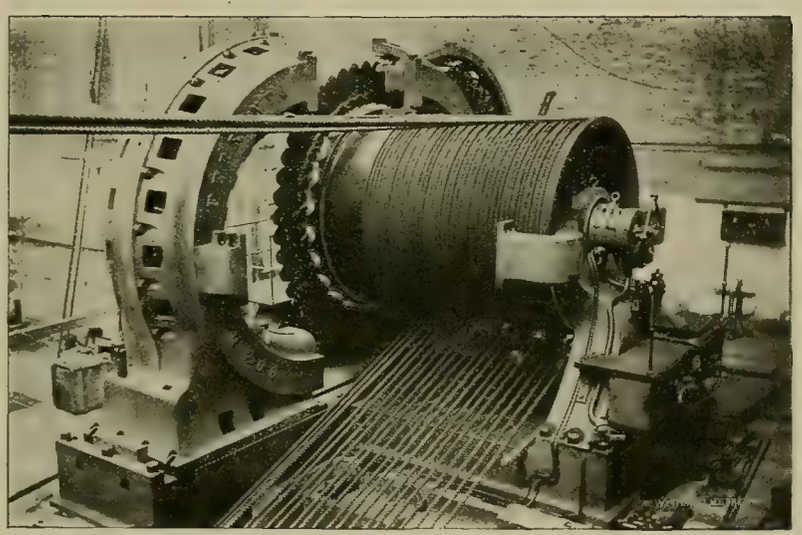
Attention should perhaps be called to the measurements as given by Mr. Ferranti. Those who have read carefully the descriptions of the Deptford generators will remember that the diameter of the armature of this machine has been given as 42 *feet*. The italics are ours. The "14 feet 6 inches" as now given by Mr. Ferranti makes the apparatus seem diminutive, comparatively speaking, but this is the correct size.

The visitor on entering the Ferranti building is struck with its enormous size. At first one is lost in admiration of the pluck and enterprise shown in setting up business on such a scale, but the feeling is soon qualified by an uneasiness as to whether the pecuniary risk is not unnecessarily great in proportion.

The present position of the corporation as regards mains may be stated. They have made and put down a mile or so of their own mains, but they are not in use. They have, therefore, to depend on the Fowler-Waring concentric mains. These are too small, and with the load now in use the loss over them amounts to over 1,200 volts. The outer conductor is only lightly insulated, and would not stand this, and the leakage all along the line from it to earth has given considerable trouble to the telephone companies. The corporation has therefore been obliged to use only the inner conductors of the cables, leaving the outer conductors idle. The action on the telephones due to the use of separate cables is avoided by crossing the leads frequently.

One engine and dynamo is now doing the Grosvenor Gallery work, and another engine and dynamo are ready for work. The cables now in use are Siemens' concentric for distributing mains at 2,400 volts, and Fowler-Waring for temporary trunk mains. The Ferranti concentric mains are being made, and about a mile has been put down, but they are not in general use yet. They have been officially and otherwise tested, by cutting through the outer insulation with a pick-axe until the outer conducting tube is exposed. The joints are long cones, so that any leakage would have to pass along a considerable distance to get to the other conductor. They are formed with the aid of ozokerite.





FERRANTI ALTERNATE CURRENT GENERATORS AT DEPTFORD.

The Montreal city electrician reported to the light committee on the 2d inst. that since April 1 there had, according to the re-arrangement scheme, been put in the east end 32 arc and 122 incandescent lamps, and a few more had still to be placed.

Electric Work in Switzerland.

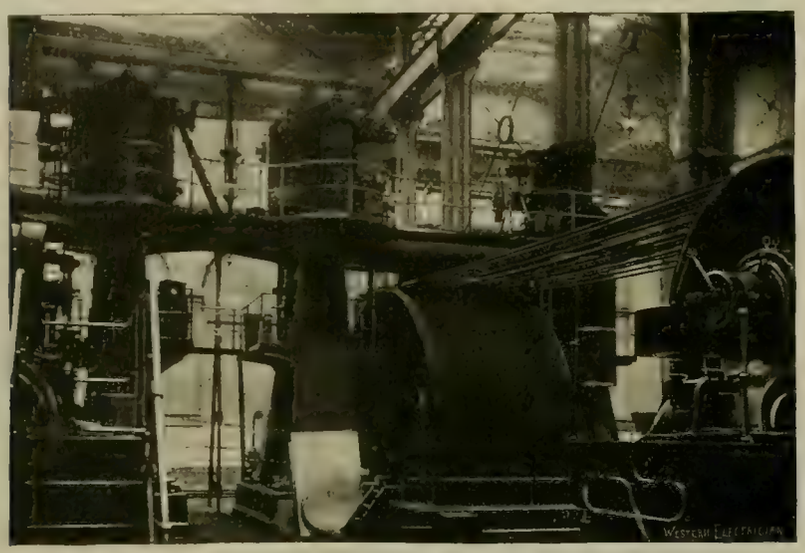
Emil Huber, of the Oerlikon Machine works, Switzerland, was in Chicago last week. Mr. Huber is the son of one of the proprietors of the Oerlikon works, and is making a combined business and pleasure trip through the United States. The readers of the WESTERN ELECTRICIAN will remember that it is the Oerlikon company, which is manufacturing Dr. Paul Schoop's accumulator with the gelatinous electrolyte, about which so much has been published of late. When asked as to what extent the Oerlikon accumulator had been introduced into practical service in the country, he stated that the cell, which is made in a separate department of the factory, had been in use experimentally on two Swiss roads for about a year. "Two railroads in Switzerland," he said, "are using Schoop accumulators for lighting some of the through trains. The cars, which are about three-fifths as large as those on American roads, are each equipped with a battery of 8 cells. No dynamo is carried on the train. The charging is all done at a station at one end of the route; 10 and 6 candle power 16-volt lamps are used in the cars, and the estimated total amount of light per car is equivalent to about that furnished by 54 candles. A battery for one car weighs about 400 pounds, and is carried beneath the car." When questioned as to the impressions of American progress in the electrical field, and of the work turned out in the factories, Mr. Huber hesitated a little before replying. "I have visited the Thomson-Houston factory and the Edison works," he finally said, "but have not yet been through the Westinghouse plant at Pittsburg. You are turning out an immense quantity of work, but for this reason I do not think it has, or can have, the finish to be found in apparatus built in Europe. But you must remember," he added, "I spent but a short time at your factories."

"The tendency with us," he continued, "is not to confine ourselves to any one system. We are experimenting with different ones all the time. What is the tendency in regard to machine design? Well, I may say that up to 100-horse power we prefer, as you perhaps know, the 2-pole machine with drum or ring armature. In larger sizes the tendency is toward 4 or 6-pole machines, with a preference for the 6-pole type."

In concluding the interview Mr. Huber was asked to name the American company which, in his opinion, turned out the best work. The question provoked a smile and an answer, but the reply was given only on the condition that his opinion should be kept a profound secret.

The Western Union Company's New York Building Burned.

Fire was discovered in the battery-room of the Western Union Telegraph company's New York building, Friday morning, July 18th. The attendants who made the discovery report that they saw a fine flame running along one of the wires, burning off the insulating material. They attempted to extinguish it, but their efforts were fruitless. The fire spread rapidly, and as 1,200 wires passed through this room, there was plenty of material for a quick blaze. Water, hand grenades and patent extinguishers afforded no relief, although freely applied. and this fact leads the company to believe that the telegraph wire must have become crossed with an electric light wire or power circuit. Nothing definite is known, however, about the origin of the fire.



FERRANTI ALTERNATING GENERATORS AT DEPTFORD STATION—DYNAMO ROOM.

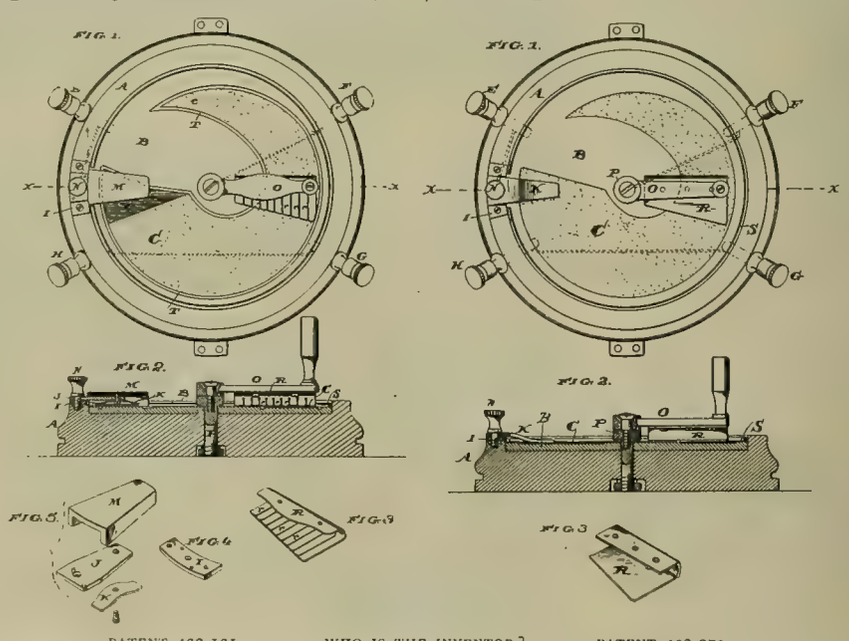
The flames soon reached the operating department on the floor above. This was the first warning the operators had, as the employes who had discovered the fire were still vainly engaged in attempting to stop its progress. When the hopelessness of this task was realized an alarm was turned in and the department responded at once. The thirty operators who were at work at the time did their utmost to extinguish the flames, but soon exhausted all their resources, and then turned their attention to saving valuable records. Five of the operators were trapped and were obliged to jump to the roof of an adjoining building, from which they were rescued by the firemen. Nine restaurant employes had an equally exciting experience. It was not until 12 o'clock that the last blaze was extinguished. The tenth and ninth floors were damaged only by water, and the same may be said also of the lower five stories and the basement. The destruction by fire was confined to the eighth floor, where were the Associated Press offices; the seventh, where was the operating room, and the sixth, which was the battery floor. The operating room was stripped of everything except the walls, the ceiling, and the floor. All the instruments, the tables, the windows, and the records kept there were destroyed. The brass and iron of the apparatus were melted into masses with the glass partitions of the tables stuck in curious shapes about them so that the floor seemed strewn with bits of conglomerate rock. It will take two months to refit this room. In the battery quarters everything was not burned up, but nevertheless everything was made useless. The dynamos which supply the current for all except a few local sounders were in the cellar, so that they are uninjured. The pneumatic tubes, except those going upstairs, were unhurt. The engines are all right, but the valves in the main building were destroyed. It is believed that an expenditure of $100,000 will be required to replace the burned apparatus and repair the damage to the operating room. This will be a dead loss, as the company, believing the building fireproof, carried no insurance.

Before the firemen had obtained control over the flames the company had begun operations looking to securing temporary relief. Linemen were summoned from Boston, Philadelphia and other eastern points, and by Monday excellent service was resumed.

Only once before in the history of the Western Union were all the wires of the headquarters helpless, and that was on "Blizzard Monday" in 1888. But this later calamity is far greater than the storm, for then linemen in a few days had repaired the damages; but in the present case it will require months to permanently replace the apparatus. The effect on business in New York and in all commercial centers was marked.

Who is the Inventor?

The accompanying cuts tell their own story. Inventors will find a comparison of these two patents highly interesting. Without commenting upon what is certainly a most peculiar proceeding on the part of the Patent Office, we simply append the first claim of each of the two patents, and leave readers to draw their own conclusions.



PATENT 432,131. WHO IS THE INVENTOR? PATENT 432,279.

Claim 1, patent 432,131, dated July 15, 1890, reads:

1. In a current-regulator or rheostat, the combination of a surface of non-conducting material coated with a conducting substance, and in which the conductivity decreases from one place upon the surface to another, means for connecting a conductor with a portion of the conducting material of greatest conducting power, and a movable contact device movable over the contact-surface and formed with a series of flexible fingers resting upon said conducting material.

Claim 1, patent 432,279, dated July 15, 1890, reads:

1. In a current-regulator or rheostat, the combination of a surface of non-conducting material, provided with a coating of conducting substance which gradually decreases in breadth from one point to another, means to connect a conductor with said coating of conducting substance at the point of its greatest breadth, and a contact-piece movable over said conducting surface with a contact face of greater width than the decreasing breadths of the conducting surface, whereby as said contact piece is moved over said conducting surface the area of its contact face in contact with the conducting surface will gradually decrease.

The application for patent 432,131 was filed by Otto Fleming, Philadelphia, March 27, 1890, and that for patent 432,279 was filed by G. B. Massey, Philadelphia, April 2, 1890. Both patents, it will be noted, were issued on the same day, July 15, 1890.

Safety Precautions in Arc Stations.

The question of safety in handling arc dynamos and circuits has occupied the attention of many central station managers. It is a noticeable fact that in the accidents reported in New York city, which attracted so much attention throughout the country, the victims in a majority of cases were linemen or employes of the electric lighting companies—men accustomed to handling high tension currents and acquainted with the attending dangers, but who had become careless. It is generally conceded that by exercising a certain degree of care, almost absolute safety may be insured. This is shown by the records made in several large central stations. In one of these, that of the Brush company at Rochester, N. Y., the superintendent, George A. Redman, has established a system which has proved thoroughly efficient. This company is running one of the largest arc plants in the country. It was a pioneer in the work of electric lighting, yet it has had a clear record throughout despite the fact that all its circuits are overhead and running through the streets. Mr. Redman has insisted upon a strict observance of the rules which he has framed for the guidance of the employes.

The printed instructions to the employes command the trimmers not to attempt repairs on circuits, but report any defects to the office immediately, in order that a lineman may be dispatched to perform the work. Specific instructions are given both linemen and trimmers as to their duties, and each is held strictly accountable for implicit observance of these regulations. In order that there may be no mistake as to responsibility, an excellent system has been devised for recording the actions of the linemen and noting the orders received from the office and the reports of all troubles, etc.

Thus, at the works, the circuits are tested five times daily, and reports of their conditions telephoned to the superintendent's office, which is in the business district. In case a ground or other trouble is reported, it is given prompt attention, taking precedence over any other work. When the trouble is reported at the superintendent's office, it is recorded in a book kept for that purpose, the man in charge of the station is

notified of the trouble, and he in turn makes an entry in a book similar to that in the superintendent's office. When trouble is reported on any circuit, a red wooden plug is placed in the circuit on the switch-board, and is not removed until the trouble has been repaired and the fact reported to the office from which instructions are sent to the station to remove the red plug. Under no circumstances is an employee permitted to go out on a circuit unless a red plug is first inserted in the switch-board, which indicates that the dynamo plugs must not be inserted until repairs are made.

A complete record is kept of all tests, also of the time of making them, and if any trouble is reported, its nature and the reports of the linemen. A record is also kept of all labor and repairs to dynamos and power plants. With this thorough system constantly before them, the employes are impressed with a sense of the dangers attending a reckless handling of live high tension circuits, and the result has been a record free from serious accidents. It will be readily seen that if these regulations are closely

FIG. 1. PHOTOGRAPHING LIGHTNING FLASHES

followed, it is scarcely possible for employes to sustain injuries through shocks, and should any occur, it is reasonable to assume that they are victims of their own carelessness.

Photographing Lightning Flashes.

The accompanying representations of lightning flashes are reproduced from photographs, taken by W. N. Jennings, of Philadelphia. He begun photographing flashes in 1882, with the object of proving that the discharge follows a wavy line and not a zig-zag path, as usually depicted by artists. Mr. Jennings writes the WESTERN ELECTRICIAN concerning this work as follows: "After eight years' photographic study of this interesting question, I have come to the conclusion that the zig-zag form of lightning is merely an optical delusion."

Fig. 1 represents a vertical discharge, which was photographed during a storm on July 11th

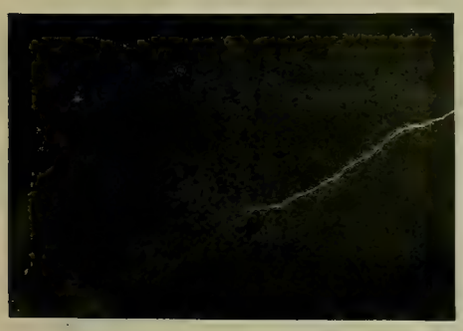


FIG. 2. PHOTOGRAPHING LIGHTNING FLASHES.

last. Fig. 2 shows a wavy horizontal discharge. Fig. 3 shows a second horizontal discharge, which was photographed during the present month. Fig. 4 represents a flash which was photographed in August, 1887. This discharge struck and fired a barn two miles distant from the point at which the camera was located.

The American Electrical company of Kansas City, Mo., has closed a contract for 600 arc lamps of the Wood type with the Fort Wayne Electric company.

Electric Railway Bonds.

A big financial deal is reported from St. Louis, which will prove interesting to all who are engaged in electric railway work, as it tends to show the confidence which experienced capitalists place in the electric railway. James Campbell, of St. Louis, last week, invested $1,500,000 in electric railway bonds. This transaction marks the heaviest financial deal of the year, and its importance as an indication of the extent of street railway development in St. Louis makes the details of the gigantic negotiation of peculiar

FIG. 3. PHOTOGRAPHING LIGHTNING FLASHES.

interest in business and financial circles. The Union Depot Railway company, of which John Scullin is president, has expended $500,000 in its change to the electric overhead wire system, and has outstanding $350,000 of its bond issue. It has decided to hold back a reserve fund of $150,000 to be used for securing increased power, and the application of the overhead electric wire system to the yellow and white lines of its system, and with this line of action agreed upon, the company authorized the $1,000,000 bond issue, covering all the extensive improvements made and contemplated. The bonds will be dated October 1, 1890, and the entire issue was sold to Mr. Campbell at a price which, while not stated, is believed to be from 5 to 6 per cent. premium. The Mound City Railway company, of which John Scullin is also president, is now in course of reconstruction to the electric overhead wire system, and new 78-pound rails are being distributed the whole length of the track, which will be relaid its total length. It is expected that the change will cost $400,000, and the increased issue of bonds to a total amount of $525,000 was made to cover the present bonded indebtedness of $125,000, and the reconstruction cost of $400,000. The bonds

FIG. 4. PHOTOGRAPHING LIGHTNING FLASHES.

will be of the same date as those of the Union Depot Railway company. The transaction represents an increase of $500,000 in the bond issue of the Union Depot Railway company, and of $400,000 in that of the Mound City Railway company, giving a total of $900,000 increase, expended in developing and improving St. Louis street railway service.

Mr. Campbell was asked if the deal contemplated any change in the ownership and management of the road. He replied in the negative, and continued: "The lines will continue under the ownership of Mr. Scullin and his associates, who have been in control for the last 14 or 15 years. Both lines have been successful since the first five years of their existence, having paid for extensions built, property bought, etc., out of the earnings of the roads, besides paying a handsome return on the investment." The increase of traffic on the Union Depot Line since its change to the overhead electric wire system has been from 35 to 50 per cent., and the stock of the company is worth from $250 to $300 per share. The stock of the Mound City Railway company is now worth $300 per share, and it is expected that when the change to electricity is made, the receipts of that road will be more than doubled.

The Polyphone.[1]

It is a well-known fact that the diaphragm of a telephone, when acted upon by a current of the proper strength, will produce sounds of various tones. In the electric trumpet, which was designed by Zigang, the current was periodically interrupted by the diaphragm itself, and a continual sound of a peculiar kind was produced. The electric trumpet is an apparatus which may be said to be intermediate between the telephone and the electric bell, for which it can be substituted in many cases. The sound of the im-

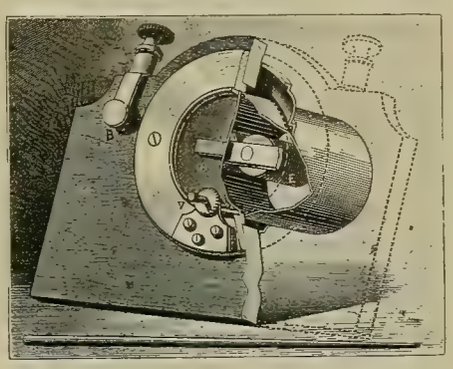


FIG. 1. THE POLYPHONE.

proved instrument resembles the oboe. Zigang desired to go farther and transform the instrument from a monophone into a polyphone, from which several distinct notes could be produced. The polyphone, as he has just designed it, is in the main the electric trumpet, spoken of above, and is composed of an electro-magnet *E*, Fig. 1, mounted opposite a diaphragm, upon which is fixed a soft iron armature, *A*. A platinum contact, *V*, makes and breaks the battery circuit leading to the electro-magnet. The diaphragm is continually attracted and released, and a sound is emitted. If a blunt point is applied to the plate or diaphragm, Fig. 2, a portion of it no longer vibrates. A shriller sound, therefore, is emitted, and the tone becomes higher and higher as the blunt point is applied to points nearer the center of the diaphragm. It is apparent that by touching the diaphragm at different points, one can produce the tones and half

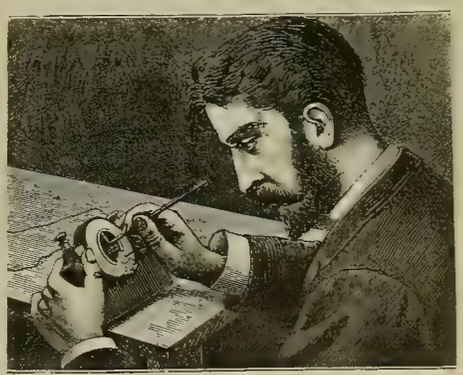


FIG. 2. THE POLYPHONE.

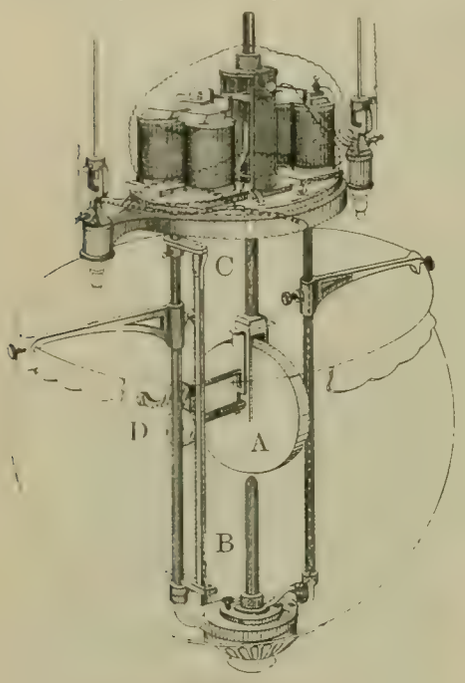
tones of the musical scale, and thus play a tune. Each note is made by pressing on the button *B*, Fig. 1, with the left hand, while with the right the blunt point is touched to the proper spot on the surface of the vibrator. It is stated that it will be possible to use auxiliary apparatus to make modulatory effects. For example, several batteries might be used, and one or more could be cut out; a solenoid with a movable iron

1 Abstract of an article in *La Nature*.

core could be introduced in the curcuit to modify the co-efficient of self-induction, and thus weaken or strengthen the tones.

Russell Disk-Carbon Arc Lamp.

The cut presented herewith illustrates the more important features of a new arc lamp in which the upper carbon is employed in the form of a disk. The principal object of this modification is to produce a lamp which will burn



RUSSELL DISK-CARBON ARC LAMP.

longer without trimming than the ordinary pencil carbon arc lamps.

From the illustration it will be seen that two lifting magnets and two shunt magnets are used, the same as is the case in a number of makes of the ordinary arc lamp; in other words, this portion of the lamp contains no very novel feature. The important modification consists in the combination, in the manner represented in the cut, of a vertically moving and intermittently rotating carbon electrode in disk form with a pencil shaped carbon electrode fixed in the bottom of the lamp frame. This portion of the mechanism may be described as follows: *A* is the disk carbon, which is suspended in a carbon holder extending downward from the top of the lamp. *B* is the lower or pencil carbon. This is similar to carbon pencils in use in the ordinary arc lamp, and is fixed at the bottom of the frame in a socket. *D* is a ratchet wheel, by which the journal and the disk carbon on it are rotated. *C* is a vertical rack-bar, the inner side of which is cut to match the teeth on the ratchet wheel. This rack is affixed to the frame of the lamp, and by engaging the teeth of the ratchet-wheel rotates the disk carbon, when the latter descends with the carbon-rod. Springs at both the upper and lower ends of the bar allow it a little play, so that it may not engage and rotate the ratchet wheel when the disk carbon and ratchet wheel are moved upward.

The operation of feeding will now be understood. When the lamp burns the arc between the two carbons is enlarged and the resistance increased. This action increasing the current flowing in the shunt magnets, actuates the armature lever and releases the clutch which holds the carbon-rod, letting it descend by gravity. At the same time the disk carbon is rotated toward the carbon point just far enough to present an unconsumed edge to the end of the pencil and near enough to make the proper arc. The pencil being stationary, the disk descends a little lower after each complete revolution until it is as nearly consumed as may be. As may be seen, the disk and pencil are held in position by mechanism which permits of their ready removal when desired. This lamp is the invention of Edwin C. Russell, of Boston, Mass.

The Evansville (Ind.) Gas & Light company will install electric apparatus costing $100,000.

Chicago Edison Plant Enlarged.

The Chicago Edison company is enlarging its plant at the central station on Adams street. Six new dynamos have been received, making eighteen machines in all, with a total capacity of 50,000 lights for the plant. The company started with eight dynamos, and in November last increased the plant by the addition of four machines. The last increase of six machines is to meet the requirements of the present time. It is thought that another addition will be required in the Fall. The Edison company's mains do not extend outside the business district of Chicago—in fact, they cover only a small percentage of the territory, yet there are 35,000 lights connected with the central station, and about 500-horse power in motors. During the last year the power service has increased so rapidly that the company has found it hard to keep up with the demand.

The company's present increase consists of six dynamos of the same style and capacity as those now in position, and three McIntosh & Seymour engines of 200-horse power each. The engines are of the standard type, but were built specially for the Chicago Edison company.

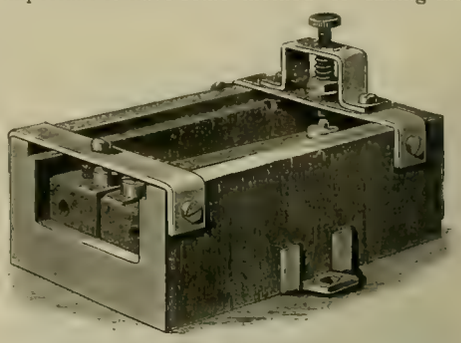
Electrical Exhibit at the Newark High School.

The physics class in the High School of Newark, N. J., devotes a great deal of time to the study of electricity. Every year the students, under the supervision of Prof. G. C. Sonn, construct electrical apparatus, of which an exhibit is made at the close of the term. The accompanying cut gives a view of the exhibit, which was made recently. The original impetus in this direction was given some years ago by Prof. Sonn, who announced to the boys that W. J. Hammer, Edison's representative at the Paris Exposition, had offered to give employment to the cleverest boy in the class. The boys took a great interest in their studies, and as a result two boys went to the Paris Exposition in the employ of Mr. Hammer. Since then Mr. Hammer has given prizes for proficiency in the physics class at the close of every school year. The Hammer prize this year was given for a Ruhmkorff coil. Most of the young men made a Leyden jar, a galvanometer and an electroscope. Several students made frictional machines, and several small motors were exhibited.

ELECTRICAL EXHIBIT AT THE NEWARK HIGH SCHOOL.

Storage Battery Cut-Out.

In using secondary batteries it is well known that too heavy a rate of discharge may permanently damage the cells, and it is, therefore, important to have some method of calling the



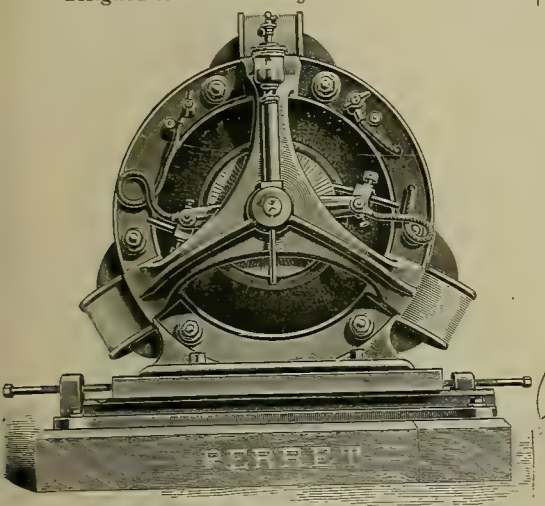
STORAGE BATTERY CUT-OUT.

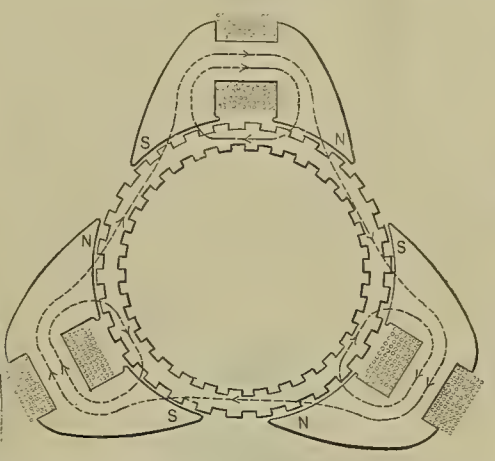
attention of the attendant when the current exceeds a certain value. With this object in view the Electrical Engineering corporation, limited, of London, has produced the device which we illustrate. The body of the instrument is of slate, on which is mounted a V-shaped compound strip, composed of two metals soldered together in the same way as the strips used in Breguet's metallic thermometers and in certain forms of compensating pendulums. The current from the cells passes down one leg of the V and up the other, and, of course, heats up the compound strip. Owing to the unequal expansion of its two metals, the end of the V coils upwards, until on the current reaching a certain value, its free end completes the circuit of an electric bell, thus warning the attendant that the

current has become excessive. The cut is from London *Engineering*.

Perret Low-Speed Electric Motors.

The accompanying cuts illustrate the automatic low-speed electric motor, designed by Frank A. Perret, electrician of the Elektron Manufacturing company of Brooklyn, N. Y. The machine is of the multipolar type—a form which the company has adopted for all sizes above 2-horse power. The low-speed motor is designed to run at from 500 to 600 revolutions per minute. For special work the armature can be wound for a speed of 350 revolutions. It is stated that while the speed is comparatively low, the machine is not heavy as is the case of many motors designed for slow speed for special work.





FIGS. 2 AND 3. PERRET LOW-SPEED ELECTRIC MOTOR.

The practical advantages of low speed machines are many. In ordinary machine shops, wood-working shops and printing offices, for example, the shafting is commonly run at from 200 to 300 revolutions per minute, and it is a simple matter to belt directly to it from a motor running at 500 or 600 revolutions. The countershaft and one belt are dispensed with, and considerable power is, therefore, saved. The same thing applies in the case of an elevator operated by a belt. In fact, in elevator work, it is possible to gear directly from the motor. The Perret machines have recently been applied by direct gearing to pumps and to coal cutting machines in mines and also to the operation of coal cutting machines by means of rope transmission from the motor to the cutter. The motors are peculiarly adapted to the direct driving of large exhaust fans and blowers, and to operating hoists and traveling cranes. In addition to the advantages of low speed in the special cases mentioned, there is, of course, in all cases a general advantage in the avoidance of the rapid wear and deterioration often connected with high speed.

The Perret machines are built with a 6-pole field and with armatures of large diameter. A powerful torque and great momentum of armature are secured, which are decided advantages when a heavy load is thrown suddenly on, as is often the case in elevator work and all sorts of hoisting.

Mr. Perret has been able to retain in these larger machines the distinctive feature of laminated field magnets which were characteristic of his smaller machines. He states that the results secured would be practically impossible with any other construction.

Fig. 1 is a side view of a 20-horse power motor complete, with sliding base and starting box. Fig. 2 is an end view of the same machine, and Fig. 3 is a diagram showing a cross section of the magnetic circuit.

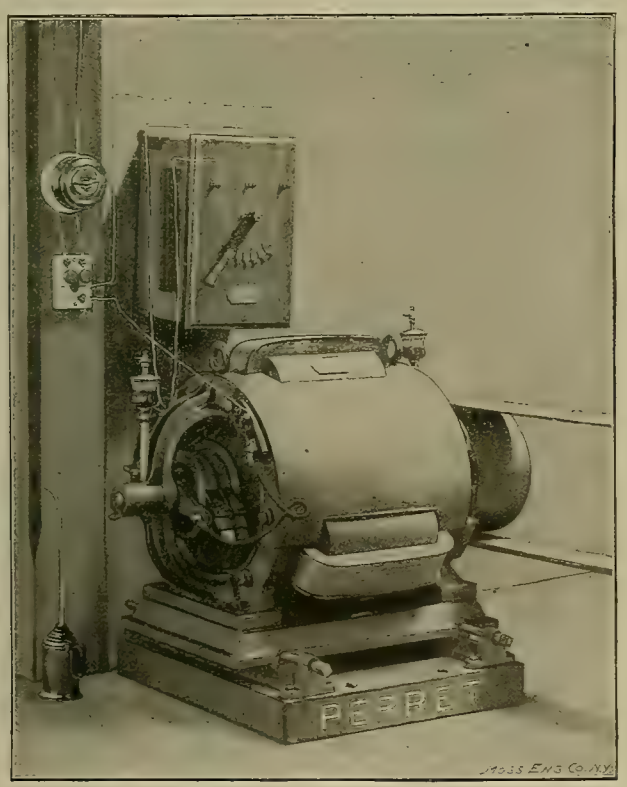


FIG. 1. THE PERRET LOW-SPEED ELECTRIC MOTOR.

It will be seen that the armature is a ring of comparatively large diameter, with longitudinal channels on its periphery, in which the conductors are wound. They are thus embedded in the iron, which is in such close proximity to the iron pole pieces that there is practically no gap in the magnetic circuit.

The field consists of three separate magnets, arranged at equal distances around the armature, each magnet having two pole pieces. The winding is such as to produce alternate north and south poles. The magnets are built up of plates of soft charcoal iron, which are shaped as shown in the diagram, and the magnet thus produced is of such form that it may be readily wound in a lathe. A non-magnetic bolt passes through a hole in each pole piece, and the plates are clamped together between washers and nuts. The bolts also serve to attach the magnets to the two iron end frames which are of ring shape, and are bolted to the bed plates of the machine.

FIG. 1. INTERIOR CONDUITS.

The magnetic circuit is of unusually low resistance by reason of its shape, its shortness, which is shown by the diagram, and the superior quality of iron used.

There is, it is claimed, no loss of magnetism in the frame or in the shaft of the machine, as the magnets are supported at some distance from the former by means of the non-magnetic bolts, and the armature is mounted on the shaft by spiders of non-magnetic metal. The whole machine is enclosed also by a shield or case of sheet metal, as shown in Fig. 1.

The machines are calculated to be equally as efficient dynamos, and are coming into use in many small isolated incandescent light plants. For this purpose they are compound wound, and the regulation, it is claimed, is so perfect that all but one lamp may be suddenly turned off without moving rheostat or brushes, and without noticeable change in the brilliancy of the remaining lamp.

Their low speed makes them well suited for direct connection to steam or gas engines, and they are suitable for lighting railway trains, yachts, steamboats, etc.

Interior Conduits.

In wiring for constant potential systems, it has been demonstrated by experience that the work can be most economically and effectively executed when centers of distribution are established from which all minor branch circuits radiate. The system of the Interior Conduit & Insulation company of New York has been modeled entirely upon this plan. For mains and feeders the company employs a separate tube for each conductor, in which a rigid wire, with either underwriter's or weatherproof insulation, is used. For branches the special flexible twin conductor, with both conductors in one tube, is always used. It is easily seen from Fig. 1, that by employing as many risers as possible long lateral runs, which are objectionable, are avoided. Fig. 2 shows the crib used in this system of distribution.

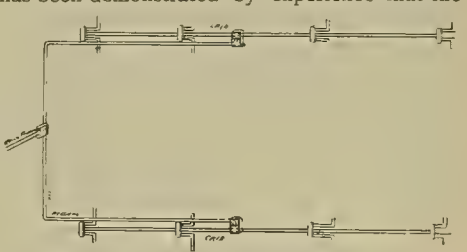


FIG. 2. INTERIOR CONDUITS.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building. - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Ferranti Alternating Generators at Deptford, England. Illustrated	41, 42
Electric Work in Switzerland	41
The Western Union Company's New York Building Burned	42
Who is the Inventor? Illustrated	42
Safety Precautions in Arc Stations	42, 43
Photographing Lightning Flashes. Illustrated	43
Electric Railway Bonds	43
The Polyphone. Illustrated	43, 44
Russell Disc-Carbon Arc Lamp. Illustrated	44
Chicago Edison Plant Enlarged	44
Electrical Exhibit at the Newark High School. Illustrated	44
Storage Battery Cut-Out. Illustrated	44
Perret Low-Speed Electric Motors. Illustrated	45
Interior Conduits. Illustrated	45
Editorial	46
German Dynamo and New Projector. Illustrated	47
Apparatus for Experiments on Electric Undulations. Illustrated	47
Potential Regulator. Illustrated	47, 48
Induced Magnetism	48
The Electric Motor. By James A. Wotton	48
Accurate Measurement of Low Resistances	48
Victory of the Bell Telephone Company	48
Working Railroads by Electricity. By Willis E. Hall	48, 49
Postal Telegraph Bill	49
DEPARTMENTS.	
Correspondence	49, 50
The Electric Light	51
The Electric Motor	51
The Telephone	51
The Telegraph	51, 52
Electrical Patents	52

THE August numbers of the WESTERN ELECTRICIAN will be of more than ordinary interest. Particular attention will be paid to electric lighting and electric power, and the Cape May meeting of the National Electric Light association. In fact, the five August issues will be special Electric Light Convention numbers, and that important event will be covered by a report which, as usual, will be thorough and systematic. This announcement, it is thought, will be of interest to both subscribers and advertisers; to the former because a large amount of unusually interesting matter will be published, and to the latter because the unusually large editions which will be issued will enable them to reach an even greater circle of readers.

IN this issue are presented several views of the Ferranti alternating generators at Deptford, England. The illustrations are reproductions of photographs forwarded to the WESTERN ELECTRICIAN by S. Z. de Ferranti. The Deptford plant has received considerable attention from the technical journals, but up to the present time the pictures of the installation, which have been published, have lacked faithfulness of detail. In the article accompanying the cuts, the correct diameter of the armatures of these immense dynamos is given. It will be remembered that it has been stated to be 45 feet.

JOSEPH CHAPLEAU, who was recently convicted of murder and sentenced to death under the new law in New York state, has been saved from the executioner by Gov. Hill, who commuted his sentence to life imprisonment. Chapleau's execution was to have taken place this week, and the governor's reprieve came just in time to save him. It is therefore probable that Kemmler will be the first victim under the new law as there is scarcely any hope for interference in his behalf. The date for his execution has been set at Aug. 4—10.

FROM time to time mention has been made in these columns of trials of an electric omnibus in London. In the last issue appeared a description of the imposing spectacle presented by the lord mayor when riding in this electrically propelled vehicle. It has seemed rather curious that Americans, who have surpassed the world in electric railway work, should allow their English cousins to get ahead of them in any department of electric propulsion. According to our Pittsburg correspondent this state of things will not be allowed to continue much longer. A company is to be organized in that city to operate electric cabs, the current for which will be furnished by storage batteries. We are all familiar with the storage battery car or cart built for the Sultan of Turkey and there is no reason why Americans should not ride in just such a vehicle.

SINCE the last issue of the WESTERN ELECTRICIAN appeared, another name has been suggested for the position of expert to take charge of the electrical section of the World's Fair, that of Lieut. F. B. Badt, of Chicago. Lieut. Badt is a competent electrical engineer, thoroughly practical, and possessed of high executive ability. He is well known as a prominent author and writer, both in the United States and Europe. Another advantage which Lieut. Badt possesses consists in the fact that he is a member of the Chicago Electric club, the representative electrical society of the West, and an organization which is bound to be prominent in all matters connected with the electrical section of the great exposition.

The Chicago *Evening Post* of July 21st publishes an unqualified endorsement of Prof. J. P. Barrett for the position of expert. The Chicago *Tribune* in its issue of Sunday last urges the selection of Prof. Gray as an expert eminently qualified to perform the duties of the office.

A MOST peculiar proceeding on the part of the United States Patent Office is recorded in this issue. In another column we present photographic reproductions of drawings and copies of first claims of two patents which have just been issued from the Patent Office. The two patents, each of which is granted to a different inventor, cover, apparently, inventions so nearly alike that we think even the skillful lawyer will have his hands full if he ever attempts to decide to whom the invention rightly belongs. As one of the inventors, however, has assigned his patent to the other no litigation is to be feared in the present case. A glance, though, over our article reveals a most interesting state of affairs. Not only were the patents issued from the office on the same day with claims and drawings almost identical, but the papers were drawn up by one lawyer and one of the witnesses signed in both cases. Without attempting to comment from a legal standpoint, upon what appears to us to be a most startling looseness and mismanagement on the part of a government department, we may say that it is high time some steps were taken to insure the electrical inventor a greater protection against infringement of his productions. It has been said that the United States Patent Office is behind the times, so far at least as its examination of electrical inventions is concerned, and a glance at the cases in question seems either to substantiate the accusation or at least indicate a carelessness of management which, if allowed to continue, cannot fail to discourage inventors. We want men to decide upon the originality of electrical inventions, who will allow claims that cover something not already covered. An inventor much prefers to have a first mortgage on a portion of his apparatus than a second and useless mortgage on the whole.

THE relation of the Chicago Electric club to the World's Fair in 1893 will unquestionably be intimate. The fact that there is such a well-organized society to represent the electrical interests at this juncture is a matter of general congratulation. During the next few years the society will have much work to perform in connection with the great exposition, and doubtless will be called upon to render assistance to the electrician who is selected to organize and direct the electrical section, whoever the appointee may be. By its influence at home and abroad the club can contribute greatly to the success of the fair. The association will have an important function to perform during the exposition. Meetings of electrical bodies will doubtless be held in Chicago; and the fact that a hospitable organization ready to welcome them is located in the city will add greatly to the enjoyment of the visitors. The club, too, will have an important duty to perform in entertaining the many distinguished electricians from abroad who will visit the city. The club will naturally be the point around which will center all the electrical and kindred interests during the World's Fair year, and while the preparations for the great event are in progress. The responsibility of the society will be great, indeed, but the organization can be depended upon to perform with credit its part of the great work.

"IT is a noticeable fact that in the accidents reported in New York City, which attracted so much attention throughout the country, the victims, in a majority of cases, were linemen or employes of the electric lighting companies—men accustomed to handling high tension currents and acquainted with the attending dangers, but who had become careless." The above paragraph from a short article in this issue on "Safety Precautions in Arc Stations," in our opinion, tells the story as it should be told. While the people at large are gradually coming to their senses in regard to the actual danger from the electric wires it will be a long time before the effect of the New York scare has entirely passed away. Electricity is now a dangerous something, and until the public are educated to it and become as familiar with it as they are now with steam, we will continue to have periodical sensations. It was only last week that a report came to us from one of the southern cities to the effect that an electric railway company had been sued to prevent the stringing of an overhead trolley wire in front complainant's factory. That the wire would be dangerous to the employes of the above-mentioned establishment was one of the claims made. The utter absurdity of such an action it would be needless to point out, but the occurrence merely illustrates the bad effect of the sensational accounts of the few accidents occurring in New York City. The milk is spilt, so to speak, and matters cannot be helped by blaming anyone, but we fear that the complainant in question would hardly have dared to cry danger had he not felt that the public was with him and just as ignorant. Why should the general public fear the electric light wires? Is anyone not in the electrical business called upon to handle wires carrying dangerous currents? The wires cannot, like a steam boiler, explode. If we leave them alone and take the simple precaution of keeping between us and them 1-32 of an inch of good insulation—dry air—we need have no fear. Above all, if the daily press will be consistent in dealing out the sensations, the heading "Deadly Wire" will give way to one reading "Death from Carelessness," or something similar. The paragraph at the beginning is instructive and suggestive, as is the article from which it is quoted, and there are not a few who might peruse it with benefit to themselves and others.

German Dynamo and New Projector.

The accompanying cuts illustrate electrical apparatus recently introduced in Germany. Fig. 1 represents the new four-pole dynamo which has just been built by the General Electrical company of Berlin. The machine has an output of 300 amperes at 120 volts. The field magnets are cast in the same piece with the base plate. The company uses cast iron for pole-pieces and cores of the field magnets. A characteristic of the machine is the "pole box" which consists of a strong, cast iron, hollow cylinder which unites the inner ends of the field magnets. This arrangement, it is claimed, is adopted

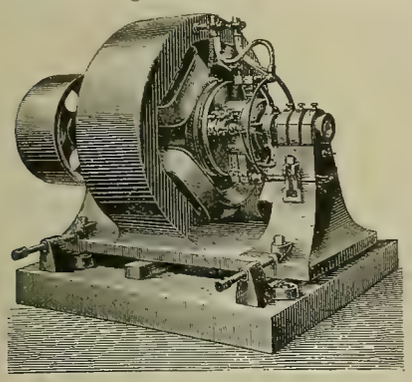


FIG. 1. GERMAN DYNAMO.

to prevent sparking or what is the same thing, to make the limits of the magnetic field less sharply defined, so that in its revolution the armature does not pass so suddenly from a neutral to a strong magnetic field. By the application of the device the poles are charged gradually and it is stated the brushes do not spark. Tests of the machine, it is stated, have demonstrated its high efficiency, under small loads. At one-third load it had an efficiency of 81 per cent., and at one-half load 86 per cent. At full load its efficiency was 90 per cent.

In Fig. 2 is illustrated a new projector built by Schuckert & Co. for the naval service. The projector proper *A* is supported by the castings *B*, which are attached to *C*. The latter revolves on the base *D*. The movement of the projector in any direction can be controlled perfectly by the operator who may be located by the side of

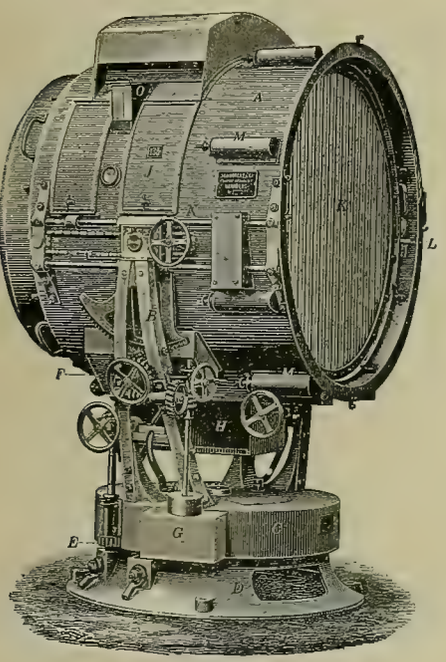


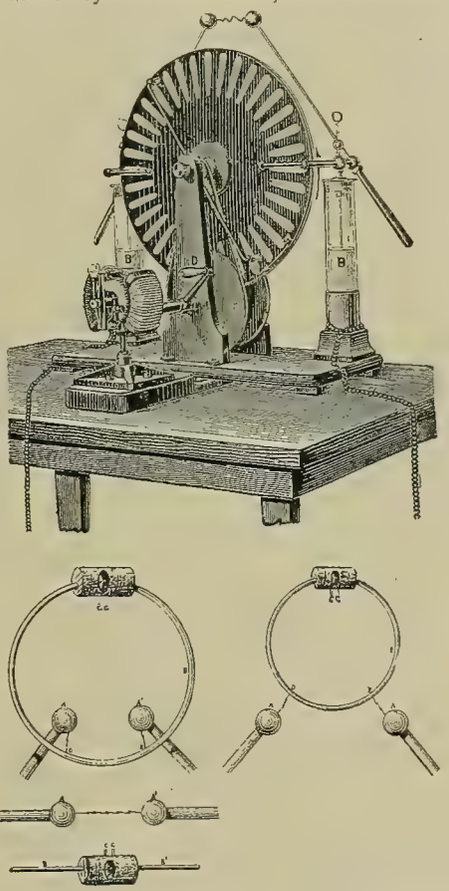
FIG. 2 PROJECTOR.

the apparatus and work it by hand or he can control it at some distance by using electric motors. The motor for turning the projector in a horizontal direction is located in the little apartment at *G*. That for turning the apparatus vertically is placed in the stationary base. Within the projector case is a parabolic reflector. The interior is not closed entirely at the bottom. A horizontal lamp is located at *H* and its carbons are wholly within the projector case. The lamp is so controlled that the crater of the positive carbon can readily be kept by means of guides in the focus of the mirror. That the attendant may observe the position of the carbons a small mirror is so located that he can see a reflection by looking in the little window at *O*. By the little door at *J* the attendant is able to reach the screws which hold the carbons in position. In the face of this projector are two rows of plano-convex lenses. The machine takes from 120 to 150 amperes. The cuts are reproduced from the *Elektrotechnische Zeitschrift*.

Apparatus for Experiments on Electric Undulations.

The remarkable experiments by Prof. Hertz upon electric undulations were quite recently repeated by Mr. Armoux, with the assistance of Mr. Trouve, says *Le Genie Civil*, at the annual exposition of the Physical Society; but the apparatus used on this occasion was reduced to the following instruments: A Wimshurst or Carre electro-static machine, Fig. 1, and a few resonators of different sizes passing from the ring to the rectilinear form, Fig. 2.

The electro-static machine can be easily kept in motion by an electric motor, in order to leave



FIGS. 1, 2, 3, 4 AND 5. APPARATUS FOR EXPERIMENTS ON ELECTRIC UNDULATIONS.

the operator's hands at liberty. The resonators consist simply of rectilinear rods or of wire rings, whose extremities, filed to a point, are held by corks. The latter contain an aperture at right angles with the axis, and through which an observation is made of the passage of the spark between the two points held by the cork a slight distance apart and opposite each other.

With such rudimentary apparatus as this Mr. Armoux was enabled to show that all resonators, the smallest 0.2 inch in diameter to the largest, 20 inches in diameter, operate equally well, thus demonstrating that a vibrator of fixed dimensions is capable of giving rise to the production of electric vibrations having very different wave lengths, contrary to the opinion of Mr. Hertz. It results from this that, from all the vibrations produced, each resonator singles out those that are suited to it.

When one has a static machine at his disposal, he can repeat these experiments without introducing any modification into them.

If the operation be performed with a machine furnished with or deprived of condensers, the sparks of the resonator will have the same appearance as those of the vibrator, which is here constituted by the exciting rods, *AA'*, of the machine. They are brilliant or latent, according as the condensers are used or not. All things equal, morever, the phenomenon is assuredly less brilliant than with the Ruhmkorff coil, but it is quite sufficiently clear with static machines, Fig. 1, having disks 20 inches in diameter.

Figs. 2, 3, and 4 show merely variants of this same experiment, which, we believe, has already been pointed out by Mr. Lodge. It gives a very clear idea of the enormous resistance offered to the passage of the undulating current when a spark is made to pass between the points, *D E*, of a ring, *B*, Figs. 4 and 5, since sparks are easily obtained between the extremities, *CC'*, despite the short circuit existing between the balls, *AA'*, of the vibrator.

The same experiment might be repeated by placing two disks parallel with each other; but the phenomenon is less marked in the second case than in the first.

Potential Regulator.

In the accompanying cuts is illustrated a potential regulator, made by La Societe des Telephones of Zurich. By its action resistances are

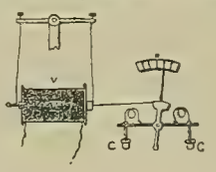


FIG. 1. POTENTIAL REGULATOR.

cut in or cut out of an exciting circuit so as to compensate for changes in the potential at the binding posts of the machine. In Fig. 1, the solenoid *V* is connected to the binding posts of the dynamo or to the points at which it is desired to maintain a constant difference of potential. In the center of the solenoid is a soft iron core, which is suspended by cords attached to each end. It is entirely free to move within the solenoid.

As the cut shows, one end of the core is at-

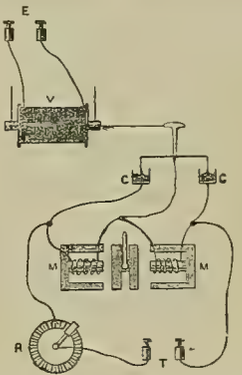


FIG. 2. POTENTIAL REGULATOR.

tached by a rod to a swinging lever, which has at each end a platinum contact dipping into a cup of mercury *C C*. The plungers, which are glass tubes fastened to the ends of the lever, terminate in points to which small platinum wires are soldered. The bottoms of the mercury cups *C C* are iron, so that outside connections may be made.

The position of the core is so arranged that when the difference of potential is normal, the

FIG. 3 AND 4. POTENTIAL REGULATOR.

swinging lever is not moved, but if the potential increases or diminishes, the lever swings and one contact leaves its mercury cup. The current then must pass through one of the electromagnets *M. M.*, Fig. 2. The armature between these magnets is then attracted, bringing into play the mechanical arrangement, which is

shown in Figs. 3, 4 and 5. The wheel *A*, Fig. 3, acts upon a set of contacts, and thereby cuts in and out resistance. A grooved pulley, *P*, is set in motion by a belt from the armature shaft or from some other source of power. Two friction wheels mounted on the same spindle move together with *P*. The wheel *A*, controlled by the armature between the electro-magnets *M. M.*, is placed between the two friction wheels *F. F.*, and revolves only when it is forced against one or the other of them, the direction of its rotation depending upon which of the two it is forced against. The wheel *A* is attached to the end of a long spindle, which has at the other end a worm. The latter engages with the gear supported by the vertical axis *S*, Fig. 5. In accordance with the motion of this gear, as actuated by the worm, the commutator cuts in or out resistance. The *Revue Internationale de l' Electricite*, from which the cuts are reproduced, states that the regulation effected by this device has proved extremely efficient.

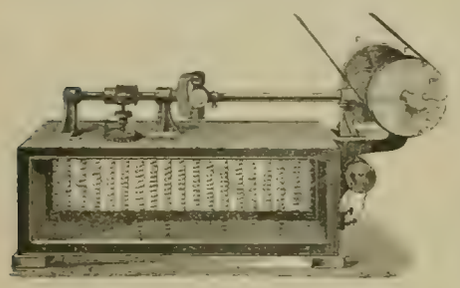


FIG. 5. POTENTIAL REGULATOR.

Induced Magnetism.

Following is an abstract of a paper on induced magnetism, recently read by Prof. J. A. Ewing before the Royal Society, London:

After referring to Maxwell's discussion of Weber's theory, which ascribes magnetization in iron and other magnetic metals to the turning of molecules which are already permanent magnets, and to suggestions made by Professors Wiedemann and Hughes, and lately by Mr. A. E. Kennelly, the writer describes experiments which he has made directly bearing upon the molecular theory. The experiments were made by grouping near to one another a large number of small permanent magnets, each pivoted on a fixed center, and by studying the manner in which the configuration of the group changed when external magnetic force was imposed. The results do not support the notion that the molecular magnets form closed chains in unmagnetized iron. They lead, however, to the important conclusion that no arbitrary conditions of directional constraint need be postulated to make the manner in which the molecular magnets turn agree with the chief features of magnetic quality. In the writer's view the molecular magnets are perfectly free to turn in response to external magnetic force, except in so far as they are constrained by the magnetic forces which they exert upon one another. He discusses this theory in a preliminary manner with regard to the form of the magnetization curve, the character of cyclic processes, the effects of temperature, of vibration, of stress, and so forth, and shows that it is in general agreement with the known facts. The summary of conclusions is as follows:

1. That in considering the magnetization of iron and other magnetic metals to be caused by the turning of permanent molecular magnets, we may look simply to the magnetic forces which the molecular magnets exert upon one another as the cause of their directional stability. There is no need to suppose the existence of any quasi-elastic directing force, or of any quasi-frictional resistance to rotation.

2. That the intermolecular magnetic forces are sufficient to account for all the general characteristics of the process of magnetization, including the variations of susceptibility which occur as the magnetizing force is increased.

3. That the intermolecular magnetic forces are equally competent to account for the known facts of retentiveness and coercive force and the characteristics of cyclic magnetic processes.

4. That magnetic hysteresis and the dissipation of energy which hysteresis involves are due to molecular instability, resulting from intermolecular magnetic actions, and are not due to anything in the nature of frictional resistance to the rotation of the molecular magnets.

5 That this theory is wide enough to admit explanation of the differences in magnetic quality which are shown by different substances, or by the same substance in different states.

6. That it accounts in a general way for the known effects of vibration, of temperature, and of stress upon magnetic quality.

7. That, in particular, it accounts for the known fact that there is hysteresis in the relation of magnetism to stress.

8. That it further explains why there is in magnetic metals hysteresis in physical quality generally with respect to stress.

9. That, in consequence, any (not very small) cycle of stress occurring in a magnetic metal involves dissipation of energy.

The Electric Motor.[1]

BY JAS. A. WOTTON.

Perhaps the electric transmission of energy for the production of power, through the medium of the electric motor, is destined to meet with the greatest development and to become the most valuable of all the industrial applications of electricity.

The economical transmission and subdivision of power is a problem that has engaged the attention of engineers in as great a degree as any other department of engineering, and the progress of the last ten years shows conclusively that electricity is the agent we must look to for its solution.

Considered from a mechanical point of view, the electric motor, though only a product of the past decade, has already reached a point of perfection that the steam engine, with its century of development, does not begin to approach. In it there are no reciprocating parts; the pull or torque is continuous and applied to the point where it can do the most good; there are no dead points; the motor will start from any position under full load; it does not require constant and skilled attention; produces no dirt or noise; is applicable to places where a steam engine or any other motor except this is out of the question; does not need any mechanical governor, that only begins to govern after the speed has varied; is perfectly self-regulating in the matter of energy consumed, which is always proportional to the work in hand; entails no danger of fire, with increased insurance rates; does not increase the temperature of the shop—a point to which the prevailing weather has given no little importance; can be started, stopped and reversed almost instantly, and, in a word, offers so many points of advantage that its universal employment in place of the existing small steam engines, and for the thousands of small industries that only await a cheap and flexible source of power to spring into existence, is but a question of a very few years.

The success of the great number of electric railways throughout the country offers unmistakable testimony to the reliability of this most marvelous production of an age of marvels. With the advent of cheaper means for the production of electricity will come a revolution in the existing methods of power production, and it does not require any great stretch of the imagination to see our ponderous steam locomotives giving place to this infant that is even now a giant. A great field for development, opened up by the electric motor, is the utilization of the numberless natural water powers that, by reason of their distance from populous cities, are now going to waste. The power of Tallulah Falls, for instance, transmitted electrically—which is the only possible method—would suffice to turn every wheel in Atlanta; and that the day will come, and that very soon, when this dream will be realized, scarcely admits of a doubt.

As an illustration of the rapidity with which the electric motor is displacing other power producing machines, let us look at the work in Atlanta, for though it is but little over a year since the first electric motor was introduced, there are now, including the power used by the electric railways, something over three hundred horse power produced and used, and the various uses to which this power is put would surprise those not familiar with the facts.

[1] Abstract of an article in *Dixi*.

Accurate Measurement of Low Resistances.

Every one who has had occasion to use the Wheatstone bridge, with the mirror galvanometer, for the purpose of measuring small resistances, has suffered from the inconvenience and difficulty consequent on inexact balance, even when unequal arms are used, writes A. Eden in the London *Electrical Review*.

Recently finding it necessary to obtain a very accurate adjustment with the bridge, with arms of equal resistance and not exceeding 100 ohms each, the minute differences of resistance existing between the arms, although nominally equal, rendered an accurate balance impossible.

The use of fine wires, sliding contacts and various other devices were tried, without any satisfactory result.

It then occurred to me to shunt one of the higher resistance arms with an adjustable resistance very much greater than itself, and this was found to be perfectly successful; alterations of the shunt, enabling a perfect balance to be obtained, although the conditions were such that a difference of $\frac{1}{10000}$th in the joint resistance of the shunted arm produced a deflection of one division.

This mode of attaining the condition of perfect balance has no doubt suggested itself to others, but does not appear to have been published before and it may be of service to draw attention to it now.

It is clear that it is not only useful in attaining a perfect balance with some predetermined fixed resistance, but may be employed in the exact determination of small fractions of an ohm which are now less accurately estimated by using arms of unequal resistance.

If determinations to $\frac{1}{1000}$, $\frac{1}{10000}$, or $\frac{1}{100000}$ are required, the shunt should be respectively 1,000, 10,000, or 100,000 times the arm resistance, and it may be used to determine a resistance which by that amount is in excess of, or is less than, the resistance unplugged in the measuring arm.

Victory for the Bell Telephone Company.

The Bell Telephone company, in the United States Court at Parkersburg, W. Va., last Saturday, secured a perpetual injunction against the Long Telephone company, restraining it from making or using any telephones made on a patent claimed by Charles Long on the ground that the patent was an infringement.

Working of Railroads by Electricity.[1]

By Willis E. Hall.

It is asserted that the day is not far distant when we will see railroads, generally known as steam lines, run by electricity from a central station. This is, doubtless, not the first time such an assertion has been made; but I have not as yet seen any discussion of the subject which has more than insinuated the advantages which would result in the operation of railroad lines by such a concentration of power. From a lack of time no attempt is made to analyze the two methods in a mathematical way, but rather it is aimed to point out some of the many advantages which the use of electricity allows, and which will inevitably result in operating a long line.

With this object let us take a few of the changes which the substitution of centralized electricity would inaugurate when used in place of the present system of locomotives.

One very important gain would be the concentration of the power at one point, for a given length of line, into a few cylinders, instead of working it in a number of isolated engines where the insulation is poor and the chances for condensation the best. A number of central stations—located, say, at a distance of 30 to 40 miles apart—could be run by large, powerful engines, and the expansion of the steam worked at an economical point by better and more mechanical means of cut-off than can be obtained in the present type of locomotive construction With locomotives the ratio of expansion at low speeds is correspondingly poor, nor can we expect to make an efficient engine of it, except in one working condition which is dependent upon the concurrence of so many variables that the engine is never worked in that ratio for any length of time. With stationary engines, however, the case is the reverse, as these are designed to work at a constant speed, and if properly proportioned would be utilized at the highest grade of expansion consistent with economy. This point would not vary much, as experience with hydraulic and electric plants would indicate. The fluctuations in the case of a railroad line would probably be even less, as the working is generally uniform throughout the twenty-four hours of the day. It would be a case of a properly loaded automatic cut-off engine against the equivalent of a similar engine vacillating between an over to an under load, and such range of the broadest nature. We must not lose sight of the fact that the question of keeping the line clear is properly held as of higher value in a closely worked system than is the consumption of coal which may result per the horse power, which the engine is to develop to reach its destination as scheduled. In furtherance of a reduction in coal consumption, the use of condensing—and possibly compounding—at a central station would raise this part of the working of the line to the highest grade of efficiency.

In experiments recently made it was found that an electric motor could climb a grade of over 50 per cent., which is far beyond the point of adhesion of locomotives; so that in this direction we could look for a marked improvement. An analysis of the conditions in the two cases will disclose the reason for this, and no doubt all who have had any experience with engines which were overloaded or which slipped their drivers easily will appreciate its importance.

The question of attainable speed enters as a factor, for the speed to which an engine can safely be driven is known to have its limits—and which, to all appearances, we are now closely approaching. The piston speed of an engine with 24 in. stroke and 68 in. diameter of driving wheels, traveling at 60 miles per hour, would be about 1,400 ft. per minute An increase in the diameter of driving wheels, with the object of decreasing the number of strokes, makes the engine correspondingly weaker, so that two sharp horns of a dilemma are placed before him who attempts to design an engine to haul the increasing weight of trains at a high speed. The questions of ports and velocity of steam are mentioned in passing. The resistance of trains is now quite positively known to increase about with the square of the velocity which would enter as a function in the power to be given to a motor to drive a train at a desired speed. With such a means, however, the speed is limited only by the power which is given in its design, and is determined more by what the conditions of the service will stand.

With electric motors it would not be necessary to have track tanks and water stand-pipes distributed closely throughout the line, which means considerable to those who are acquainted with the attention and repairs (especially through the winter season) which such arrangements demand. The delay, too, where freight engines are not equipped with water scoops, is apparent; and even this latter method of filling tanks is beginning to show its effects upon the schedule, which it is possible to make on lines which are worked closely to their limit Nor would it be necessary to carry the dead weight of tender which contained water, which is hardly as easy an accompaniment as its name would imply. In this connection it might be well to mention the annoyances from cleaning fires, as is required in freight service where the division is a long one.

The experience with the centralization of power where large hydraulic, electric or pneumatic plants are in operation, is that a greater amount can be supplied than it is necessary to develop at the station—that is, where there is much division (such as would be the case when the power is distributed through commercial districts and divided into small parts) a 50 to 60-horse power plant can take and supply satisfactorily about 100-horse power. In railroad work such a ratio could hardly be looked for, as the number of trains would not be as large as the division where the power is distributed for mercantile and commercial purposes; but a reduction of some 25 per cent. can safely be counted upon. The reason for this is evident, as it never occurs that all the power will be used simultaneously which each division is capable of exerting. With railroads, too, it will not occur that all trains would be exerting their maximum power, such as, for instance, climbing heavy grades at the same time.

The best kind of mechanical ingenuity and high efficiency

[1] Read at the Cincinnati Meeting of the American Society of Mechanical Engineers.

of any mechanical design which is made to accomplish a given object are dependent, principally, upon reducing the number of parts which it contains, so long as the desired result is obtained. Multiplication of parts increases the number of pieces to wear and consequent repairs, as well as the chances of failure from breakage. No argument is necessary to indicate the advantage which electric motors would have over the present design, or over any other design of locomotive where all the requisites of an engine must be incorporated in so many isolated places. The failures from leaky flues, broken eccentric strap knocking a hole in the fire-box, blowing or knocking out cylinder heads, and the multitude of accidents which are happening every day on railroad lines, would be decreased to a marked extent. The reduction in the internal friction of the driving mechanism is also apparent.

No comparative mention has been made of the cost of repairs, the too large percentage of power which is idle to have this work done, the reduction in the number of motors required to make the same train mileage (due to more uniform and consequent higher average speed, resulting in a reduction of time to go over a length of line,) together with the loss of coal from irregular working of engine and boiler where the line is undulating, as is the case with all to a greater or less extent; also the attention and care which a large number of isolated boilers demand to keep them in safe working condition as well as the rapid wear of machinery where it is exposed to out-door influences, such as dirt and the elements, as is the case with locomotives. In fact, the elimination of such details could be extended almost indefinitely, and in them there would appear visions of a removal of a mass of the little annoyances from the shoulders of those who are now held responsible for the maintenance of this accumulation of complications

The loss in electric transmission has not been neglected, which in a station controlling a line of, say 30 miles would, at the present state of the science, amount to some 50 per cent.—which includes loss in dynamo, line and the loss from an average working of motor. This, together with the cost of necessary plant as capital, comprise the two main objections against the introduction of electricity for transportation purposes.

No attempt is made to take up the advantages or disadvantages (as shown by mathematical calculation) resulting from such a system, but it is merely desired to mention some of the many practical points which would be met, eliminated or improved upon by the substitution of electricity in general railroad working. Nor is it that its introduction is anticipated within a year or two; but we cannot but acknowledge that the application of electricity is becoming more general, and, from the rapidity of its development, its use for such purposes is hardly more distant than the most sanguine of its advocates would predict.

The combination of electrical with mechanical engineering will bring about as much of a revolution in the future as it has done in the past; but in all its applications we must expect to see it creep before we may see it walk. A more thorough intermingling of the mechanical, however, would hardly be a detriment to much of the so-called electrical engineering.

A CRITICISM.

After the presentation of Mr. Hall's paper F. A. Scheffler advanced the following points in criticism of several of the statements which were made:

In reading over the article which has just been presented by Mr. Hall. I am tempted to give a few points in regard to the cost of installing a railroad plant, such as the author of the paper thinks will be required in the near future, and at the same time I desire to state that it is to be regretted that Mr. Hall did not spend some little time, before writing his paper, in looking up the matter of electrical data as far as railroads are concerned, and the necessary cost of installation of the generating stations at a distance of not more than 30 miles apart.

The ordinary locomotive of to-day, when running at the average rate of speed and hauling the average load, does work of not less than 300 horse power. Supposing the station to be built to have a capacity to each 30 mile section of not more than one locomotive, the capacity of the generating station would necessarily have to be not less than 360-horse power. As the best forms of motors at present have an efficiency of only about 80 to 85 per cent., it will require, therefore, for the generating station a 360-horse power engine and sufficient boilers for operating same. The cost of the station can be summed up about as follows:

One 360 horse power engine	$10,000
Battery, A 1, of 360-horse power boilers	7,000
Station building	5,000
Steam connections, pumps, feed-water heaters, etc	2,000
Generating dynamo	12,000
Electrical station, appliances, etc	1,000
Making a total of	$37,000

The foregoing station outfit will not permit of having an auxilliary plant of engine, dynamos and boilers, which ought really to be included in the outfit, so that in case the engine or dynamos or boilers should, at any time, become inoperative, there would be another set of appliances to operate the railroad with. An auxiliary set of appliances would almost double the total cost of the station

For operating expenses of the station we have the following:

	Per year.
3 per cent. depreciation on engine and boilers	$ 835
4 " " " dynamo	480
6 " " interest on the station plant	2,220
2 firemen, night and day	1,440
2 engineers, " " "	2,080
Maintenance, such as oil, waste, etc	300
Making a total of, not including the cost of coal	$8,355

In order to ascertain what the cost of coal would be, we will suppose that the total power is required for only one-half the time, and one-quarter the power for the balance. This will give us 2,774 tons of coal, per year, required. This assumption is based on the supposition that the engine will require 3 lbs. of coal per horse power hour; if it were a condensing engine, of course the assumed rate of coal per horse power would be too high, but I should not think it would be advisable to use a condensing engine where the power would be so largely variable, and water along railroad lines is not always available for condensing purposes. Basing the cost of coal at $3 per net ton, the expense per year for same will be $8 322; adding this to the operating expenses of the plant at the station, we have a total of $16,677.

So far, we have only taken into consideration the necessary cost of operating expenses of the station plant. We have now to consider the erection of the necessary electrical circuits along the line, the depreciation of same, and interest on the cost of same.

Suppose that the pressure at the terminals was fixed at 2,000 volts, in order to deliver 300-horse power to the motor, it would be necessary to carry 112 amperes on the line, and allowing 20 per cent. drop in the pressure, by simple calculation, we find that the conductor will have to be of an area equal to a copper rod, 1 in in diameter. The pressure of 2,000 volts is altogether too high to think of safely using the rails for the return circuit, and a copper conductor would also have to be used for this circuit making two lines of copper conductors, 1 in. in diameter for the outgoing and return circuits. If the circuit is 30 miles long, it would require the enormous quantity of 476,784 lbs. for each conductor; and the cost for copper wire at the present time being 17 cents per lb , the amount required to pay for the copper wire would be $ 62,106. The interest on this outlay, at 6 per cent., would be $9,726.

As an overhead circuit would be the cheapest possible way of conveying the current to the motor, and as the wire is of such an enormous weight, it would not be well to have the poles more than 50 ft. apart. This would require 6,300 poles. Basing the cost of the poles and erecting same at $2.50 each, we have the total of $15,750. Erecting the line would be charged at $150 per mile, and this is a very low figure. This would give us $4,500, making a total cost for the line $20,250. The interest on this, at 6 per cent., would be $1,215.

Continuing the statement of operating expenses, it would be necessary to add the interest just given to same, and also the depreciation of the line. Putting this latter at about 2 per cent (which is very low), which would be $3,627, we have a sum total of $31,245 as the actual annual cost of operating expenses of the station plant, and interest, depreciation, etc., on each section of 30 miles.

It will not be necessary to take into consideration the cost of operating the motor, as this would be about the same as the cost of operating the steam locomotive; and the cost of same would be about the cost of a first-class locomotive. The only comparison which should be made between the operating expenses of the steam locomotive and the electrical, would be that of the difference in coal consumed between the station and the steam locomotive, and possibly the cost of repairs of the motor, compared with that of the locomotive. We have not the exact figures of the coal consumed by the ordinary locomotive, but I do not think it is any less than 8 lbs. of coal per horse power hour. This being the case, and as the locomotive develops 300-horse power for 12 hours, and one-quarter of this horse power for the balance of the day, we would have, per year, a consumption of 6,570 tons. This. at $3 per ton, is equivalent to $18,710. Deducting the same from the total operating expenses of the electric station, we find that the difference is in favor of the steam locomotive to the extent of $12,475 per year. I do not think there would be any difference in cost of repairs between the electrical and the steam locomotive. The total cost of the station, copper wire, poles and line, complete, would be $219,356. This amount of money would buy about twenty new locomotives.

The foregoing estimates are all based on inside figures, and if the railroad were 600 miles long, it can be readily seen what an enormous expenditure for electrical purposes would be necessary, and comparing this with the cost of the present steam railroad would be sufficient to upset any calculation in the line of electrical railroads.

I have selected an average of $2,000 as a basis for estimating the cost of line, simply because it would require extraordinary care in insulation for a higher potential, where the bare conductors, connections, insulating material, etc., would be subjected to all kinds of rough weather. If it were found that 4,000 volts could be satisfactorily insulated (and this has been done with covered wires in a few special cases), the first cost of line equipment would be very largely reduced to, say, about one-half of the above estimated cost, thereby reducing the yearly expenses of operating by decreasing the interest and depreciation of the plant. As far as safety to human life is concerned, I do not believe that 4,000 volts would annihilate more completely than 2,000; but the chances for leakage of current at the higher tension would be much greater. This would mean greater coal consumption and reduced efficiency of the electrical apparatus. The operation of the plant at the full power for one-half the time involves, of course, the use of several motors, which has not been considered in the matter of operating expenses. Such considerations would not make any difference in cost of operating expenses, because there would necessarily be the same amount of expense in the line of engineers, firemen and depreciation, etc., for the locomotives, as there would be for an equivalent number of motors.

A statement made by Mr. Hall is as follows: "In experiments recently made, it was found that an electrical motor could climb a grade of over 50 per cent , which is far beyond the point of adhesion of locomotives." I would like very much to make an inquiry as to the facts of these statements; it would be very interesting to the members to learn what motor it was, and how long the grade was, and what speed was attained. It is well known, of course, that there is some very peculiar action between the tread of the wheels of electrical street cars and tracks, whereby they can ascend a higher grade than any other kind of motor power, except the cable system; but I am very loth to believe that an electric motor can ascend a grade of over 50 per cent.

It is safe to say, that unless there are some radical changes made from the ordinary design of electric generators, and in the method of the transmission of the current to the motor, as well as a motor of greater efficiency, that we will never see electric railroads operated in this, or any other country.

I am particularly desirous of furthering any matter which pertains to the advancement and introduction of electrical work of all kinds, as there is no branch of the world's industry which is or will not be influenced by the electrical industry.

I, too, desire to see electricity supplant the present steam railroad, but *at present* I cannot see exactly how this can be accomplished from a commercial standpoint.

If as much progress is made in the next ten years as has been achieved in the past decade, there will be more of a possibility of our capitalists adopting electricity in place of steam on railroads.

Three different members have asserted that I have estimated too highly by 50% in three different items. I do not desire that my figures shall be taken as absolutely correct, but I would like to have a comparison of cost by parties who are familiar with electrical and mechanical estimates, from a conscientious point, made upon the same basis which I have estimated. I shall be happy to acknowledge any error which I may have made, and will be only too glad to cut down the apparently enormous first cost of even one section of the suggested railway plant.

A specially devised method of feeders will possibly reduce the cost of the copper circuit, but at present I do not see wherein even this could be accomplished, unless, perhaps, a 3-wire system should be used, but which would involve a further complication of carriers, etc. One thing certain is that to carry 300-horse power at 2,000 volts, with 20% drop, requires the same amount of copper for conductors, whether the latter be composed of one or is subdivided. I have taken as a basis the lowest possible generating capacity, and an increase of this simply means additional first cost, and some of our heavy locomotives surely develop a much higher amount of power at certain times than 300 horse-power. I have also estimated upon only one motor being in operation on the 30 mile section, whereas it would not be a very paying road which would operate under such a condition. More than one motor upon the section at the same time involves a still further increase of generating plant and conductors. I have only presented these latter considerations to show that I do not think my estimates too high.

Postal Telegraph Bill.

On July 16th Mr. Sawyer introduced in the United States Senate a bill to establish a postal telegraph service. It provides as follows: All post-offices where the free-delivery system exists shall be postal telegraph stations, and, in addition, the postmaster-general may designate other post-offices and telegraph offices as postal stations; the postmaster-general shall contract with one or more of the telegraph companies now in existence for a period of ten years. Rates proposed are as follows: For the first 20 words or less, counting address and signature, between postal stations in the same state, and less than 300 miles apart, 15 cents; between stations not less than 300 miles apart, and not in the same state, 25 cents for the first 20 words or less; no rate shall be greater than 50 cents for 20 words. Within two years after the passage of the bill one half of the postal telegraph stations contemplated shall be connected by wires of the companies receiving the contract, and within the next succeeding year at least one-half of the remainder shall be so connected. The postmaster-general shall prescribe the rules and regulations for carrying out the purposes of the bill. The bill was referred to the Post-office Committee.

CORRESPONDENCE.

New York Notes.

NEW YORK, July 19.—There are some interesting figures in the quarterly report of Commissioner Gilroy to Mayor Grant on the public improvements. It appears that the electric lighting companies are slowly regaining the place they occupied before the crusade against overhead wires was begun. There are at present 872 electric lights used for illuminating the streets, and the probability is that the number will be largely increased, as the gas commission is now considering propositions from the electric companies. Just now, however, the first city in the Union is a little behind the times on the light question. The report states that 8.45 miles of conduit were built in the period referred to. Here is a sentence from the report that will furnish a text for economists and reformers: "The streets were opened in 7,256 places by gas companies, other corporations and individuals." Only one street railway is operated by electricity, the Julien storage battery system on Fourth and Madison avenues. If electric traction is to be generally adopted within five years, as Henry Villard says, the local surface line companies should begin at once to transform their systems. This should be done any way, and at once. This is another important department in which this great metropolis is sadly behind the smaller cities.

The gas commission has opened the new bids of the electric lighting companies. It finds that the prices named will come within the range of the appropriation for street lighting. The two previous bids were rejected as they were too high, although the electric companies showed

good cause for an advance until subway differences could be settled. The new bids are at about 35 cents per lamp until January 1st, when an additional 8 cents, it is expected, will be allowed.

Judge Patterson has decided that William H. Cotterill and James U. Robertson, president and treasurer of the Electric Sugar Refining company, are individually liable to the English capitalists who were induced to buy stock at $300 per share, the understanding being that the money was for the express purpose of buying Friend's secret process, which turned out to be the stowing of bags of raw sugar in a hay loft and drawing Havemeyer's Mould A refined sugar out of the feed chute on the stable floor. The judge says that, although it does not appear that Cotterill and Robertson were in any way connected with the stupendous fraud, yet they knew that the process could not be accomplished several days before any of the money was paid out, and they could have recalled the money by canceling the loan.

Manufacturers of electrical apparatus will be interested in the announcement that the principal manufacturers of celluloid and zylonite goods have decided to consolidate in a big corporation, with a capital of $6,000,000. The concerns which will go into the combination are the American Zylonite company of North Adams, the Celluloid company of Newark, and the Lithoid company of Newburyport. It is said that the works of the American and the Lithoid companies will be abandoned or rather transferred to the other concerns. The new company will be known as the United Celluloid company. Sharp competition has led to the consolidation.

The argument in the appeal of the Steam Heating company from the order of the Board of Health will be continued on Tuesday next. The appeal is based on the ground that the board did not consider the company's arguments or rights in the premises when the order was made.

Kemmler will probably have the distinction, if such it may be called, of being the first murderer to suffer the death penalty under the new law. It was thought that after all the legal controversy Joseph Chapleau would step in and take Kemmler's lightning, but the action of Gov. Hill forces Kemmler to the front again.

The Franklin Experimental club, organized by a number of scientific and professional men, with modest headquarters in Newark and no newspaper announcements of its character, existence and scope of usefulness, concluded its first year's work at its laboratory last Tuesday evening, and adjourned until September. The officers of the unique organization are: William J. Hammer, president; Dr. T. W. Corwin, vice-president; Edwin W. Hammer, secretary and treasurer; Prof. George C. Sonn, curator and historian, and Paul Jaehnig, sergeant-at-arms. The club has prospered beyond expectations, and an effort is being made to widen its sphere of usefulness by increasing the membership. Considerable valuable physical apparatus and chemical supplies have been added during the past month. Two honorary members have been elected. The club is modeled after the Franklin Institute of Philadelphia. During the winter a series of lectures and experiments occupy the attention of the members. W. H. T.

Milwaukee, Wis.

MILWAUKEE, July 18.—Henry Villard has bought the plant and good-will of the Badger Electric Light company. The consideration is something like $300,000. The sale was made through John A. Hinsey, who secured an option on the property some time ago, at the time that it was reported that he had purchased the plant himself. The directors of the new company are John A. Hinsey, Edward C. Wall, R. L. Jennings and Clarence S. Brown, of Milwaukee, and David S. Wegg, of Chicago. Mr. Wall, who has managed the business for some little time, will be made president. The fact that not a single one of the directors is interested with Villard in the Milwaukee Edison Electric company is taken as proof that the Edison incandescent plant, which is now being constructed, and the Badger arc light plant will be conducted as separate enterprises. It was at first supposed that a practical consolidation would take place. The Badger company will make a strong effort to retain its street lighting contract. The contract will expire in December, and bids will be received by the Board of Public Works early in August. There are two other companies in the field.

The Villard syndicate has secured an interest in both the Milwaukee City and Cream City Railways, and it is reported that it will soon be a part owner of the West Side system, although Washington Decker denies that he is going to dispose of any of his holdings.

It was reported some time ago that John A. Hinsey had secured a controlling interest in the Whitefish Bay Dummy line. It now turns out that in the case of the railroad, as in that of the electric light plant, he simply secured only an option. However, his option on the dummy line has resulted in the sale of the Hadley interest to Charles F. Pfister, who is now the president of the company. The relations between the dummy line and Hinsey's road will be quite intimate. The North Avenue extension will be rushed, and the East and South Side lines will be built. Electricity will be used on the whole system.

A new company has been incorporated for the purpose of building a suburban road from the West Side to Wauwatosa. The chief mover in the enterprise is Daniel Wells, Jr., one of Milwaukee's wealthiest men. Mr. Wells is the chief proprietor of the Watertown plank road, and the new line, which is to be equipped with electric motors, will run along that thoroughfare. The company may build into the city. The new enterprise will probably result in the abandonment of the scheme to build a road to Wauwatosa still further north.

The National Home & North Greenfield Railroad company is likely to draw out of the fight for a franchise to build along the National Avenue road in order to give the Milwaukee City Railroad a clear field. All that the incorporators of the National Home & North Greenfield Railway company and of the other companies as well desired was to secure street car service for North Greenfield. The Milwaukee City Railroad company will not meet with any great amount of opposition if it proves its intention of building to the Soldiers' Home and North Greenfield. Such an extension would be more satisfactory than an independent line, as it would give the suburban residents access to all parts of the city.

The contracts for the Edison Electric company's new building, on the corner of River and Oneida streets, have been awarded. The structure will be quite large and solid, and will cost in the neighborhood of $60,000. The work must be completed by October 1. The company is making very satisfactory progress in the work of laying its wires underground. Much of the work in the business section has already been done. P.

Cleveland, O.

CLEVELAND, July 19.—The Buckeye Electric company has opened an office in the new Arcade, and proposes to do business on a larger scale than heretofore. It manufactures incandescent lamps and appliances.

The business of C. B. North will be hereafter carried on by the C. B. North Electric Works.

The Newark and Granville motor line, 8 miles, is nearing completion. A Sprague equipment has been bought.

The proposed electric road in Sandusky is very slowly materializing.

Within a short period the Fulton Foundry will turn out a full complement of electric railway supplies; Palmers & De Mooy are now in the market with electrical castings, and Dorner & Dutton will eventually add electrical equipments to their railway supplies.

The *Leader* is waging war against the electric railways, branding them as property despoilers. When Cleveland had no electric railways they were very much desired by the *Leader*. Now as they have proved satisfactory to the general public and built up the outer town the *Leader* howls. R.

Pittsburg, Pa.

PITTSBURG, July 19.—The Allegheny City electric light plant was started on the evening of July 17th with great *eclat*. The city was celebrating semi-centennial day, and this was made the occasion of throwing the streets into a great glare of illumination. The electric plant is a grand success. It consists of 3,000 incandescent lights, Westinghouse alternate current system, and 450 arc lamps of the same system.

The Citizens' Traction company of this city, operating a cable road, has just held a meeting to increase the capital stock from $2,500,000 to $3,000,000. At this meeting the company also published a financial statement of the road for the first six months of the present year, which offers a very powerful argument in favor of the electric railroad system. According to the statement, the receipts of the company amounted to $288,061.92, and the running expenses to $199,617.57, which leaves a net profit of $88,444.35. Among the items of expenditure is mentioned the sum of $109,000 for conducting transportation and maintaining the road. When it is considered that this means for six months only, and that for a road which is but three miles long, it is well worth pondering over the difference in the cost of maintaining a road by using electric power instead of a cable.

The latest development in the novelties of rapid transit in this city is the project about to be entered into by the Electrical Cab company. This corporation proposes to establish a regular line of travel throughout the entire city by electric cabs. It is similar to the system said to have been operated in London and Berlin. The company intends to start with fifty cabs all fitted up with the latest improvements of the storage battery system and the promoters are very sanguine of success. The scheme has apparently been started to get ahead of the many other companies having lately secured the right of way upon nearly every street in Pittsburg with a view of establishing electric railways.

The Tesla motor of the Westinghouse Electric & Manufacturing company is now being extensively used on the vestibule trains of the Pennsylvania lines between New York and Chicago.

The Duquesne Traction company is erecting a car stable in the eastern part of the city, which is to cost seventy thousand dollars. E. H. H.

Nashville, Tenn.

NASHVILLE, July 19.—The operation and the management of the 59 miles of electric road have been such as to insure golden opinions from all who have had occasion to use the cars; and it is safe to say that the average street passenger traffic is more than double what it was under the mule system. All the lines are under one management, the United Electric Railroad company, but this will not be the case long. About all the main points of litigation have been settled, and the Citizens' Rapid Transit company has a full force of hands laying track and putting up wires. This company has adapted the Sprague overhead system, and has ordered in addition to the generators all the material necessary for the equipment of about four miles of railway. The right-of-way and franchises cover a very important portion of the city

Your correspondent has found thirteen isolated electric light plants besides those used on the steamboats that ply the river from this point; most of these plants are small and of old patterns. Two cotton mills, one woollen mill, two ice factories, two hotels, two large business houses, one of the suburban parks, a daily paper and a saw mill have each an electric light plant.

The city has been suffering from a partial water failure caused by the destruction of a part of the pumping machinery by fire, and no sprinkling of the streets is allowed. The street car companies, however, are permitted to use water to wash their tracks. With the overhead system in use here, unless the rails are kept clean of the limestone dust, which is the greatest nuisance we have to contend with, there is considerable sparking at the point of contact of the wheels and rails. This trouble is particularly noticeable at the switches and crossings. This limestone dust and sand also causes the gear wheels of motor cars to wear out very rapidly.

There has recently been some trouble between the negroes and the street railways. A company of state troops, composed wholly of negroes, and armed with rifles and bayonets belonging to the state, while parading on the 4th of July, persisted in taking their line of march between the rails of the electric cars. The movement of the troops was much slower than that of the car, and when the motor man remonstrated and insisted upon being allowed to pass, he was assaulted and threatened with bayonets. The police, however, succeeded in preventing a serious riot. President Wrenne, of the United Electric Railway company, has laid the matter before the governor, and asked that the company be disbanded until the members qualify themselves as law-abiding citizens. Judge Bell, of the City Court, decided that the street cars had the right-of-way, inasmuch as the companies are required "to keep the streets in good condition between the rails of their tracks and for two feet on each side thereof."

The city authorities have called for bids for furnishing four and a-half miles of wire for the fire alarm service.

The 100 additional arc lights ordered by the city months ago have not been put up yet. The only reason given for the delay is the non-arrival of the wire.

The newspapers state that a company has been formed to establish an electric street car line in Clarksville, Tenn.

The Rock City Electric company is awaiting action of the city council on its petition for right-of-way.

The Capital Electric Light company is putting in a number of small stationary motors for hotels, office buildings, etc. The question of cost is the only thing in the way of the extensive introduction of these small motors. The water pressure here is too variable to make the use of water motors practicable.

Joseph Wills, the electrician and master mechanic of the United Electric Railway company, has resigned his position and accepted one with the Short Electric Railroad company of Cleveland, Ohio. Charles T. Hardy has taken his place here.

Representative men from all the electric companies in the city will meet on the evening of the 23rd inst. to consider the advisability of organizing an electric club in this city. There are enough of them to give a good working

membership for such a club, and they are fully capable of making it a success The reason a club has not been formed sooner is that most of the electric enterprises here are comparatively of recent date and the officers and men have had but little time to form acquaintances. The initial meeting is looked forward to with considerable interest.

B.

THE ELECTRIC LIGHT.

Negotiations are pending at Plaquemine, La., for an electric light plant.

Laurel, Md., will have an electric light plant within six months, it is promised.

An electric light plant at Corinth, Miss., is among the improvements contemplated.

The city has purchased the plant of the Gainesville (Ga.) Electric Light company and will operate it hereafter.

The San Antonio (Tex.) Gas company, which purchased the electric light plant, is already remodeling the power house and will soon add new apparatus. The system will be extended.

A. J. Corriveau of the Royal Electric company, Montreal, has closed a contract with the town of Costicook for 30 arc and 500 incandescent lamps for the streets. Water power will be used.

The California Electric Light company has announced its intention to assert its claims to the sole right to use the double carbon arc lamps in California, Oregon, Washington and Nevada, under the Brush patents.

The Oakland Gas, Light & Heat company has offered to operate the Alameda city electric light plant at less than it is now costing the city. If the proposition is accepted, the arc lights will be operated from the Oakland company's plant, and the incandescent from the city plant.

The Monongahela Electric Light company of Monongahela City, Pa., has been chartered with a capital stock of $40,000. An alternating system is to be adopted but the make is not yet decided. A city franchise has been granted the company, which will commence with plant for 650 lights.

An electric light franchise has been granted the Pasadena Electric Light & Power company by the Pasadena trustees. It provides for the right to operate an electric light plant for thirty years, gives the right to erect poles fifty yards apart, under such provisions as the council may direct, the city to have the privilege of using any of the poles free of charge for the purpose of conveying wires for a fire alarm system.

The New York *Sun* presents the facts attending the municipal control of electric plants in the following terse summary of a familiar case: "A case bearing on the question of the advisability of the ownership by municipalities of lighting plants has occurred at Milwaukee. The estimate furnished to the common council of that city for the erection of a municipal lighting plant is nearly $600,000. The question is simply whether the inhabitants prefer to undergo the burden of taxation for the raising of the principal and interest involved, as well as to suffer all the ills that come in the train of the creation of a new city department under political control, or whether they desire the option of contracting at any time for all the lights they want at a certain rate without any further responsibility or burden."

One of the promised sights of Sorrento, on Frenchman's Bay, this season, is Frank Jones' illuminated fence, the erection of which is a source of wonderment to all the natives along that shore, says a correspondent at Bangor, Me. In front of his summer house the great brewer will have nineteen hollow stoneware posts, surmounted by as many stoneware vases, the latter to be filled with plants of various kinds. An electric wire will run up inside each post and through the earth in the vase, diffusing light through an incandescent globe. The vases are all of different designs, and no two of the globes are of the same shade. Between the colored globes and the sheltering foliage it is expected that rather a romantic light will be secured. It is quite a job to adorn that side of Frenchman's Bay, but money will do wonders, and it is a first rate place from which to view Mount Desert's breezy heights.

The good people of Bloomington, Ill., have decided to "regulate the electric wires" in that city. A dispatch says: An important conference, comprising Mayor Koch and members of the City Council, together with representatives of the various electric companies operating in this city, was held here today with a view of framing legislation that will control the electric wires in this city. There are six different systems of wires, including telegraph, telephone, electric light and electric motor lines, and they have become in such a condition that they are a menace to the people. The different lines were constructed without being properly superintended, and of late great annoyance and considerable damage has been occasioned by the lines crossing each other. At the conference it was decided to divide the electric wires into two systems, the telegraph and telephone to comprise one and to be strung on one side of the street, and the electric light and electric motor wires on the other, and to run on the opposite side of the street. The people here are almost wrought up to the pitch of insisting that all the wires be put under ground.

Electric lighting is making some progress in Central America. An electrical engineer from this country now engaged in installing plants in Guatemala writes as follows: "The advent of the electric light in this country will, I think, mark a more distinct revolution in matters than almost any other invention. Rapid transit the people will not permit. Such a condition of affairs is incompatible with their nature. The electric light is something that will stir even the lazy, gray matter of their brain-pan without causing them to hustle. I don't know that any great amount of good could be evolved even were all the intellect of the country consolidated in one set of brains, but the tendency of thinking is not bad, even in a native. What the people think about the light is a matter of mystery. They will stand in groups stupidly gazing at the silvery horse shoe or the blazing mass of intensely brilliant light as it splutters and sings, with an expression of awe upon their countenances. Some of the people whose intellect has been cultivated with a hoe gravely remarked in my hearing the other day that the light was 'little suns.' Not so bad for a Central American savage, was it? The light is a matter of much concern to young people. In the semi-light of the splendor of the star-sprinkled tropical skies much inspiration was found for the young man who would 'a wooing go.' The electric light threatens to break up all such scenes and *seances*. Then in addition to this the dusky senoritas don't show up well under the light. It gives them a shadowy effect that is not at all enchanting and I would not be surprised if one result of the introduction of the light was to cause a tremendous use of complexion powder by the ladies. However, this is only a theory." Not the least matter that calls for admiration is the idea of a country that is popularly supposed in the United States to be so far in the rear of the front rank of civilization, being able to boast of a system of illumination as good as that of the large cities of the United States.

THE ELECTRIC MOTOR.

The Rochester, N. Y., Street Car company has completed the work of relaying the tracks throughout the business district for the electric system, and the work of erecting poles and stringing wires will be vigorously pushed.

The Westinghouse Electric & Manufacturing company is now making a new alternating current motor, for which many advantages are claimed. It does not require any higher tension than the ordinary 50 volt alternating current. The company has already received orders for 500 motors.

The power of the Presumpscot river will be utilized through electric motors at the S. D. Warren paper mills, Falmouth, Me. A dam will be constructed across the river 1¼ miles from the mills, and at this point an electric power station will be established Five 80-horse power motors will be installed at the mills by the Mather Electric company of Manchester.

R. L. Caldwell, superintendent of construction on the Rochester, N. Y., electric street railway, is experimenting with a view of connecting the rails on streets paved with asphalt without tearing up the entire road-bed. The company wants to lay its ground wire between the tracks without tearing up the whole asphalt pavement with pick and shovel, as would seem to be necessary. Mr. Caldwell's plan is to cut a channel less than an inch wide through the pavement by means of a steel tool carried on a four-wheeled truck traveling on the rails like an ordinary car. The truck has a wooden frame, and at a point between the wheels the tool-stock of an iron planer is fixed to a crossbeam, and in the stock or tool-holder is placed a square-nosed tool such as machinists use for cutting slots in iron. In the first experimental run it cut the asphalt nicely for a short distance, but the tool then dipped in too deep or jumped out of the channel. The sand in the asphalt wears out the tool rapidly, but in spite of all difficulties Mr. Caldwell thinks it can be made to do the work much cheaper and better than would be a general tear-up. If the planer makes a satisfactory channel it will still be necessary to cut out a block of the pavement at the joints of the rail, to permit insertion of the wires in the rails as usual.

The first electrical equipment turned out by the Westinghouse Electric & Manufacturing company was put in operation on the Pleasant Valley road, Pittsburg, Pa., on July 4, and has been in daily operation ever since without a hitch of any kind. The motor made by the Westinghouse Electric & Manufacturing company does not require wrought iron pole-pieces. Its principal part is a strong and rigid cast iron frame which carries the bearings and and pole-pieces. The gear-wheels and pinions have broad faces; in fact, everything about the apparatus indicates strength and reliability. The caps for the bearings and the pole-pieces are arranged so that the armatures, coils and field magnets can be conveniently removed for the purpose of repairs, and there is used an electric governing apparatus of novel construction which seems to possess great advantages. To protect the gears from rapid wear, and to deaden the sound, it is proposed to surround the gear-wheels by a cast-iron dust-proof box, which will contain a sufficient amount of oil to keep the teeth of the gears constantly lubricated. This lubrication will lesson the friction and the noise and the box which will surround the gears will so far deaden the sound as to make it unobjectable. The noise of the apparatus which has been in use a considerable time and which has become badly worn, becomes an intolerable nuisance, and street railway officials generally are expressing the hope that some way may be found for transmitting the motion from the motor to the car axle without the use of gear-wheels, for the reason that they are not only troublesome on account of the noise, but because the rapid wear involved heavy expenses for repairs.

THE TELEPHONE.

The French government telegraph department has completed an exhaustive study of the Paris telephone system and has formulated a plan for entire reorganization. There are at present twelve different exchanges, among which intercommunication is extremely difficult, owing to insufficient trunk-line facilities; most of these exchanges are also poorly equipped and cramped for room. The original plan of establishing one gigantic exchange for the whole of Paris has been abandoned as impracticable, or, at any rate, defective, and it has now been decided to construct four new exchanges to replace the twelve in actual operation. One of these will be in the Rue Gutenberg, near the postoffice, and consequently in the business part of the city where the greatest number of subscribers concentrate; this exchange will accommodate all the subscribers at present distributed between five different offices. The other three exchanges will be erected in the outskirts of Paris, two on the right bank of the Seine and one on the left.

A good many amusing incidents are related about the introduction of the telephone. "I remember," said one of the down-town old-timers to a Chicago reporter, "when we first had the telephone. It was much more of a curiosity than the phonograph is now. I used to wait for the bell to ring so as to have an excuse to howl in the thing. One day it went off, and I was on hand promptly. I discovered that the talker at the other end of the line was one of the most prominent society ladies of the South Side. I also discovered that she thought our office was a butcher shop. She wanted to know if Mr. ——, the butcher, was in, and I said that she had the honor of talking to him then. 'What do you mean,' she asked, 'by sending me such a roast of beef as that of yesterday?' I asked her what was the matter with it, and she replied that it wasn't fit for a dog to eat. I spunked up at this and told her that I had had more trouble about her trade than all of the balance of my customers combined. I told her that she not only did not know a good piece of roast beef when she saw it, but that she didn't know how to prepare it, and that she didn't know how to eat it after it was prepared. Of course she rung me off, and I went to my desk and rolled over and laughed. In a few days I had occasion to go into the butcher shop miladi had been talking about, and while waiting for my order I said to the butcher: 'Does Mr. —— trade here now?' mentioning the name of the husband of the lady who had talked to me over the wires. No, sir,' the butcher replied. 'He came in here and said that I had insulted his wife over the telephone. I tried to explain, but he wouldn't have it. So I have ordered the confounded thing to be taken out of here. I was afraid of it in the first place, and told the fellow that it wouldn't work. It is a humbug.' I looked up at his telephone and saw that he had a chunk of leaf lard stuck in the transmitter and a kidney tied under the bell. He said he had had the thing stopped up until it could be taken out. I suppose I ought to have told him the truth, but I couldn't summon the nerve. Besides, I enjoyed the tongue lashing which I gave the lady on the South Side, but I always feel guilty when I meet her."

THE TELEGRAPH.

In compliance with the provision of the law recently passed in New York, telegraph operators in that state have been paid every week since July 1st. The new order of things, as may be expected, is a great change in telegraphic traditions, and while it is welcomed by some, others look upon it unfavorably.

The advocates of governmental control of the telegraph point to England and never cease calling attention to the "low rates" charged in the kingdom for telegraph service. The following information on the same subject, from the Hamilton *Spectator*, will prove interesting: "The telegraph department of the English postoffice is being worked at a loss which is increasing year by year. During the entire period from Jan. 1, 1872, to March 31, 1887, the total deficiency of income to meet expenditure and interest at 3 per cent. on the capital created for the purchase of the telegraphs amounted to no less than $15,000,000, and of late years the annual loss has increased from $560,000 in 1881-2 to $2,300,000 in 1886-7.

The New York *Tribune* says that, "according to a writer who has taken the trouble to hunt up the statistics of this branch of business, there are in use now throughout the world 2 500 000 miles of telegraph wire—enough to surround the world with 100 strands. Of the sum total of lines, those of the United States constitute a little more than 30 per cent., and our mileage is increasing more rapidly than that of any other country on the globe. Sixty-one per cent. of the telegraph lines of the world are owned and operated by governments. Leaving this country out of consideration, about 88 per cent. of the remainder is under the control of governments; or, leaving the United States and Canada out, fully 95 per cent. is owned by governments. As to the charges for the transmission of messages, they vary greatly. It would be supposed that in the United States, the birthplace of the electric telegraph, the tariff would be lower than elsewhere. But it is not. In North America the body of the message only is charged for; in other countries the address or signature, or both, are tollable. In the United States the toll ranges from 25c. to $1 for ten words, according to the distance; in the Argentine Republic it is 40c. for ten words, and 20c. for each additional ten words; in Denmark, in Sweden and Norway, 13.4c. for ten words, and 1.34c. for each additional word; in Ecuador, 20c. for ten words; in Egypt, 49.6c. for ten words; in Germany, 1.4c. per word, the minimum being 14c. per message; in the United Kingdom, 6d. for twelve words; in the Cape colonies, 1s. for ten words, and 6d. for each additional 5 words or part thereof; in Guatemala, 25c. for ten words, exclusive of the address, in Honduras, 25c. for ten Spanish words, and double that amount for English words; in Italy, 20c. for fifteen words, and 1c. for each additional word; in Japan, 4c. per word, including the address and signature; in Portugal, 5c. for the first word, and 1c. for each additional word; in Roumania, 1.56c. per word; in Siam, from 35c. to $3.65 per word; in Switzerland, 1½c. per word; in Turkey, 2c. to 4c. per word, and in Venezuela, 20c. for twelve words. In New Zealand messages are classified as urgent, ordinary and delayed, the rates being respectively 2s., 1s. and 6d. for ten words, with ½d. for each additional word.

Miscellaneous Notes.

H P Young and H G. Rich have incorporated the Electric Protector & Specialty company of Newport, Ky., to manufacture protectors for electric instruments. The capital stock is $10,000.

Naval authorities generally will be greatly interested in learning that the Spanish submarine torpedo boat, the Peral, has recently completed a long series of tests to which the Spanish Government compelled its inventor to submit it before its final acceptance. These trials have included experiments as to the speed, endurance under water, radius of action, ease of control, and other matters connected with the practical value of the boat. They concluded with a sham contest with the cruiser Colon, one of the largest, swiftest, and newest vessels of the Spanish navy, said to be a fair sample of the average war ship of the present time. The first trial of this sort was in the day-time in the open sea off Cadiz, with weather so rough that most of those who went out in other boats to witness the tests were made seasick. The Peral practicaly failed in this test, those aboard the Colon being able to locate the submarine vessel at a considerable distance, and to keep out of the way, the speed of the Colon much exceeding that of the Peral. The same night the test was repeated, and with exactly different results Although the Colon used powerful electric search lights and all the other modern contrivances for detecting the approach of torpedo boats, the Peral, with only her small observation tower above water, passed all around the Colon undetected, approaching within 100 feet of the big vessel without being discovered. The little submarine boat could have blown the cruiser out of the water a dozen times without trouble or danger to itself had the contest been a real one. The search light was found to be entirely use'ess in picking out so small an object amid the waves. On the strength of this trial the committee conducting the tests has notified Lieut. Peral that it will report favorably to the acceptance of his vessel. The lieutenant is preparing a report of his own, in which he sets out the deficiencies which use has developed in his boat, with a view to having them corrected in other vessels of the same type which he hopes will be built. This is said to be the first time that a submarine vessel has undergone an actual test in the open sea under conditions approaching those of actual war.

The electrical engineering course of the University of Michigan, is elaborately described in the *Technic*, the official organ of the Engineering society. This department is under the direction of Prof. H. S. Carhart. The course of study is thus described: "The electrical portion of the electrical engineering begins with a course of illustrated lectures in electricty and magnetism, which serves as a foundation for a subsequent laboratory course in electrical measurements. This practical work is accompanied by lectures on units and the most modern and approved methods of making measurements of the various electrical and magnetic quantities, together with the method of calibrating the instruments and finding their constants. During the past year a good deal of work has been done in the systematic testing of batteries, obtaining their polarization and recovery curves, curves of current, internal resistance, and terminal electro motive force. This course is followed by one in dynamo-electro motive force. This course is followed by one in dynamo-electric machinery, two hours a week being devoted to class work, and two days to making tests of dynamos. The laboratory is now provided with two constant potential, and two constant current dynamos, the latter of ten to twelve lamps capacity each. A storage battery, fifty incandescent lamps, sixteen arc lights, an iron resistance of 120 ohms, capable of carrying about fifteen amperes and provided with a switch board which allows of ready coupling in parallel so as to carry 300 amperes, together with ammeters and voltmeters of sufficient capacity, permit of making elaborate tests on dynamo machines. During the year characteristic curves have been obtained of the several dynamos, tests of efficiency have been made, and a small dynamo has been compounded for constant potential. Motor tests for efficiency have also been carried out. A course in Mascart and Joubert's electricty and magnetism is offered as advanced work, and a course in distribution, of electricity and photometry of incandescent lamps is required of electrical engineers. The photometric room is provided with an accurately graduated bar six meters long, made by Darling, Brown & Sharp and has a methoen screen and an excellent rotating stand for measurement of spherical candle power. Important work on fuse wires, batteries, incandescent lamps, standard cells and other standards is also in progress. The entire basement floor is devoted to the electrical work. The largest room is devoted to the engine and dynamos. The smaller work rooms are all provided with substantial stone capped piers. In them apparatus has been placed for the most accurate work in electrical measurements and investigations. A portion of the building, remote from the dynamos, has been kept reasonably free from iron, so as to permit of measuring of horizontal component of terrestrial magnetism. A large tangent and cosine galvanometer, made by Edelmann, of Munich, is placed in this part of the building.

Personal Mention.

W. S. Rogers of C. H. Holmes & Co., St. Louis, was in Chicago last week.

Business Mention.

Frederick Pearce announces that he has succeeded to the business of Pearce & Jones, manufacturing electricians, New York City, and will hereafter conduct it at the old stand, giving it his personal supervision.

Wm. S. Turner of Woodbridge & Turner, has recently closed the contract for building the new electric street railway at Quincy, Ill. There will be 11½ miles of track. Mr. Turner was in Chicago last week making purchases.

The Fibrone Manufacturing company of New York announces its readiness to furnish fibrone and plasticon for electrical fittings and devices, such as battery jar covers, cells, switch handles and bases cut-outs, bell boxes, push buttons, rosettes, thumb screws, telegraph keys, annunciator dials and handles, switch boards, etc., and all kinds of insulating specialties.

The Accumulator company of 44 Broadway, New York, has been organized to succeed the Electrical Accumulator company. The capital stock is $5,000,000 The officers are: Theo. N. Vail, president; D. H. Bates, vice-president and general manager; Charles R. Truex, assistant general manager; H. R. Parish, secretary and treasurer. The company is thoroughly organized to furnish accumulators for light and power.

The Elektron Manufacturing company of Brooklyn, N. Y., which builds the Perret motors, has recently added largely to its cash capital to enable it to handle properly its large and constantly increasing business It has doubled its manufacturing facilities twice during the last six months. It now occupies nearly all of the large new factory building, 79–81 Washington street, Brooklyn, N. Y, one block from the bridge entrance. The works are notable for fine machinery whereby all parts are made accurately and interchangeably to standard gauges, and for the methodical and careful arrangement of its business.

E. K. Glass of Richmond, Ind. is putting on the market a new style of primary battery, for the efficiency of which great claims are being made. This is a zinc-carbon bichromate battery of large surface of elements; zincs are amalgamated and will need no remalgamation, Mason's zincs being used. The connections are non-corrosive. The capacity of one charge is stated to be over 100 ampere-hours; internal resistance, one-half ohm; life of zinc two months if battery is used continually. If used for lights five or six hours every day they should last four months. The experiments made by Mr. Glass cover a period of almost a year and the battery has been used for running lights and motors.

Electrical Patents.

Issued July 15, 1890.

432,022. Means for Generation and Conversion of Electric Energy. Angel De Castro, New York, N. Y.

The invention relates to improved means or apparatus for converting electric currents or pulsations generated by any suitable source of energy into currents or pulsations of different character suitable for any required use. It also relates to apparatus for generating electric currents or pulsations.

432,040. Electric Stop Motion for Warping Machines. John P. Haslam, Wilmington, Del.

432,049 Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

432,050. Induction Coil or Transformer. Carl E. Kammeyer, Eau Claire, Wis.

432,053. Electric Meter. Phil'p H. Korst, Racine, Wis.

The invention relates particularly to such meters as are used for measuring electricity furnished to houses, and has for its object to furnish convenient means therefor.

432,063. Trolley. William C. Miller, Albany, N. Y.

432,095. Electric Railway Switch. William D. Swart, Boston, Mass.

The first claim follows:

"In an electrically operated railway switch the combination of a permanent magnet pivotally placed beneath the surface of the road-bed, with its poles near contact posts which are electrically connected with two electro magnets placed on opposite sides of the actuating mechanism of the tongue of the switch, and an electro magnet secured to the car in such a position as to influence the permanent magnet as the car passes over it."

432,098. Telegraphic Relay. John M. Treber, Louisville, Ky.

432,131. Current Regulator or Rheostat. Otto Flemming, Philadelphia, Pa

432,136. Electrically Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa.

The invention consists of an electric motor to propel the vehicle, a motor circuit carried by the vehicle and including the motor, a signal circuit parallel with said motor circuit, and an electric signal in said signal circuit.

432,142 Electric Locomotive. Walter H. Knight, New York, N. Y.

The invention consists in combining with the driving wheels of an electric locomotive a motor consisting of two oppositely rotating parts which mutually react upon each other, and which are mechanically connected to the driving wheels in such a manner as to give a coincident rotative tendency thereto.

432,169. Dynamo-Electric Machine. Frank A. Perret, Brooklyn, N. Y.

The invention relates to improvements in the construction of armatures and commutators, the design of which is to cheapen the cost of manufacture, and, as regards the commutator, to provide a simple and cheap manner of "cross connecting" the segments thereof and of connecting the ends of the armature coils with the commutator segments.

432,197. Electric Cigar Lighter. Robert Graham, Reading, Mass.

432,202. Electrode for Secondary Batteries. James F. McLaughlin, Philadelphia, Pa.

432,204 Means for Electric Locomotion. James F. McLaughlin, Philadelphia, Pa.

The invention consists in an electric motor traveling within a properly constructed conduit, and mechanically connected to a surface car to be driven thereby, as distinguished from an electric motor carried on the car which is to be propelled.

432,205. Electric Heater. James F. McLaughlin, Philadelphia, Pa.

432,206. Commutator Brush. James F. McLaughlin, Philadelphia, Pa.

432,207. Electric Switch. James F. McLaughlin, Philadelphia, Pa.

The first claim reads as follows.

"In a system of car propulsion, the combination of a motor carried upon the car and a clutch for applying and disconnecting the motive power, with a brake for the car wheels and a single switch mechanism for actuating the clutch and brake or the brake and clutch in succession."

432,208. Electric Motor Car. James F. McLaughlin, Philadelphia, Pa.

The invention has reference to that class of cars in which a continuously operating electric motor is employed, and is coupled with or uncoupled from the drive wheels of the car by means of a suitable clutch.

432,209. Electric Clutch. James F. McLaughlin, Philadelphia, Pa.

432,215. Apparatus for Detecting Short Circuits. Harvey Redding, Everett, Mass.

Claim one is given:

"The combination of an electro magnet included in a main or primary electric circuit, an armature for said electro magnet included in a local circuit which is closed by a movement of the armature toward the poles of the electro magnet, a liquid holding casing inclosing said armature, and a body of liquid confined around the armature in said casing, whereby the movement of the armature to close the local circuit is retarded."

432,234. Electric Switch. Arnold C. Frey, Wilkinsburg, Pa.

The invention consists in a metallic post mounted on a plate of suitable insulating material, and having attached thereto a three-pronged contact piece adapted to be revolved and brought into or out of contact with a pivoted contact, thereby insuring a substantial connection.

432,237. Electrically Propelled Vehicle. John W. Henderson, Philadelphia, Pa

432,271. Trolley Toboggan. Daniel M. Harman, Baltimore, Md.

432,279. Current Regulator or Rheostat. George B. Massey, Philadelphia, Pa.

432,284. Electric Arc Lamp. Edwin C. Russell, Boston, Mass.

432,310. Regulation of Arc Light Circuits. Daniel Higham, Boston, Mass.

The mode consists in first dropping the potential to check the rise of current, and then raising the potential while the current is still above normal, or, when a fall of current occurs, in first raising the potential, but dropping it again while the current is below normal.

432,345. Multiplex Electric Locomotive. Charles J. Van Depoele, Lynn, Mass.

The invention relates to improvements in electric locomotives, and comprises an improved method of arranging, sustaining and connecting the propelling motor or motors, with relation to the axle or axles of the driving wheels to which the power is to be applied.

432,387. Armature of Dynamo Electric Machines. Oscar A. Enholm, New York, N. Y.

The object of the invention is to so construct the armature core that it shall constitute a perfect magnetic bridge between the field poles, and thus more effectually direct and concentrate the lines of force upon and through the armature, and at the same time be capable of a more ready magnetization and demagnetization as it revolves than are those forms of cylindrical armature cores that have been heretofore employed.

432,416. Conduit for Electric or Cable Railroads. John Lynch, Washington, D. C.

432,432. Animal Shears. Chester M. Palmer, Lamartine, Wis.

432,433. Animal Clipper. Chester M. Palmer, Lamartine, Wis.

432,436. Trolling Spoon. Ernest F. Pflueger, Akron, O.

432,453. Printing Telegraph Wm. W. Taylor, Mansfield, Mass.

The object of the invention is to provide an apparatus by which type-written messages may be sent by telegraph and recorded at both ends of the line by a person not familiar with telegraphy; also, in providing means for sending printed dot and dash messages to different points over different lines at one operation, and also to so construct the apparatus that a single tap upon a key, as the key of a type writer, will transmit a whole letter or character and record the same at both ends of the line.

432,490. Manufacture of Carbon Conductors. Achilles de Khotinsky, Gelnhausen, Prussia, Germany.

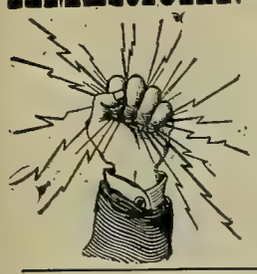
432,500. Armature. Edmund Wagemann, Little Rock Ark.

The invention relates to an armature for a dynamo electric machine or electric motor. Its object is to so construct a cylindrical ring armature as to obtain simplicity of construction and efficiency of action.

432,501. Electric Car. Edmund Wagemann, Little Rock, Ark.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

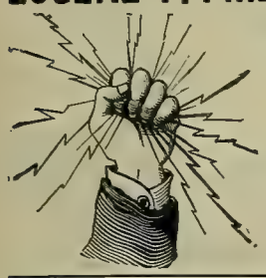
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union,** under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof,* and *will not deteriorate, oxidize* or *crack,* and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

The Board of Councilmen

of the City of Hopkinsville, Ky., will, August 14, 1890, receive and consider sealed bids for the erection and operating of an Electric Light Plant in said city—Arc and Incandescent—of sufficient capacity to supply the citizens for next two years, and after expiration of two years, when the contract with the Gas Company will expire, for lighting the streets, to supply both streets and citizens.

The grantee to have the exclusive rights of the streets for ten years.

The council reserving the rights to reject any and all bids.

The population of Hopkinsville is about six thousand.

H. R. LITTELL,
City Clerk.

July 14, 1890.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

PURDUE SCHOOL

—OF—

ELECTRICITY.

New laboratory, fitted with best appliances, dynamos, storage batteries, and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue. **Purdue University,**

LA FAYETTE, IND.

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

THE TURNER BRASS WORKS

MAKE ANYTHING IN BRASS.

4 LASALLE AVE CHICAGO.

WANTED

A Superintendent for arc and incandescent construction work; a man who has had experience in installing isolated plants, and is familiar with Edison apparatus. A permanent position for the right man; must be thoroughly steady and reliable. State age and experience. Address,

'CONSTRUCTION,'
Care of WESTERN ELECTRICIAN.

WANTED.

Electrician, thoroughly competent to supervise the wiring of Cars, Station and Line work for Sprague Road. Address stating experience, reference and salary wanted,

H. M. LITTELL, General Manager,
Cincinnati Inclined Plane Ry. Co.,
Cincinnati, O.

FIBRONE

Is the recognized **BEST SUBSTITUTE** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES

Also Sheets (which can be sawed, drilled, turned in a lathe, etc.), **Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.**

We claim to manufacture **the very material** wanted by the Electrical Trade. Send for estimates and prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. **Factory, 300 and 302 Monroe St., NEW YORK.**

OKONITE

TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

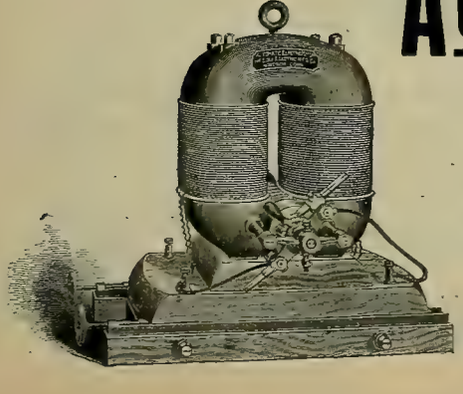
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

THE SPERRY ELECTRIC CO.,

D. P. PERRY, Vice-President and General Manager,

—MANUFACTURERS OF THE—

SPERRY IMPROVED SYSTEM

—OF—

ARC LIGHTING,

HIGH OR LOW TENSION.

WE GUARANTEE:

1. The new Sperry apparatus free from repairs for twelve months.
2. That the new Sperry Improved Dynamos can be coupled in series with perfect safety.
3. That any number of lamps from one to capacity of dynamo can be cut in or out of circuit, singly or in groups, with perfect safety, and without sparking at the brushes.
4. To absorb power in exact proportion to number of lights burning.

WE BELIEVE:

1. The new Automatic Sperry Dynamos and Lamps surpass in efficiency those of any other make.
2. That there is greater economy in operating the new Sperry System than any other.
3. That our automatic regulation has no equal; no rheostat, no wall boxes, no solenoid or dash-pot.
4. That if you will visit our factory we can show you the best arc lighting apparatus in existence.

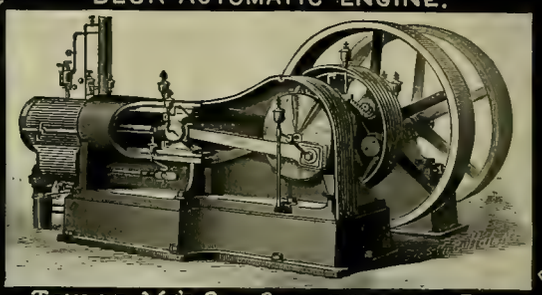
We invite correspondence with electrical engineers, intending buyers, and interested people everywhere.

THE SPERRY ELECTRIC CO., 195 to 207 South Canal Street, CHICAGO ILL.

MATERIAL AND WORKMANSHIP OF THE BEST.

ECONOMY UNEXCELLED

REGULATIONS PERFECT



BECK AUTOMATIC ENGINE.

HOT BEARINGS UNKNOWN

PRICES MODERATE

TAYLOR MFG CO. CHAMBERSBURG, PA.

COMPLETE STEAM PLANTS A SPECIALTY

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

You Will Oblige

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

LEVER UP—SHOWS OIL DROPPING.

LEVER DOWN—SHOWS OIL STOPPED.

POWELL'S PATENT IMPROVED SIGNAL OILERS

for DYNAMOS and HIGH SPEED ENGINES.

AUTOMATIC, UNIQUE STYLE, DURABLE, EFFICIENT. | EVERY OILER GUARANTEED.

Send for Special Circular and Price List. Address

THE WM. POWELL CO. CINCINNATI, O.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

DICTIONARY

—OF—

ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an **Encyclopædia** than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a **short, concise definition**, giving the sense in which they are correctly employed.

2d. A general statement then follows of the **Principles of Electrical Science** on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an **Illustration or Diagram** of the apparatus is given.

4th. To facilitate study, an elaborate system of **Cross References** has been adopted so that it is as **easy to find the definitions** as the words, and aliases are readily detected and traced.

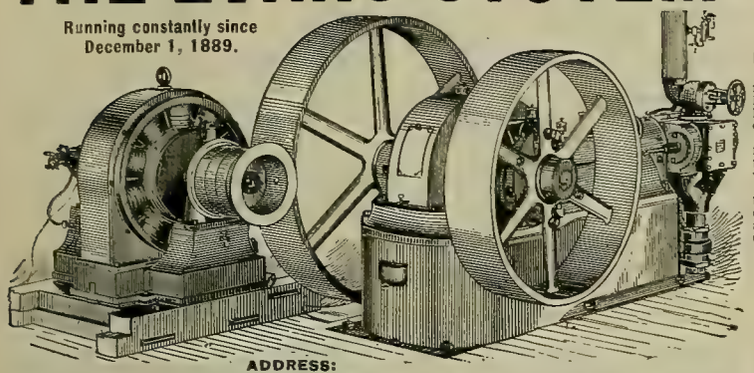
In applying these rules great care has been exercised to secure **CLEARNESS**, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, - - - - - - - CHICAGO, ILLINOIS.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

Running constantly since December 1, 1889.



UNION ELECTRIC LIGHT CO.,
FRANKLIN, MASS., June 13, 1890.

EVANS FRICTION CO., 85 Water St., Boston, Mass.:

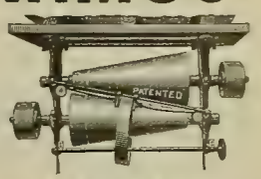
GENTLEMEN: In reply to your inquiry, we will say that we are more than pleased with your system of driving dynamos. We have it in use on our 500 light alternator, and the severe tests which we have successfully applied to it have convinced us that it is a device of remarkable efficiency and power.

This dynamo had previously given us a great deal of trouble from hot bearings, but since the use of your friction, it has run perfectly cool. The belts prove durable and the power is transmitted with no slip, and a remarkably steady light as the result.

We find that it gives us perfect control of the dynamo, and that a sudden load of the full capacity of the dynamo can be thrown on without any jump, jar or slip. We have tested it in every way and do not hesitate to pronounce it the best system for driving dynamos in existence.

Yours truly,
F. W. CROCKER, Superintendent,
Union Electric Light Co., Franklin, Mass.

We guarantee less pressure on the bearings for the same power than with ordinary belting.



Also manufacturers and patentees of Cone Pulleys (as per cut) which have been in successful operation for over three years, transmitting from one to fifty H. P.

ADDRESS:

The EVANS FRICTION CONE CO., 85 Water St., BOSTON.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD W LKINS

TRADING AS

PARTRICK & CARTER,

Manufacturers of and Dealers In Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

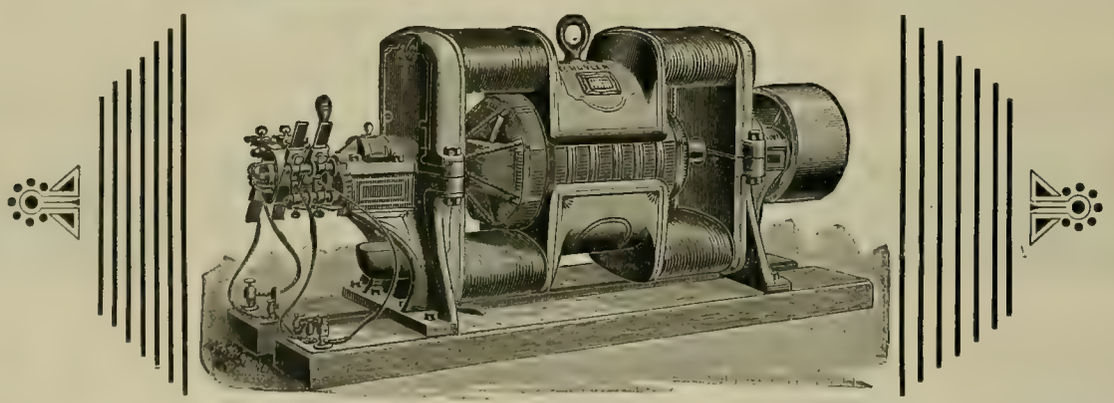
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.

THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S

Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

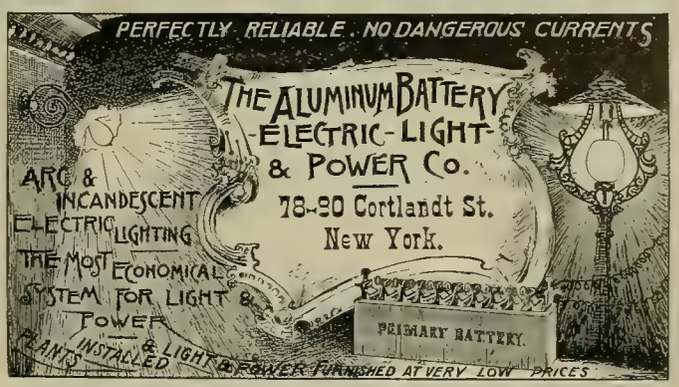
OKONITE
TRADE MARK.
WIRES, CABLES, TAPE and CORD
FOR
PROMPT SHIPMENT.

HOGGSON'S

IMPROVED
Door Spring.
Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

WHEN YOU BUY A MOTOR

From ANY Manufacturer or Dealer,
State that you WANT IT SUPPLIED WITH the
Whittingham Automatic Switch.
Send for Catalogue.
Automatic Switch Co.,
No. 8 Keyser Building,
BALTIMORE, MD.



GONDA

The Standard Open Circuit Batteries of the World.

AXO

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

TRADE
GONDA
MARK.

THE ONLY
Genuine Leclanche Batteries
Made or Sold in America.

LECLANCHÉ BATTERY CO., 149 West 18th St., NEW YORK.

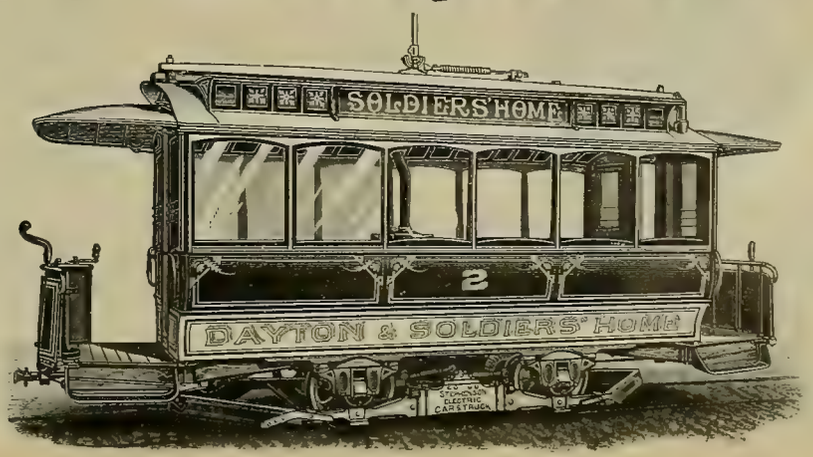
WESTERN ELECTRIC CO.,

We are the Exclusive Western Agents for the Sale of
A. G. Day's Kerite Wires
For Telegraph, Telephone, and Electric Light Use.
PRICES ON APPLICATION.

CHICAGO. NEW YORK.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
FOR
ELECTRIC MOTORS
CARS ADAPTED TO ALL SYSTEMS.



Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

W. D. Sargent, President. John A. Barrett, Vice-President and Cons. Electrician.
E. H. Cutler, Treasurer and Manager. Frank A. Perret, Electrician.

THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,

MANUFACTURERS OF THE

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets

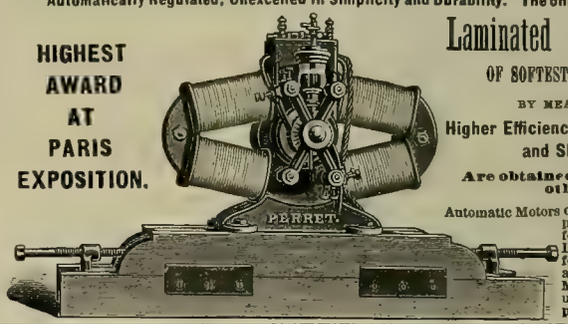
OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting, Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

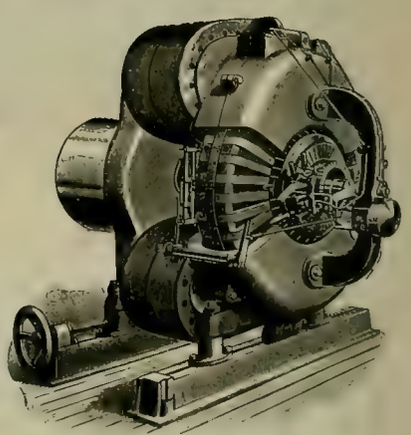
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)

MANUFACTURERS OF

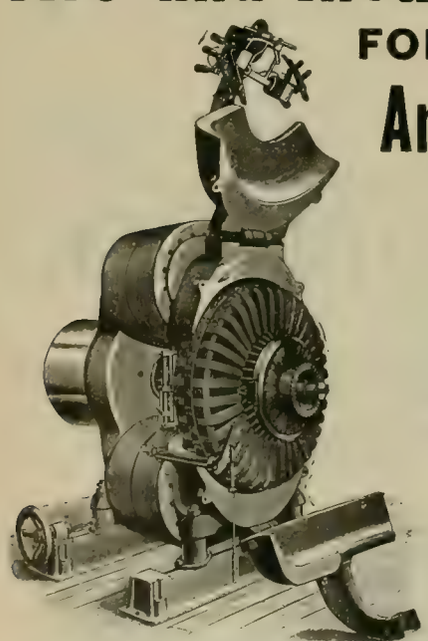
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

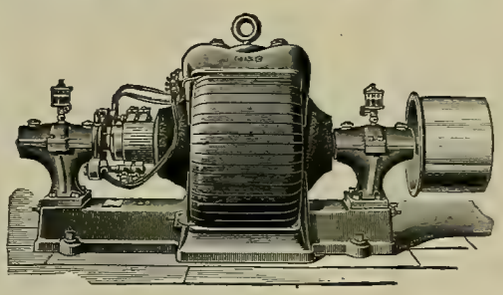
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 8,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

POND ENGINEERING CO.

707 and 709 Market St., St. Louis.
427 "The Rookery," Chicago.
31 Waterworks Building, Kansas City.
319 Ramge Building, Omaha.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

Erected Ready for Service.

SPECIALTIES:-The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, etc.

SEND FOR LATEST CATALOGUES.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

Binders FOR THE Western Electrician $1.00.

ELECTRICAL BOOKS OF ALL KINDS.

Send for New and Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO, ILL.

GEORGE P. BARTON,

LAW OFFICE,
225 DEARBORN STREET,
CHICAGO, ILL.

Patent and Trademark Cases.

C., B. & Q. R. R.

—IS THE—
Best Appointed Line
—FOR REACHING THE—
West, Northwest and Southwest.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st	Edition	2,500	Copies.	Incandescent Wiring Hand-Book,	2d	Edition....(Just ready.)	2,500	Copies.
" " " "	2d	"	2 000	"	Bell Hangers'	1st	"	2,500	"
" " " "	3d	"	(Just ready.)	2,000	"	" "	2d	"	1,000	"
Incandescent Wiring	1st	"	2,500	"	Total within Eighteen months			15.000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE OF MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

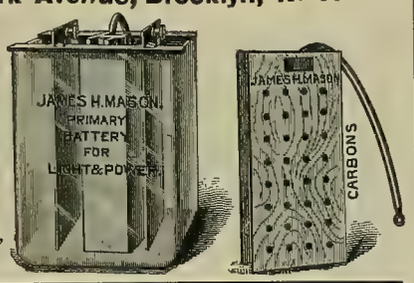
SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

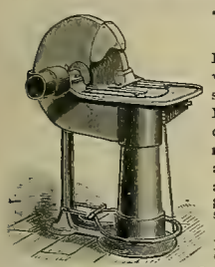
JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.
These Batteries are in practical use, and giving perfect satisfaction.



THE BARNES WATER EMERY
Tool Grinder.



It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.
Sold subject to approval. Send for full description and price.
W. F. & John Barnes Co., Rockford, Ill.,
Address No. 761 Ruby Street.

Barnes' Patent
UPRIGHT DRILLS,
20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.
Barnes' Patent
ENGINE LATHE,
15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.
They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to W. F. & JOHN BARNES CO., Rockford, Ill., Address No. 761 Ruby st.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.
STREET OR TRUNK LINES.
ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.
AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.
Factory: JERSEY CITY, N. J.

SPRAGUE
ELECTRIC RAILWAY
SYSTEM.

More than one hundred different street railways in operation or in course of construction.

MORE THAN 175
SEPARATE ORDERS
From Street Railways for Electrical Equipments.

The Sprague Electric Railway System has been proved to be the most

DURABLE,
RELIABLE,
ECONOMICAL,
CONVENIENT.

Sprague
ELECTRIC RAILWAY & MOTOR
COMPANY,
16 and 18 Broad St., NEW YORK.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
ESTABLISHED 1820.
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES:

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the **ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES** by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully endorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL. 403 Sibley Street.

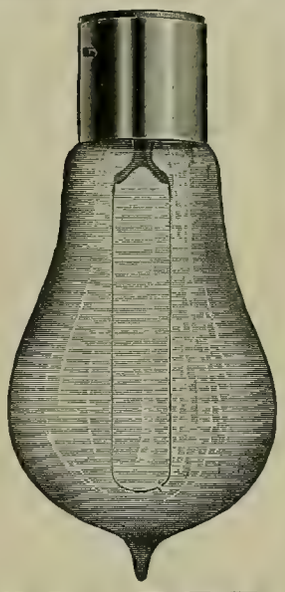
THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,
ALL CANDLE POWERS,
ANY VOLTAGE,
ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT Co., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER Co, Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

GRIMSHAW WHITE CORE
WIRES AND CABLES.

=FOR=

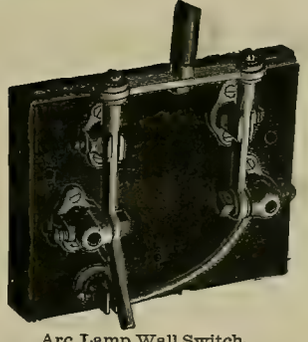
TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

Switch-Board Cables,
Grimshaw White Tape,
Grimshaw Black Tape,
GRIMSHAW SPLICING COMPOUND.

McLennan Switch.

Paiste Switch.



Arc Lamp Wall Switch.

Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.,* CHICAGO, ILL.

THE Electrical Supply Co.,

171 RANDOLPH ST.,

C-H-I-C-A-G-O.

MANUFACTURERS OF

BARE AND INSULATED

WIRES AND CABLES

AND

GENERAL ELECTRICAL GOODS.

Catalogues or Quotations upon Application.

NO CHARGE MADE CUSTOMERS FOR EXPERT ADVICE.

A large and well assorted stock of Shield Brand and Habirshaw Wires constantly on hand.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:--

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219,208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219,208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

Manufacturers of the

SLATTERY INDUCTION SYSTEM

—OF—

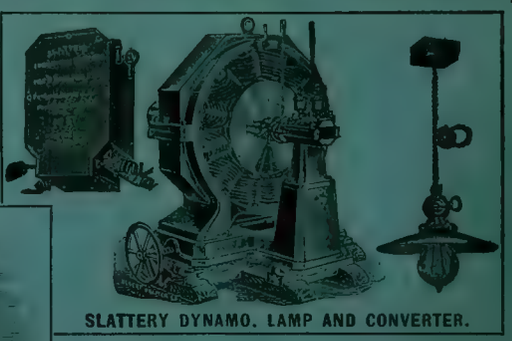
Incandescent Lighting,

—AND THE—

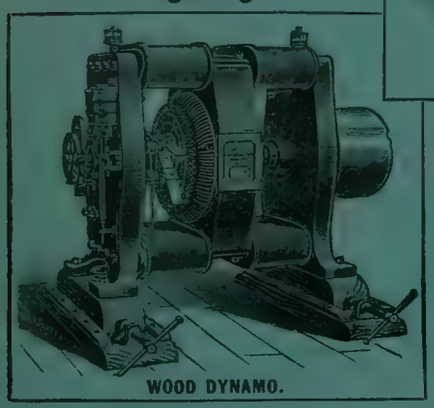
WOOD SYSTEM

—OF—

Arc Lighting.



SLATTERY DYNAMO, LAMP AND CONVERTER.



WOOD DYNAMO.

The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12--16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.

CORRESPONDENCE SOLICITED.

MAIN OFFICE AND WORKS, FORT WAYNE, IND.

NEW YORK OFFICE,
115 Broadway, Boreel Bldg.

SAN FRANCISCO OFFICE,
217 Sansome Street.

CHICAGO OFFICE,
185 Dearborn Street, First Floor,
W. J. BUCKLEY, Manager.

PHILADELPHIA OFFICE,
907 Filbert Street,
G. A. WILBUR, Manager.

PITTSBURGH, PA., 533 Wood Street.

CITY OF MEXICO OFFICE, F. ADAMS, Successor.

BERGMANN & CO.,

ELECTRIC LIGHT, COMBINATION

AND

GAS FIXTURES,

ADAPTED TO ANY SYSTEM OF INCANDESCENT LIGHTING.

ALL APPLIANCES FOR THE EDISON ELECTRIC LIGHT.

Illustrated Catalogues, Designs and Estimates Furnished on Application. Correspondence Solicited.

Office and Works, 292-298 Avenue B, } **NEW YORK** { Show Rooms, 65 Fifth Avenue.

T. W. WILMARTH & CO., 227 State Street, CHICAGO, ILL.

AGENTS FOR OUR FIXTURES IN THE NORTHWEST.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, AUGUST 2, 1890. No. 5.

ALUMINUM BRASS AND BRONZE COMPANY,

COWLES' ALUMINUM AND SILICON COPPER ALLOYS,
IN INGOTS, SHEETS, RODS, WIRE AND CASTINGS.

Sheet Copper, Sheet Brass, PURE ALUMINUM.

STEWART BUILDING, 53 Chambers St., New York.
ROLLING MILLS, Bridgeport, Conn.

THE HOLTZER-CABOT ELECTRIC CO.,
MANUFACTURERS OF AND DEALERS IN
EVERYTHING ELECTRICAL.
SEND FOR 256-PAGE CATALOGUE.
111 Arch Street, BOSTON, MASS.
SPECIAL AGENCIES: BAKER, BALCH & CO., Seattle, Wash. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.
A full line of our manufactures can be found at our Agencies.

--AN INVITATION BY CABLE--
MANUFACTURERS
To Visit The Stockton Hotel, CAPE MAY.
We will be there during the National Electric Light Convention, Commencing August 19th, 1890, with samples of Wire and Cables.
GEO. WILEY. FRED. DEGENHARDT.
STANDARD UNDERGROUND CABLE CO., PITTSBURGH, PA.

MAGNOLIA METAL.
—INDORSED BY THE—
United. States and German Governments.

BEST ANTI-FRICTION METAL
For Dynamo, High-Speed Engine, Steamship, Car, and all Machinery Bearings.
MAGNOLIA ANTI-FRICTION METAL CO.,
Owners and Sole Manufacturers,
London Office: 75 Queen Victoria St.
Chicago Office: 41 Traders' Building.
74 CORTLANDT ST., NEW YORK.

(2121)
ELECTRIC LIGHT,
HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.
ABSOLUTELY PURE RUBBER CABLES,
CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF
THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.
CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.
Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.
TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.
NAVY PORTABLES, SILK, COTTON and HEMP.
BELL WIRE, rubber covered, for Marine Work.
PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.
Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations
GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,
Sole Manufacturers of COWLES' PATENTED
Fire-Proof and Weather-Proof
ELECTRIC LIGHT LINE WIRE.
Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.
a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.
Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.
WAREROOMS: 19 and 21 Cliff Street, New York. 133 and 135 Wabash Ave., Chicago, Ill.
FACTORIES: ANSONIA, CONN.

THE EDISON MACHINE WORKS,

MANUFACTURERS OF

Weatherproof Wire. Insulated Iron Wire. Magnet Wire. Rubber Covered House Wire.
Annunciator Wire. German Silver Wire. Office Wire. Flexible Brush Holder Cable.
Gas Fixture Wire. Arc Lamp Cords. Tinsel Cords. Flexible Cords.
Telephone, Telegraph and Electric Light Cables.
PARAGON TAPE.

JAMES F. KELLY, General Sales Agent, - 19 Dey Street, NEW YORK.
WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964		3,964
Westinghouse		27,710	27,710
Edison		10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734		734
Ball	613		613
Western Electric	566	250	816
Indianapolis Jenney	794		794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324		
Van Depoele	285		285
Waterhouse	222		222
Heisler		500	500
Remington	159	300	459
Sperry	130		130
Excelsior	90		90
Hochhausen	60		60
Weston	30		30
Fuller	10		10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc	Inc
Thomson-Houston	16,927	[illegible]
Brush	6,080	4,259
Westinghouse	321	49,767
Edison	..	[illegible]
American	1,537	175
United States	632	6,141
Schuyler	1,766	.....
Ball	952	6
Western Electric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	160	.....
Excelsior	205	30
Hochhausen	70	.....
Weston	138	.....
Fuller	10	.....
Reliance	80	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	[illegible]
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

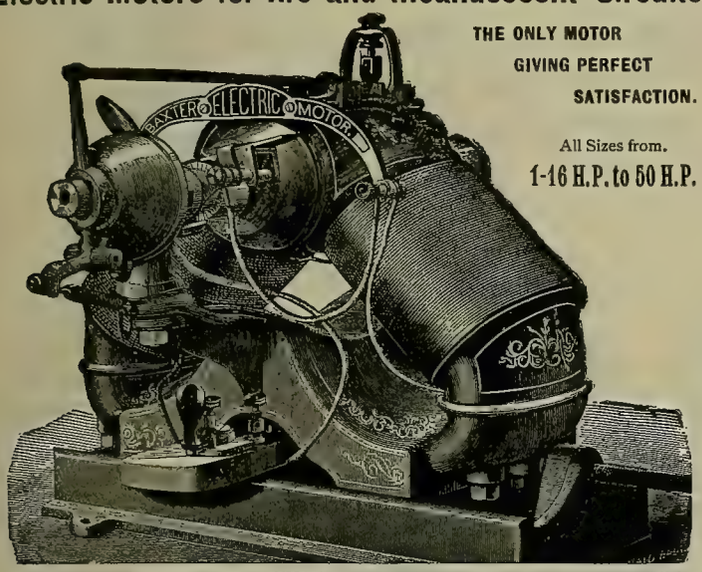
It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%

	Arc.		Incandescent.	
	T. H. System.	All other Systems	T. H. System.	All other Systems.
Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Increase	5,843	4,402	36,229	40,652
Percentage of increase	52 7-10%	43%	410%	86 8-10%

To Arc and Incandescent
POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,
MANUFACTURERS OF
Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

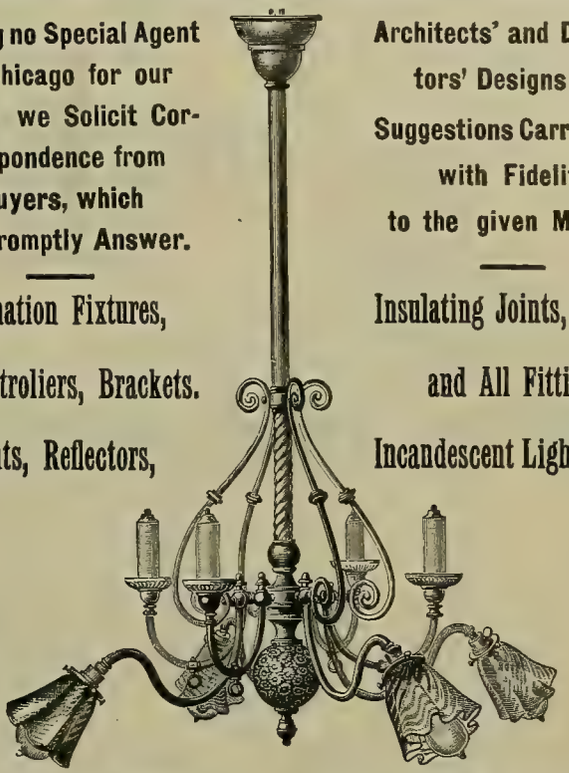
—— Every Motor is Guaranteed. ——
Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

THE MITCHELL VANCE CO.,
(Successors to MITCHELL, VANCE & CO.)
DESIGNERS AND MAKERS OF
ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.



Combination Fixtures,
Electroliers, Brackets.
Pendants, Reflectors,

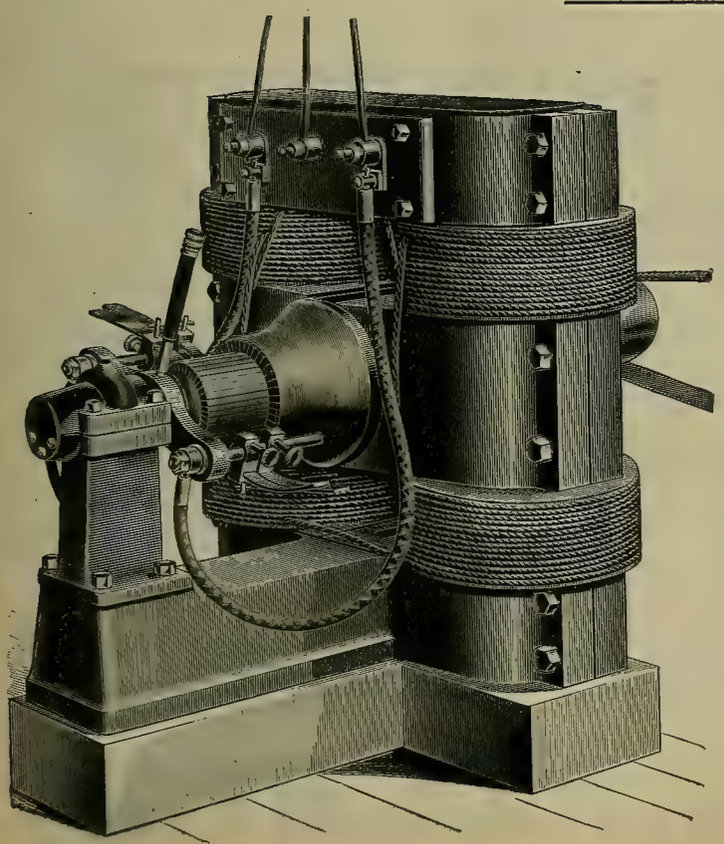
Insulating Joints,
and All Fittings for
Incandescent Lighting.

MANUFACTORY,
24 and 25th St. and 10th Ave.,

SALESROOM,
836-38 Broadway and 13th St.,

NEW YORK CITY.

FOREE BAIN,
ELECTRICAL EXPERT AND MANUFACTURER.



I have more Electric Motors in Practical Operation in Coal Mines than all other manufacturers combined. They aggregate over

350 H. P. to Date.

These installations are not experimental—the Motors are in actual service cutting coal, some of them have been working

20 Hours Per Day

for more than one year, and during this time not one of them has required repairing.

NO SHORT CIRCUITS.
NO BURN-OUTS.

I have secured patents on a full and complete system of Mining by Electricity. Contracts solicited.

84 Market St., - CHICAGO.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

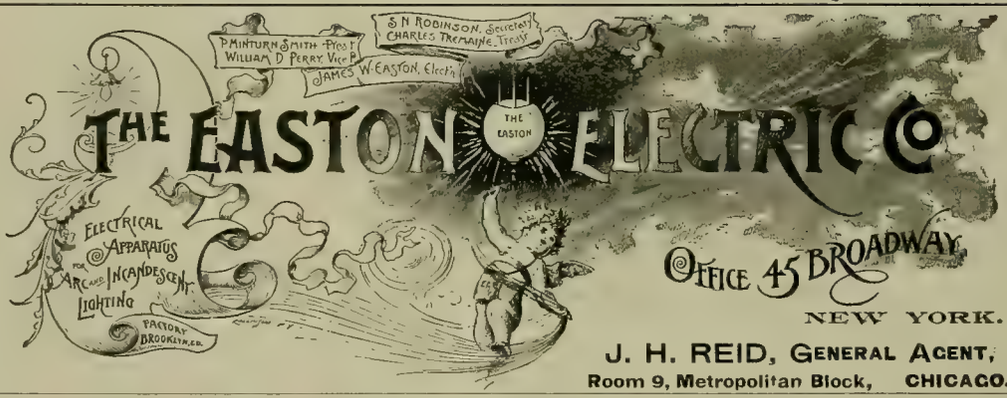
Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.



J. H. REID, GENERAL AGENT,
Room 9, Metropolitan Block, CHICAGO.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 10 AMPERES.

ADVANTAGES OF THE CROSBY DRY BATTERY FOR OPEN CIRCUIT WORK.

THE CROSBY DRY BATTERY is the **best Open Circuit Battery in the market.** It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing **more work** than any other. In addition to this, it is the **most reliable, most compact, most durable** and **simplest** cell yet discovered. It is so constructed that it **is not destroyed** or seriously injured by **short circuiting,** and we are prepared to prove at any time that its **power of recuperation** is proportionately greater than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks, and all the uses to which Open Circuit Batteries may be put, **it has no equal,** whether it be compared with **Liquid or other Dry Batteries.** We guarantee **depolarization, abscence of offensive crystallization and perfect cleanliness.**

The Crosby Battery is the only Dry Battery sold **semi-charged. It does not work until wanted.**

The preference as **between Liquid and Dry Batteries** should always be given to the **latter,** provided the amount of working power required and a constant current can be obtained. **No form of Dry Battery** has as yet been placed before the public, **except the Crosby Dry Battery,** which will do the work of Wet Batteries and **give a constant supply of Electricity sufficient for reliable Open Circuit work at all times.** The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with which their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance, and easily broken and injured. **The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids,** and, after once being properly connected, **requires no attention whatever,** while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.

The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for **Open Circuit Work.** If, however, through an accident, it becomes **Short Circuited, it recoups itself.** This cannot be said with equal truth of any other Dry Battery known.

The Crosby Dry Batteries are manufactured in **different sizes and forms,** to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in **the Crosby Dry Batteries Varies from one to ten amperes,** according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

CYLINDRICAL.

SIZE IN INCHES.

	Height.		Diam.
No. 3	7¼	x	2½

RECTANGULAR.

SIZE IN INCHES.

	Height.		Width.		Length.
No. 2	5	x	1⅛	x	4½
No. 3	9	x	1½	x	8

TELEPHONE.

SIZE IN INCHES.

	Height.		Width.		Length.	Price.
Long Distance	7½	x	2½	x	4¾	$2.00
Telephone	7½	x	2	x	4¾	1.50

N. B.—OTHER SIZES AND SHAPES TO SUIT PURCHASERS.

[COPY.]

CROSBY ELECTRIC COMPANY, New York.

OFFICE OF FLEMMING'S ELECTRO MEDICAL INSTRUMENT MANUFACTORY,
No. 1009 ARCH STREET, PHILADELPHIA, March 8, 1890.

GENTLEMEN: The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan. 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29, when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan 30, 7:30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing.

Very respectfully,
(Signed) OTTO FLEMMING.

THE CROSBY ELECTRIC CO., Judge Building, Fifth Ave. & Sixteeth St., NEW YORK.

GREAT WESTERN ELECTRIC SUPPLY COMPANY.

190 & 192 Fifth Avenue, CHICAGO, ILL.

ELECTRICITY IN MINES

REQUIRES EXTRA INSULATION.

SIMPLEX WIRE AND SIMPLEX PAINT

Give in Every Respect a Superior Insulation.

SIMPLEX WIRE

Weather-Proof.

Water-proof.

Its tough, compressed insulation resists abrasion.
Its pure caoutchouc gum will not harden.
Its even, seamless surface prevents leakage.

STANDS THE TESTS.

Use simplex Wire in the dampest place in your mine plant or where it is most liable to abrasion.

Get a sample, put it into a bucket of water, connect the wire with one pole of a high potential dynamo, and the bucket with the other; see how Simplex Insulation stands practical tests.

SIMPLEX INSULATING PAINT.

Insures thorough Insulation in all mine work.

For Moldings, Cut-Outs, Etc.

Use it freely when installing your mine plants, and the gain in insulation and safety will well repay you.

CATALOGUE IN PRESS.

ST. LOUIS ELECTRICAL EXHIBITION,

Sept. 3,--Oct. 18, 1890.

Parties desiring space at the coming exhibition should apply **AT ONCE**, as the number of applications already received occupies nearly all the available space.

FREE SPACE, FREE POWER AND FREE FREIGHTS

Are offered to all, and an attendance of over one million people is assured.

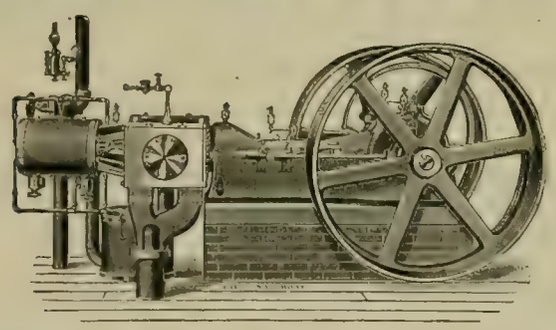
GOLD MEDALS Will be awarded by a competent committee, and everything done to advance the interests of Electricity. All the leading manufacturers have secured space, and the exhibit will surpass anything of the kind ever seen in America.

WRITE FOR PARTICULARS TO

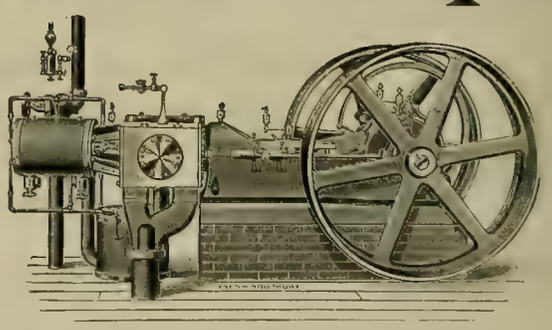
FRED. H. WHIPPLE,

GENERAL MANAGER, DETROIT, MICH.

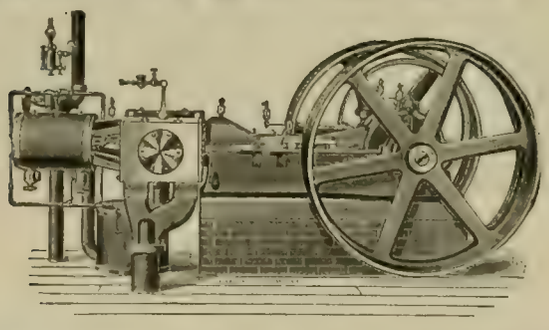
None so Good, None to Equal.



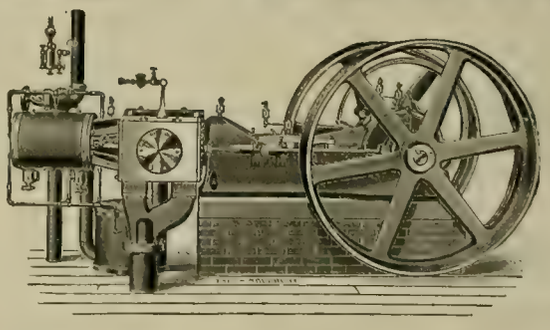
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

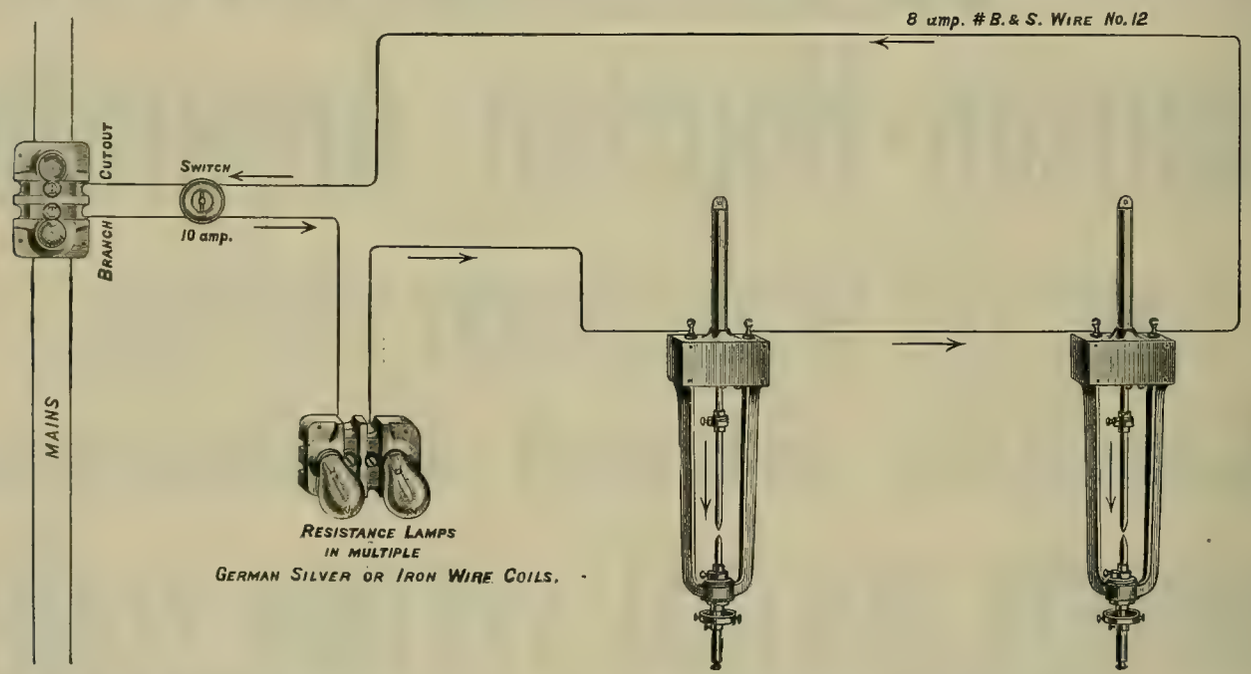
We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

EDISON

GENERAL ELECTRIC CO.,

EDISON BUILDING,
BROAD ST., NEW YORK CITY.

LIGHT & POWER DEPARTMENT.



ARC LIGHTING FOR INCANDESCENT CIRCUITS.

WIRING DIRECTIONS:

In installing these lamps, a branch cut-out should be put in at the mains, and the wire of the leads to the arc lamp should be of a size sufficient to carry the current, 8 amperes, with the usual drop in practice for multiple arc work.

A ten ampere fuse should be used in the cut-out. Place in the positive lead, leading to the arc lamp, a resistance of about one ohm for each ten volts above 90 volts, the amount used by the two lamps in series.

For short runs we use No. 12 B. & S. wire, and for longer runs in proportion. All the joints should be securely made.

The current passes through the lamp from the top or positive carbon to the bottom carbon, and the direction of the current can be told by the carbons; that is, the hottest one at its point being the positive carbon. Should the lower carbon be the hottest, when current is turned on the lamp, simply reverse the connectinos where the current enters the lamp, and the desired result will be produced.

For inside lighting we furnish specialy lmade incandescent lamps for resistance, and use a branch cut-out wired so that the two resistance lamps are connected in multiple, their resistance being of the proper amount, according to the voltage of the circuit on which lamps are connected.

For outside lighting we use a resistance best suited to the position in which the lamps are to be placed, and have a hood, specially designed, containing a resistance which is interchangeable, and can be adapted to varying voltages. The hood is so connected up that, when the lamp is hung within the hood, both lamp and resistance are in the circuit.

The alignment of the lamp should be carefully looked to, the fixture carrying the lamp should be well guyed, and porcelain insulators should be used between the fixture and the hood carrying the lamp.

A ten ampere switch to control each pair of lamps should be placed in the most convenient position.

CHIEF EXECUTIVE OFFICE, EDISON BUILDING, 44 BROAD ST., NEW YORK CITY.

DISTRICT OFFICES:

Chicago, Rialto Building. San Francisco, Chronicle Building. New Orleans, Cotton Exchange. Denver, Col., Masonic Building. Portland, Oregon. Toronto, Can., Bank of Com. Building.

FACTORIES:

New York City. Schenectady, N. Y. Harrison, N. J. Hamilton, Ontario. Sherbrooke, Quebec.

THE BEST SOLID RUBBER CORE WIRE ON THE MARKET.

In order to meet the demand for an **ABSOLUTELY RELIABLE, YET LOW-PRICED** solid rubber core-wire, The Edison Machine Works have produced a new line of this class of goods made up in all sizes, from No. 0000 to No. 20. It is the equal in quality, finish and durability of their other well-known wires. Once tried, it will always be used in preference to any other.

IT IS THE NE PLUS ULTRA.

FOR PRICES, SAMPLES, AND OTHER INFORMATION, ADDRESS

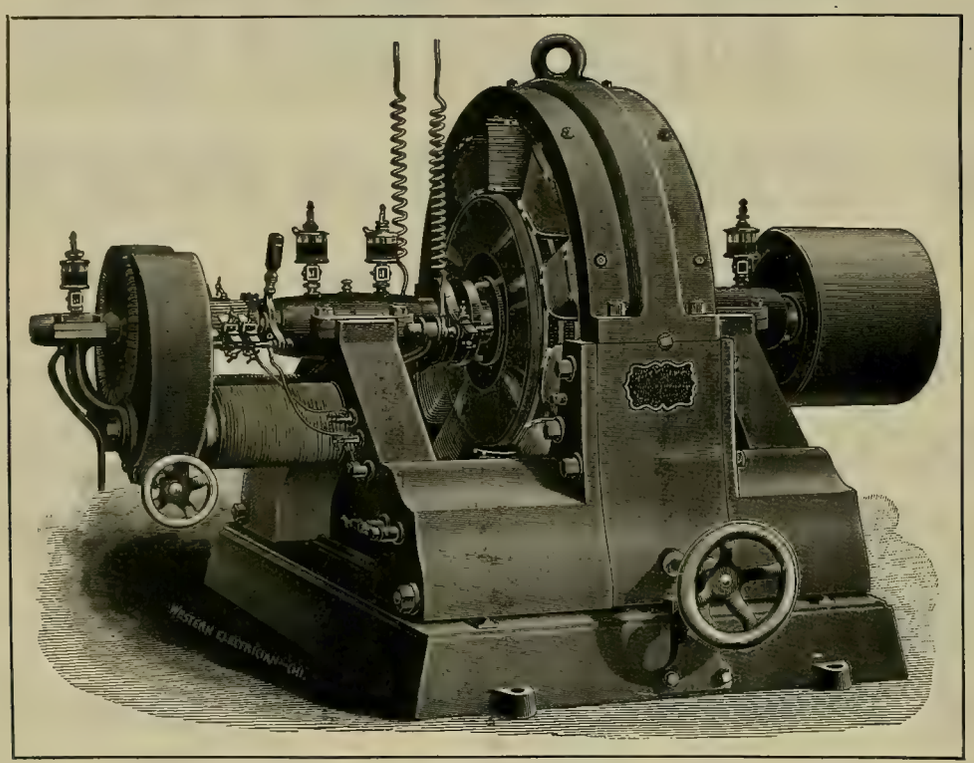
THE EDISON MACHINE WORKS,

JAS. F. KELLY, Gen. Sales Agent, 19 Dey Street, NEW YORK.

THE BEST OF ALL

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., Seattle, Washington.
THOMAS WOLFE, Southwestern Agent, Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts., 141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts., 1517 Larimer St., Denver, Colo.
CHAS. M. BLANCHARD, Agent, Girard Building, Philadelphia, Pa.
L. N. COX, Agent, 16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent, Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts., 531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

AUTHORITIES TALK.

Sir Wm. Thomson, F. R. S., and Dr. John Hopkinson, F. R. S.

— VERSUS —

Mr. Bottomley and Mr. Harber.

Sir WILLIAM THOMSON, F. R. S.

THE UNIVERSITY, GLASGOW,
June 19th, 1890.

I have tested the insulation of two specimens of Okonite Wire sent to me recently, and have found thoroughly satisfactory results for all ordinary temperatures and potentials.

The thickness of the Okonite in these specimens was 1.8 millimetres (.072 of an inch), and its insulation resistance held good up to **7,500** volts. After the passing of current through it at this very high potential for some time, I found the insulation resistance for ordinary potentials only reduced from 6,700 (its original value) to 4,500 megohms per statute mile at 16° Cent.

I am well acquainted with Dr. Hopkinson's tests of December, 1886, which were submitted to me early in 1887, and I know the results of his recent tests of the same specimens, showing no deteriorations, but actually an improvement, in the insulating quality after three-and-a-half years' keeping.

I have also seen the published certificates of many practical men of different dates from March, 1886, to December, 1888, which give trustworthy evidence of the practical success of Okonite Wire for telegraphs, telephones, and electric light and power.

With this evidence before me, in addition to my own electric tests and examination of the insulating material in respect to toughness and other mechanical qualities, I believe Okonite to be a very valuable material for the insulation of electric conductors in a large variety of practical uses.

(Signed.) WILLIAM THOMSON.

Dr. JOHN HOPKINSON, F. R. S.

WESTMINSTER CHAMBERS,
5 VICTORIA STREET, S. W., June 19th, 1890.

In December, 1886, I made a series of careful and somewhat elaborate experiments upon Okonite Wire, and fully reported upon the same. My report, of which I append a copy, was as complete as it could be at the time. One point it was then impossible to determine, and that, practically, the most important point of all, namely, the question of the durability of the insulation.

It is almost impossible, in most instances, to judge of the suitability of any particular insulating compound for wires **until it has stood the test of time for some years.** It so happened that samples of Okonite Wire that I tested in 1886 had been left with me, and have remained in my possession ever since, parts of the same having been used in my laboratory and for various other purposes.

I have now again tested these samples, and append the tests, together with the results obtained in 1886. In the case of A and C, the test is after one minute's electrification; in the case of B_1 and B_2 the test is a mean during an interval from one-half minute to five and one-half minutes from first electrification; the temperatures are practically the same, viz.: 15°5C. in 1886, 15°C. now. Samples A and C have been immersed in water for five days, B_1 and B_2 for a shorter time. B_1 is a sample which had been twisted in 1886 for the purpose of ascertaining whether the material would stand mechanical disturbance. B_2 had six kinks made in it for a similar purpose.

A, in 1886	6,180	A, now	7,000	...	Megohms per statute mile.
C, in 1886	7,590	C, now	11,680	...	do. do. do.
B_1 in 1886	5,435	B_1 now	11,740	...	do. do. do.
B_2 in 1886	4,750	B_2 now	13,700	...	do. do. do.

In my last report I stated that I was most favorably impressed with the qualities of the wire, both on account of its high insulation and mechanical reliability. Tests on the samples proved that the **insulation was practically perfect,** both for high and low potentials, and that the insulation would stand very rough handling and a considerable temperature, without injury, and indeed with but slight reduction of its insulation resistance. I can now add that the **result of time has shown** that not only is the insulation excellent when made, and that it will stand mechanical disturbance, **but that for a term of three-and-a-half years it is perfectly durable, and remains as good as at the first.**

(Signed.) J. HOPKINSON.

Buy the wire that stands the test of the highest authorities in the world and is ordered in 1,000,000 feet lots by the largest buyers.

CENTRAL ELECTRIC CO.,

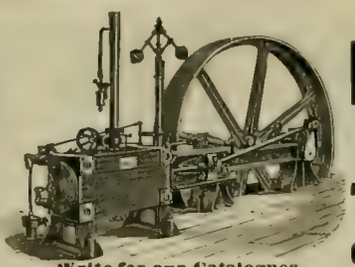
116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable System.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



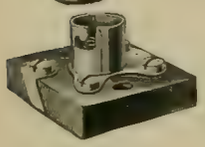
Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.
Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.
CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

E-D-I S-O-N
Miniature Incandescent
ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,
Which shows prices of, and experiments with Edison Lamps, and gives directions



How to Make a Cheap Battery,
And how to operate them. Any intelligent boy can operate these batteries and lamps.
EDISON LAMP COMPANY, Harrison, N. J.

COLUMBIA
Incandescent Lamp Co.,
1912--1914 Olive Street, St. Louis, Mo.,
MANUFACTURERS OF
INCANDESCENT LAMPS.
Lamps Made to Fit any Socket.
Send us a trial order. Satisfaction Guaranteed.

JUST COMPLETED

THE LARGEST AND BEST EQUIPPED

INCANDESCENT LAMP FACTORY

IN THE WORLD.

Sawyer-Man Electric Co.,

510-534 W. 23d Street,

NEW YORK.

CINCINNATI HEADQUARTERS
ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.
WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE ·
FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.
The JONES-BROS-ELECTRIC-CO. 28 30 & 32 West Court St.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

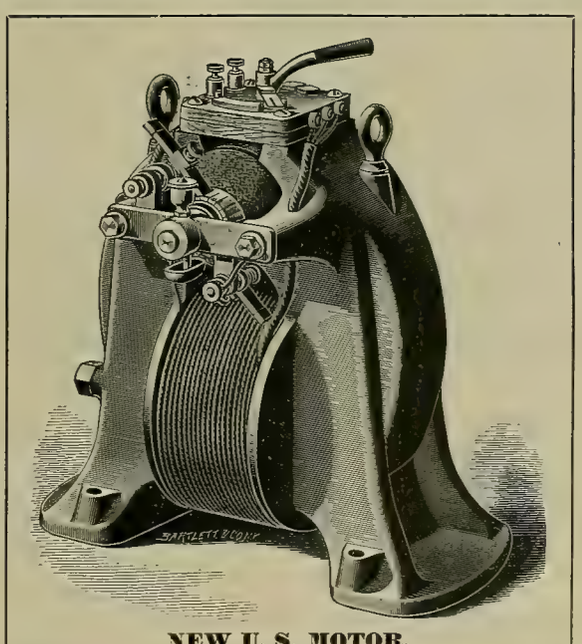
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

WANTED.

At once, experienced armature winders. Best of reference required.

COLUMBIA ELECTRIC CO.,
207 E. Fourth St.,
ST PAUL, MINN.

WANTED.

Electrician, thoroughly competent to supervise the wiring of Cars, Station and Line work for Sprague Road. Address stating experience, reference and salary wanted,

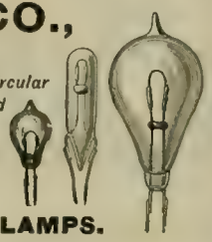
H. M. LITTELL, General Manager,
Cincinnati Inclined Plane Ry. Co.,
Cincinnati, O.

THE E. S. CREELEY & CO.,

GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.

ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.



MINIATURE INCANDESCENT LAMPS.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,
32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, June 9, 1890.

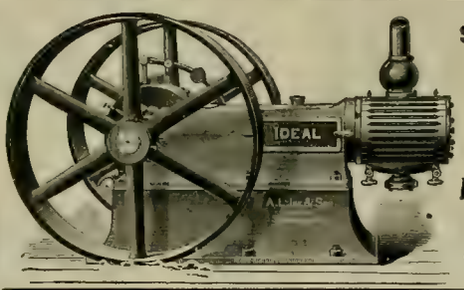
Messrs. Hazazer & Stanley.

GENTLEMEN:—We have used your Dust Proof Iron Box Bells for the past five years and have always found them to give entire satisfaction and should be happy to recommend them to any one in search of a reliable bell.

Yours respectfully, *McCREERY & PENDERGAST.*
Electrical Contractors,
986 Sixth Avenue, NEW YORK CITY.

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street

THE WESTON STANDARD

Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,
Office and Factory, 114 William Street, Newark, N. J.

IT KNOCKS THEM ALL!

BISHOP RUBBER COVERED WIRES.
BALATA INSULATED DROP CORD.

Prof. Henry Morton says: "These wires showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas."

THE "BISHOP"
Always Leads the Procession.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, - 341 ROOKERY BUILDING, CHICAGO.

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS } Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS } Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.
Edw. H. Johnson, President.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co

MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

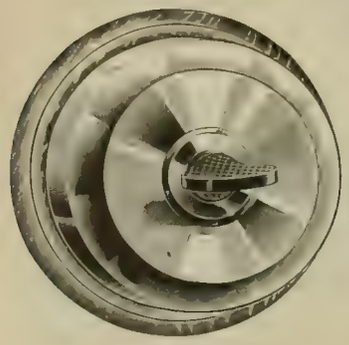
PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH

FOR INCANDESCENT WORK



Recognized as the best, simplest and most durable circuit breaker in existence.

H. T. PAISTE,
12th and Market Sts.,
Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

—THE—

Celebrated P. AND B.
ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,
59 Maiden Lane, - NEW YORK.

Western Electrician.

EVERY SATURDAY.

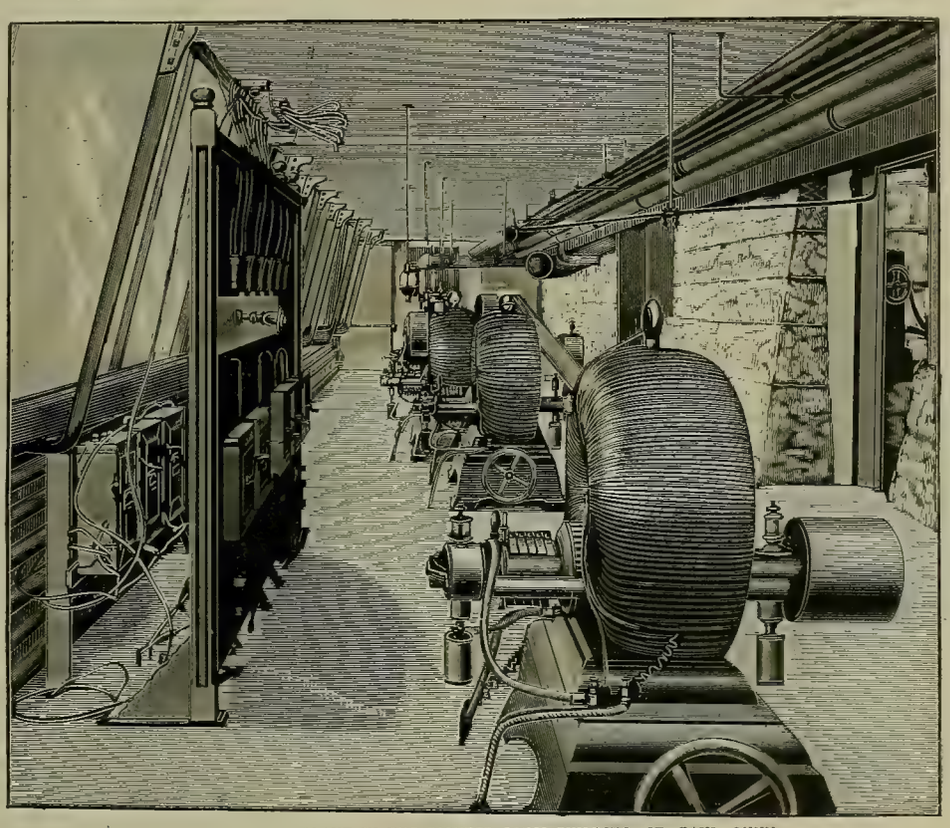
Vol. VII. CHICAGO, AUGUST 2, 1890. No. 5

Electric Light Plant in the Pioneer Prass Building, St. Paul, Minn.

During the last few years there have been many handsome buildings erected in St. Paul, Minn. These immense structures created a demand for isolated incandescent plants. One of the most interesting of these is illustrated in the accompanying cut. It is located in the *Pioneer Press* building, one of the handsomest commercial buildings in the Northwest. The structure is twelve stories high, and that portion not devoted to the publication and business of the paper, is divided into offices. There are 2,400 lights distributed throughout the building. There are also a number of motors in use. The generating plant consists of one 200 light and four 500 light incandescent dynamos of the Mather type. They are driven by high speed engines. The switchboard is substantial and handsome, and is located directly opposite the entrance to the room, attracting much attention. The installation is complete in all details. The wiring was done by the Mather company. Okonite wire was used through out the building. All the wiring is concealed. The Perkins' lamps are used.

Four motors are operated in the press and stereotyping rooms. Two of them are, 7½-horse power each, one 2-horse power, and one 1-horse power. They are all of the Mather type.

The building was completed last November, and the plant has been in operation since that time, giving entire satisfaction. J. H. Reed, manager of the Chicago office of the Mather company, installed the plant.



ELECTRIC LIGHT PLANT IN THE PIONEER PRESS BUILDING, ST. PAUL, MINN.

National Electric Light Association.

The headquarters of the National Electric Light association at Cape May during the convention beginning August 19, will be at the Stockton hotel. The association will hold its sessions in the large ball-room, which has a seating capacity of 800. The morning sessions will be held from 10 to 12, and the afternoon sessions from 4 to 7. Rooms for 150 persons have already been engaged by members of the association. No general exhibit of electrical apparatus will be made at the convention, although, doubtless, many members will make small exhibits of their appliances.

Each evening a concert or hop will be given in the ball-room under the direction of the reception committee.

Those who desire to engage rooms at the Stockton should address letters to F. Theo. Walton, the proprietor, Cape May. The hotel rates are as follows:

One person, per day, annex room	$ 3 50
" " " Land view	4 00
" " " Ocean view	5 00
Two persons, per week, annex room	40 00
" " " Land view	42 00
" " " Ocean view	50 00
Two persons for the electrical season:	
Annex room	50 00
" Land view	54 00
" Ocean view	64 00

The "electrical season" at Cape May continues from Saturday, the 16th, to Monday the 25th.

The trains on the Pennsylvania Railroad for Cape May leave New York daily, except Sunday, at 11 a. m. and 1:30 p. m., and reach Cape May respectively at 4:33 p. m. and 6:10 p. m.

Three trains over the West Jersey Railroad leave Philadelphia for Cape May daily, except Sunday. The time table is as follows:

Leave Philadelphia.	Arrive Cape May
9 a. m	11:05 a. m.
2:30 p. m	4:33 p. m.
4 p. m	6:10 p. m.
8:20 a. m. (Sunday train)	10:40 a. m.

The steamer Republic leaves the Race street wharf, Philadelphia, for Cape May at 7:30 a. m. and arriving at 1 p. m. daily, including Sunday.

Underground Electric Light Company, Chicago.

The Underground Electric Light company, Chicago, has been organized with a capital of $1,000,000. The incorporators are Andrew J. Cooper, Frederick J. O'Connor and Charles A. Munson. The company will at once apply to the city council for a franchise to establish power houses and build conduits. It is proposed to construct a station on the South side at Nineteenth and State streets, another on the North side and two on the West side, the sites for which have not yet been selected. It is expected that the capital will be increased to $5,000,000 to execute the plans of the company. The Fort Wayne company's apparatus will probably be installed.

Nashville Electric Club.

The electrical fraternity of Nashville, Tenn., decided to organize an electric club at the meeting last week. In response to an announcement the following named gentlemen met to consider the matter: A. H. Stewart, Western Union Telegraph company; E. G. Connette, superintendent United Electric Railway company; L. E. Marple, electrician Electric Railway company; A. Dahlgren, treasurer; W. A. Burkholder, superintendent; T. A. Achison, president, Capital Electric company; Robt. L. Morris, attorney; J. W. Braid, electrician; J. A. Tarpley, chief engineer, United Electric Railway company; Fred W. Fairfield, city electrician; T. W. Johnson, late electrician Telephone company; J. U. Rust, Western Union Telegraph company, D. W. Baird, correspondent WESTERN ELECTRICIAN.

After an informal discussion it became apparent that those present were of one mind as to the necessity and propriety of forming an electric club, and A. H. Stewart was called to the chair and D. W. Baird appointed temporary secretary. The objects of the meeting being fully explained and understood, on motion a committee on permanent organization was appointed to report at the next meeting an outline of the basis for a permanent organization, the probable cost and such recommendations and suggestions as they might deem proper. The committee consists of A. H. Stewart, chairman; Fred. W. Fairfield and J. U. Rust.

By request Adolph Dahlgren read the constitution and by-laws of the Chicago Electric Club and after some discussion the following gentlemen were appointed a committee to formulate and submit to the next meeting a constitution and by-laws: Adolph Dahlgren, chairman; E. G. Connette and L. W. Johnson.

Telephone Convention.

A great deal of interest is being manifested in the forthcoming meeting of the National Telephone Exchange association which will take place in Detroit on the 6th and 7th of September. The headquarters of the association will be at the Russell House, where fine accommodations have been secured for the delegates and visitors. The meetings of the convention will be held in the ladies' ordinary and the best rooms in the house will be placed at the disposal of the convention. Messrs. Jackson and Forbes, of the Michigan Telephone company, have charge of the arrangements and a pleasant time is promised to all who may attend the convention.

Electric Heating.

About a year ago C. E. Carpenter of Minneapolis, an enthusiastic electrical student, conceived the idea that the heating of surfaces could be done economically by electricity. He accordingly went to work and built a pan-cake baker as an experiment. This device, which proved to be quite successful, was brought to the notice of F. W. Nevens, a practical clothier of the same city. Mr. Nevens was impressed with the results obtained by Mr. Carpenter, and suggested that the invention be applied to the heating of ordinary flat irons. He gave Mr. Carpenter his ideas on the subject, and the latter made a number of tests which proved so successful and promising, that patents covering the apparatus were applied for, and a stock company was organized under the state laws of Minnesota. This corporation, the Carpenter-Nevens Electro Heating company, has been in existence about six months, and it is now manufacturing flat irons, soldering irons, pan-cake bakers and a number of other heating devices for restaurants, laundries, tin shops, etc. Fig. 3. Several weeks ago the company decided to establish a branch office in Chicago, and T. E. Morford was appointed to take charge of the business at this point. The apparatus which is now on exhibition at the Chicago office is represented in the cuts. Fig. 1 shows a cake-baker in Ernest W. Kohlsaat's restaurant, Jackson street. The current in this case is taken from the Edison 3-wire system, which supplies current for the lights. The voltage used was 110.

FIG. 2. ELECTRIC HEATING.

A general idea of the construction of the various devices in which this heating apparatus is employed, may be had from an inspection of Figs. 2 and 3. Fig 2. represents a flat-iron taken apart. That portion of the iron which comes into contact with the material to be ironed, is shown beneath a piece of mica cut into a similar shape. Just above the mica sheet is the heating conductor proper. This conductor is of iron wire which has been "zig-zagged" to economize space and concentrate the heat. It is attached, or, more properly speaking, stitched to a card of asbestos of the shape indicated by means of fine iron wire staples bent over on the back of the card. Between the conductor-card and the upper or outer casing of the flat-iron there are placed sheets of asbestos and another iron plate. A piece of asbestos felt is on top next to this iron plate. When in place the whole is clamped down by two ⅛ inch screws, which extend through into the bottom piece. It may be mentioned that Mr. Carpenter in his early experiments depended solely upon the elasticity of his heat-insulating materials to produce the pressure necessary to make a good contact with the surface to be heated. This method, however, was not entirely satisfactory, and he gradually reached the conclusion that a compression plate of some material should be used which would cause the nearest approach to a constant contact of the heater proper with the surface to be heated. In other words, he decided that the best results could be attained when the iron wire conductor was kept under pressure in the closest possible contact with the working surface of the utensil. The patents of the company, therefore, cover this particular feature. The thin sheet of mica is all that is between the conductor and the base-plate of the iron.

With the object of securing reliable data as to the cost of operating its appliances, the above-mentioned company has made a number of tests which show the quantity of current required in each piece of apparatus. The following is a table of results obtained on a 110-volt circuit in Minneapolis; the cost of current is based on rates allowed by the Minneapolis Edison company:

Heating Apparatus.	Current required — 110-volt circuit.	Cost per day of 10 hours in Minneapolis.
Soldering iron (ordinary form)	0 5 amp.	2½c.
" " (hatchet form)	2.2 "	11c.
Embossing Stamp	1.6 "	8c.
Hat Iron	2.1 "	10c.
Flat Iron	1.5 " to 3.0 "	7 to 15c.
Griddle Iron (three discs)	4.5 "	22c.
Goose Iron	2 0 " to 3.5 "	10 to 17c
Tea Pot	2 "	10c.

In regard to the above table it may be stated, generally, that this electric company's prices for power are one-fourth of the lighting rates. As the current is furnished to the heating apparatus through meters the Edison company charges for this service a fraction more than one-fourth the lighting rates. In other words, 200 watt-hours in heating service cost the consumer one cent. In motor service 212 watt-hours cost the same.

It is stated by Mr. Morford that there are at present in use in Minneapolis four electrically-heated tailoring irons in an overalls factory. These four irons are doing the work of five of the old-style irons. The Hennepin Steam Laundries in the same city, he says, are also being fitted up entirely with the Carpenter-Nevens system; that is, the irons in use in the laundry, the machine rolls, etc., will all be heated by current from an isolated plant, which is to be installed with this object in view. In St. Paul, one of the electric hat-irons is in daily use at R. A. Lanpher & Co.'s, and Lindeke, Warner & Schurmeier, dry goods firm in the same city, is using four of the tailoring irons. This last-mentioned house has its own electric light plant, consequently the operation of this apparatus costs, practically speaking, little or nothing. In Chicago two of the electric soldering irons are being tested at Armour's canning factory.

FIG. 1. ELECTRIC HEATING.

The Electric Motor in Chicago.

There is an installation in the establishment of the Booth Packing company, Chicago, that would cause general rejoicing in the motor field a year ago, yet to-day it creates little more than passing comment. The Belding company has just installed two incandescent motors in the building—a thirty horse-power in the cellar; and a fifteen-horse power on the fourth floor. These motors operate all of the machinery in the building. A visitor to this establishment cannot fail to be impressed with the many points of superiority of the electric motor over the steam engine. For instance, the relative space occupied by the electric motor and steam engine is shown. The engine is still in position in the basement and it seems hardly possible that the motor can accomplish the same results as the ponderous machine which it has replaced. The same example can be found in the canning factory on the fourth floor where a fifteen-horse power motor, hidden away in the corner, is driving all the machines in this department. The engine which it displaced occupied considerable floor space which will hereafter be utilized for other purposes. The current for the motors is supplied by the Chicago Edison company.

The same considerations that induced the Booth Packing company to substitute the electric motors for the steam engine have had a similar effect on many other Chicago corporations. A year ago most of the electric motors in Chicago operated ventilating fans, sewing machines, coffee mills, and extremely light machinery. A ten-horse power motor was a novelty and a thirty-horse power could command a good fee if placed on exhibition. During the last year, however, the enterprising agents for the motor companies have been doing considerable work —the results of which are shown in many of the factories about the city. Very few people know the extent of the growth of the business in Chicago during the last year, and many of those

most interested do not realize the advancement that has been made. This fact was clearly shown in an interview with a gentlemen connected with the Chicago Edison station last week. He was speaking about the increase in the capacity of the company's plant. In relation to the motor business he estimated that there was "in the neighborhood of 500-horse power connected with the station." An examination of the books of the company shows that at the present time there are 850-horse power in motors on the station and that the installations now being made will raise this above 900-horse power within a very short time. This by no means represents the total horse power of motors in operation in Chicago but only those connected with the Chicago Edison company's central station. In addition to the motors in the arc circuits of other electric lighting companies there are many private installations such as the Auditorium, and other large office buildings.

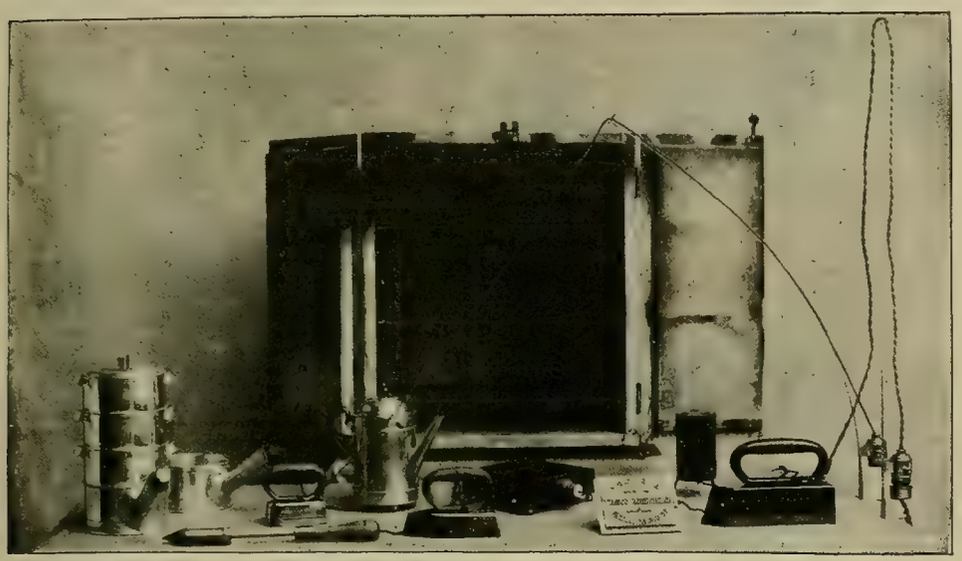


FIG. 3. ELECTRIC HEATING OVEN, EMBOSSING IRON, COFFEE POT, SOLDERING IRON.

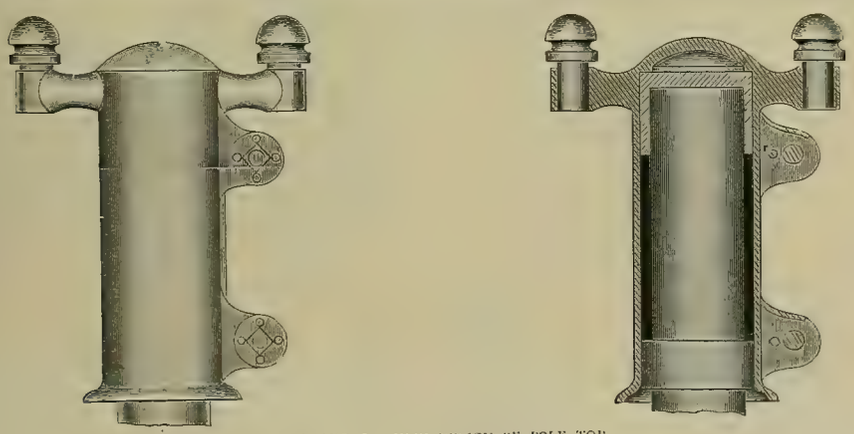
Many of Chicago's largest printing establishments are operated by electric motors. The Chicago Printing company has one five-horse power and one twelve-horse power C. & C. running its presses, the *Tribune* has a fifteen-horse power Mayo and a five-horse power Sprague. The *Inter-Ocean* has a number of Thomson-Houston and Mayo motors in operation, aggregating 77½-horse power. The Rand-McNally company has a fifteen-horse power Sprague. Lyon & Healy have a ten-horse power Sprague pumping water for elevators, etc. In the Columbia theater the Detroit Motor company recently installed twenty-two-horse power to operate fans and run elevators. These motors are all connected with the Chicago Edison company's station.

Another interesting feature of the motor business in Chicago is the operation of the telegraph systems. The Western Union has forty-horse power in Sprague motors operated from the central station and the Postal company has twenty-horse power United States motors, depending on the same source of energy. These motors operate small dynamos specially wound for telegraph service which take the place of the batteries formerly used. Both of these installations have been illustrated and explained in recent issues of the WESTERN ELECTRICIAN. It may be remarked, however, that by the new arrangement a saving of thousands of dollars is effected. This is only one of the many advantages derived from the new arrangement, however. When it is remembered that the telegraph system of Chicago depends entirely on this service it will be seen that the companies have implicit confidence in the system. In addition to these systems the Gold and Stock tickers are all operated on a similar system. At the headquarters of this company there is an installation of Sprague motors, fifteen-horse power, operating small dynamos which furnish the current to the lines.

This is certainly an encouraging condition of affairs. The advancement made during the last year has given the motor companies much encouragement and it is confidently expected that even greater advancement will be made in the next year.

A New Design of Pole-Top.

Refinement in the construction of the overhead equipment of the electric road is now the order of the day. It is only lately, however, that engineers have turned their attention to the features needed in pole-tops. As is well known, these should be strongly made, so shaped as to shed the water, and should insulate both trolley and guard wires from each other and from the pole. There should be also provided ready means for taking up the slack in both suspension wires and feeder insulators. These features all seem to be found in the new pole-top designed by Edmund Verstraete, the electrician in charge of the construction of the Union Depot Railway company's plant in St. Louis.

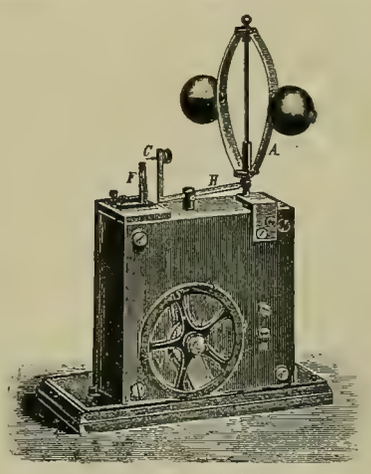


FIGS. 1 AND 2. NEW DESIGN OF POLE TOP.

As the cut shows, this cap is of iron, and is so designed that it may be used with either iron or wooden poles. The wooden poles do not need to fit it tightly, as the pull of the guy wires will keep it pressed against one side of the pole. The pole-top is merely slipped over the end of the poles, the top adjusting itself. With iron poles a wooden plug and bushing are used, as shown in the section. These bushings are thoroughly soaked with Simplex paint, and as the iron flange keeps the adjacent part of the pole dry, the casting is always insulated from it. The lower end of the pole-top is flared out so as to shed the water. This construction insures the insulation of the trolley wire from the ground. The suspension wires are wound on a drum, whose enlarged ends are provided with six holes. A pin through one of these holes keeps the drum from unwinding. These pins allow the slack of the wires to be readily taken up. The drum for the guard wires is 9 inches above that for the trolley wire. These drums are made of insulating material. The insulators for carrying the mains or feeders are set above the guard wire. By this arrangement, if both the trolley and the guard lines are put up before the mains are strung, the latter need not be slipped through between the suspension wires, but may be readily thrown over the top and fastened to the insulators. This feature will be appreciated. The Great Western Electric Supply company, Chicago, is handling the device.

Low Water Signal.

A little device designed by an inspector in the municipal water works at Breslau, Germany, is shown in the cut. It is utilized to send in an alarm when the water in the reservoir falls more quickly than the normal consumption would warrant. The rapid falls denote leaks which may be speedily repaired if timely warning is given. The band wheel, *S*, is put in motion by a float and a counter weight. By means of gearing the little governor, *A*, is kept in motion, its speed becoming greater and greater as the fall of the water proceeds more rapidly. Attached to the governor is the lever, *H*, at the end of which is a platinum contact, *C*. When the speed of the governor reaches a certain point the lever, *H*, is raised so high that the contact point reaches *F*, and the circuit is completed and the alarm sounded. The cut is reproduced from the *Elektrotechnischer Anzeiger*.



LOW WATER SIGNAL.

Spokane Falls Electrical Society.

The Spokane Falls Electrical society is arranging for a large display of electrical apparatus in the Northwest Industrial Exposition to be opened at Spokane Falls on October 1. This exposition, which promises to be a great attraction, will embrace exhibits from Washington, Oregon, Idaho and Montana. The Electrical society of Spokane Falls has taken in hand the Electrical Exhibit Department, and has secured a large space for this purpose. One prominent electrical house has volunteered to light the exposition, and supply power to run the machinery. Current will be furnished by generators of 200-horse power, operated by the water power of the Spokane river, about a mile from the building. Other firms are coming forward with offers to place exhibits in the exposition. A Spo-

kane correspondent writes: "There is no section of the world where electrical interests are making such rapid strides as in the far west, and this exhibit will be eagerly examined by men of influence and capital who have electrical interests in the various sections from which they come."

Thermal Cut-Out.

Electrical cut-outs of all kinds are now the order of the day. The little device illustrated herewith was designed by Stephen D. Field, Stockbridge, Mass., to usurp the office of the fuse wire as protector from abnormal currents. Where the last named device is employed as a

THERMAL CUT-OUT.

protection to telegraphic and other circuits, carrying currents of small quantity, it is difficult to obtain a wire which is sensitive and prompt enough in its operation to work with certainty when relied upon to protect any delicate apparatus. Lack of uniformity in the size of the wire or its composition, together with great fragility when adjusted for small currents, give rise to uncertainty of action.

The object of this invention is to overcome these objections and at the same time provide an apparatus which will also automatically reclose the circuit should the cause of the abnormal current be removed. The illustration shows one form of cut-out employed by the inventor. The device consists of a glass tube formed as indicated and filled with mercury. The conducting wires are sealed into the ends of the tube. The chamber or bulb at one end is provided with a small air space. In the operation of this cut-out the inventor claims that the passage of an abnormal current through the mercury will heat and vaporize the column in the capillary portion of the device, and thus break the circuit. The air space prevents the rupture of the tube.

Reckenzaun Motor Reversing Gear.

It has been well known ever since the introduction of electric motors that the armatures of such machines will rotate right-handed or left-handed, according to the position in which the

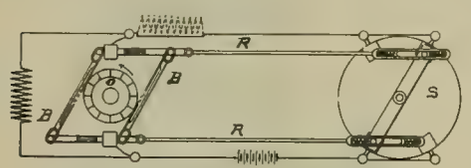


FIG. 1. RECKENZAUN REVERSING GEAR.

brushes are placed relatively to the poles of the motor field magnets. If, however, the brushes of a motor are moved from the commutator while a current is flowing through the armature, two serious things will happen: First, a damaging arc is formed between the receding brush and the nearest commutator-segments, and, secondly, the flow of the current from the generator being suddenly directed into the armature through different points, the currents induced by the sudden make and break have a tendency to destroy the insulation between the adjacent wires. It was with the object of overcoming these difficulties that A. Reckenzaun, of

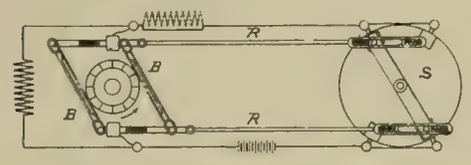


FIG. 2. RECKENZAUN REVERSING GEAR.

London, designed the mechanism illustrated diagrammatically in the cuts. Fig. 1 shows the position of the parts before reversal and Fig. 2 represents their position after reversal.

The entire arrangement is so simple as to require but little explanation. The two pairs of brushes are attached as shown to the parallel bars *BB*. These are attached as indicated to the pair of horizontal and parallel rods *RR*, which connect with the switch *S* employed to make and break the main circuit to the motor. The parts are so constructed as to have sufficient lost motion, so that the contact at the switch is broken while the brushes are at a standstill, and off the commutator. By moving the switch-handle still farther the brushes are reversed, and finally by putting the lever to the end of its course contact is made in the switch to allow the current to flow.

Welding Dynamo.

The accompanying cut represents a new dynamo recently designed by Prof. Elihu Thomson. This machine was devised with a view of securing great compactness, and to enable the welding currents to be carried directly to the work without collecting brushes.

The chief feature of this generator consists in the employment of a revolving field magnet, a stationary coil in which currents are developed by the revolution of the field magnet for supplying the exciting current of the machine, a second stationary conductor in which the heavy welding currents are developed by the revolution of

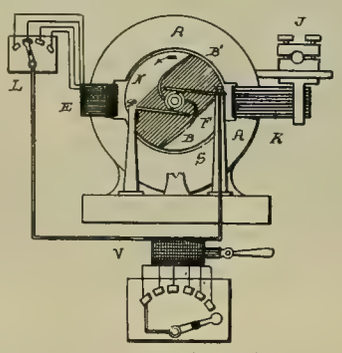


FIG. 1. WELDING DYNAMO.

the field magnet, and a commutator on the shaft of the field magnet for commuting the exciting currents before they reach the revolving field-coils.

Regulation is secured, first, by governing the current supplied to the work by means of a coil of variable reaction or self-induction interposed in the circuit of the exciting current between the exciter supply coil and the commutator, so as to be traversed by the alternating currents before they are commuted to pass through the revolving field magnet as a straight or unidirectional current.

The general design of this machine is represented in the cuts. Fig. 1 is a side elevation and Fig. 2 an end view of the generator. In the diagrams *NS* are the poles of the revolving field magnet, resembling in form an armature of the Siemens shuttle type. *AA* is the iron of the armature, which is here represented as a laminated ring with spaces cut away for the exciter

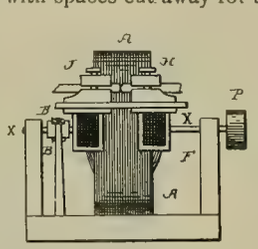


FIG. 2. WELDING DYNAMO.

supply coil *E* and work supply conductor *K*. A commutator of two half circles with brushes *BB'* has its segments connected, respectively, with the terminals of the field coil *F*. The brushes are connected, respectively with the appropriate terminals of the exciting coil *E*. Interposed in the exciter circuit is a variable self-inductor *V*. The work-supply conductor *K* terminates in two clamps *JH* for holding pieces of metal to be welded. The work-supply conductor *K* consists of one turn, or two or three turns around the armature core *AA*. The exciter supply coil *E* is wound in sections, and a switch *L* is used to vary the number of sections included in circuit for use. During operation the current, which is generated in *E* and excites the field, is varied by *V*, so as to control the potential and current of the work-supply conductor *K*,

A Method of Localizing Partial or Dead Earth Faults in Insulated Conductors.

BY H. CUTHBERT HALL.

This method is applicable to the elimination of faults from leads which have not been laid in pipes, or otherwise rendered inaccessible for manipulation.

The mode of procedure is as follows: The cable in which the fault occurs is wound on an iron drum of special construction, as shown in Fig. 1. *A* is the barrel of the drum, *B* an aperture cut in the barrel large enough to admit a man's hand, *C* a hollow tube which acts as the spindle of the drum. In *C* a slot about 10 inches in length is cut, and to one end of *C* an insulated collector, *D*, is fixed. A brush, *E*, also insulated, and fixed to the stand which supports the drum, makes contact with the collector *D*. One end of the cable to be tested is passed through the aperture *B*, threaded through the slot in *C*, and attached to a

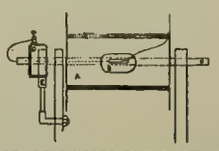


FIG. 1. METHOD OF LOCALIZING PARTIAL OR DEAD EARTH FAULTS IN INSULATED CONDUCTORS.

terminal on *D*. The other end of the cable is led through a vessel containing water and insulated from the ground, the cable being then wound on an iron drum, mounted on an iron stand In Fig. 2, *Z* represents the water vessel, *X*, *X*, *X*, *X*, the insulating supports, and *Y* a pulley fixed under the water, and under which the cable passes. The end of the cable on *A* is connected to one pole of a battery by a lead, one end of which is attached to a terminal fixed to the brush, *E*. The other pole of this battery is put to earth. In the insulated water vessel, *Z*, a metal plate dips, to which is attached, by a terminal above the surface of the water, a lead connected to a Thomson galvanometer. The other side of the galvanometer is put to earth. While the fault or weak place remains on the drum, *A*, no deflection is obtained on the galvanometer; but as soon as the fault leaves the drum the galvanometer is deflected, this deflection being greatest at the moment when the fault enters the water. Thus a fault or a weak place can be localized with great accuracy, even to a few inches.

The advantages claimed for this method are, that all cutting of the outside sheath of the cable is avoided; a great number of weak places in a cable can be localized in a very short time, the time occupied in detecting the faults being dependent only on the speed with which the cable is wound from one drum to the other; faults of very high resistance can be localized with accuracy, any variation in the insulation resistance of different parts of the lead being at once apparent on the galvanometer. The test is not applicable to armoured cable, but has been used by the author with complete success with tape-covered, felted, and braided lead or cable. In the case of braided lead, this method of localizing faults is of exceptional value, as the expense of repairing faulty braided lead is very much augmented by

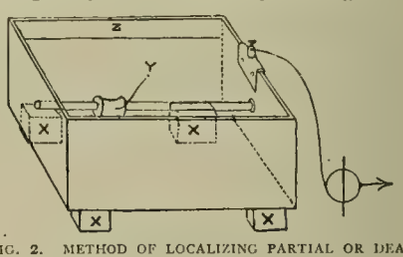


FIG. 2. METHOD OF LOCALIZING PARTIAL OR DEAD EARTH FAULTS IN INSULATED CONDUCTORS.

the fact that any cuts in the braiding have to be repaired by hand.

A distance of several yards between the first drum and the tank is advantageous, as the absence of deflection on the galvanometer, while the fault remains on the drum, is dependent upon the resistance of the sheath of the conductor between the drum and the tank. Also it is desirable, for this reason, to have the cable as dry as possible before beginning to test. Neither of the above precautions is, however, essential to the test; but the best conditions for making the test are not obtained if these points are neglected.

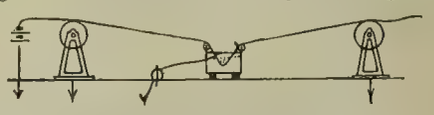


FIG. 3. METHOD OF LOCALIZING PARTIAL OR DEAD EARTH FAULTS IN INSULATED CONDUCTORS.

In Fig. 3 a general arrangement of the test is shown, which will make the above description more easily understood.—*London Electrician.*

"It was only a short time ago, apparently, that an earnest warfare waged in the city council against the lighting of Hartford's streets by electricity," remarks the *Times* of that city, and adds: "Great cost, unreliability, danger and various other objections were urged, and so earnestly, that very many conservative citizens became inclined to the opinion that it would be wiser to continue the old system. But what a change has come. To-day not a gas or naptha lamp remains in the city, and our streets are lighted by 460 electric lights far better, and we believe, at an expense not greatly in excess of the old and inefficient system. And the electric lights shine every night in the year, without regard to the moon."

Electric Railway Gearing With Wooden Teeth.

Perhaps the most important point in the application of electrical power to street car propulsion is the problem of transmitting the power from the armature shaft to the car axle. In the earlier experiments both abroad and in this country, belts of leather and rope were used, and also the sprocket wheel and chain. These methods were abandoned and some system of gearing is now almost universally adopted. Owing to the high speed of the armature, it is customary to use a small pinion, and at least one counter-shaft between the armature and the large gear on the axle, in order to get the desired reduction in the number of revolutions of the car wheel. If the car wheel and axle are making 115 revolutions per minute, the intermediate 345, and the armature pinion 1380, the

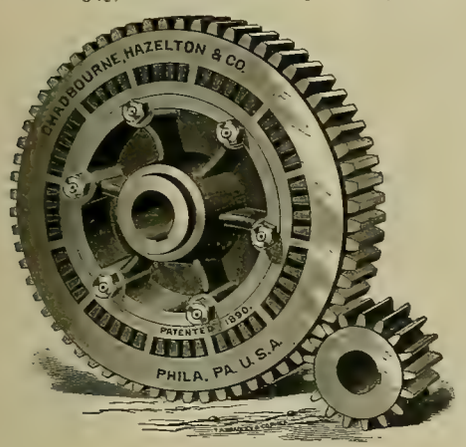


FIG 1.—ELECTRIC RAILWAY GEARING—INTERMEDIATE GEAR AND PINION—WOODEN TEETH.

ratio would be 12 to 1. The axle gear containing fifty teeth would make 115x50 or 5750 meshes of teeth per minute for axle gear and intermediate pinion. The small diameter of pinion will not allow more than seventeen teeth, which are usually less than four inch face. In ordinary mill practice this pinion would be considered entirely too small to transmit-10 horse power or even 5-horse power for any considerable length of time running at more than 800 revolutions. When it is placed under a motor car the revolutions exceed 1000 per minute, transmitting from 15 to 20-horse power. At the same time mud and sand must be contended with.

With this form of gear certain difficulties were encountered. The gear caused too much noise and its teeth were liable to break. To overcome these defects the interchangeable gear illustrated in the cuts was designed.

The old form of gear, when new, seems to give

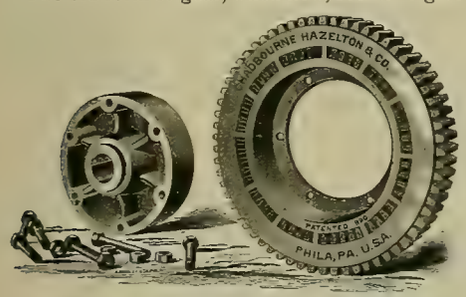


FIG. 2.—ELECTRIC RAILWAY GEARING—INTERMEDIATE GEAR, RIM REMOVED—WOODEN TEETH.

good satisfaction with pinions made of either cast iron or steel. After the car has been used a few weeks however, so much wear comes upon the pinions, which have to do about four times the work of the gears, that they become badly worn and very noisy. Furthermore, there is considerable twisting of the motor in stopping and starting which tends to throw the shaft out of alignment, and results in wedging the teeth apart and breaking or nipping them out.

An effort was made to overcome the noise of the metal pinion running on a metal gear, by substituting some soft material for the pinion. Raw hide, vulcanized fiber, and combinations of rawhide and metal have been tried.

Since the pinion must necessarily do several times as much work as the gear on which it runs, the result is the former wears out so rapidly, that the expense has made it difficult for the management of roads to keep rawhide or soft pinions on motors. The result would have been different if the softer cog had been put in the wheel having the greatest number of teeth. If seventeen soft teeth in the armature pinion would last three months, transmitting a given power, it is not unreasonable to assume that thirty-four soft teeth in the intermediate gear, transmitting the same amount of power would last twelve months under similar condi-

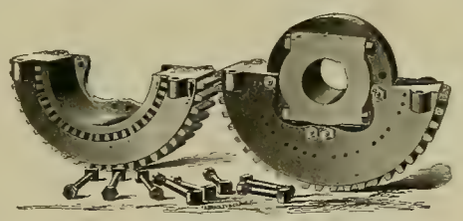


FIG. 3.—ELECTRIC RAILWAY GEARING—SPLIT AXLE GEAR—SECTION OF COGGED RIM REMOVED—WOODEN TEETH.

tions, therefore the intermediate gear and split gear on the axle should have cogs of some softer material than the pinions, it is claimed.

The intermediate gear shown in Figs. 1 and 2 consists of three parts: the blank or hub which is keyed fast to the axle, and the removable rim which holds the cogs, and which is bolted to the hub, and the wooden teeth which are inserted in the rim.

At first thought it may seem that the wooden teeth would hardly stand the strain and wear and tear which is brought upon them in the street car service. In New England where the largest mills are driven by turbine wheels, and where thousands of horse power are used in a single mill, the entire energy is transmitted through bevel gearing, the larger gear always having wooden cogs. These are used because nothing else has yet been found that will stand the work. The cogs last several years, and are renewed at a slight expense, being simply driven in the iron frame of the wheel, and they have the advantage of being elastic and noiseless.

The teeth which are used in the gear shown in the cuts are driven in with white lead, and wedged at the base in the usual way. They are then put into the gear cutter and shaped in the ordinary manner. The rim which is made of cast iron, slips over the blank, being held in place by six bolts. Between the rim and the hub is laid a sheet of oil paper, which prevents corrosion and tends to stop vibration or "bell tone" from the gear.

The blank is keyed firmly to the intermediate shaft and need never be removed; after the wooden teeth have become entirely worn out, all that is necessary is to remove the six bolts and slide off the rim, Fig. 2. An extra rim with the teeth in it can then be put on, the entire change not occupying over ten or fifteen minutes. An ordinary carpenter or wheelwright, it is asserted can recog the old rim and cut the teeth in a half day's time.

The armature pinion for running in this gear and the pinion on the intermediate gear, are made of forged steel with the teeth case-hardened, after being cut.

The split axle gear, Figs. 3 and 4, has a rim similar to the intermediate gear, into which are driven wooden teeth. The split gear is composed of two parts, the blank or hub which is

FIG. 4.—ELECTRIC RAILWAY GEARING—CONSTRUCTION OF SPLIT GEAR—WOODEN TEETH.

split and put on to the axle, and the rim which is also split and put on so as break joints with the hub.

Figs. 5 and 6 show split gear for the axle in which the toothed rim of phosphor bronze, is removable. This gearing for electric railways is introduced by Chadbourne, Hazelton & Co., Philadelphia, Pa.

The Western Union Fire.

The Western Union Telegraph company is recovering rapidly from the effects of the great fire in its New York building, but it will be fully four or five months before the old order is resumed. The executive committee held a special meeting, at which Jay Gould, Russell Sage, ex-Gov. A. B. Cornell, John C. Terry and Gen. Eckert were present. Gen. Eckert presented plans prepared by J. B. Smith for the necessary alterations of the building, and the whole matter was referred to Gen. Eckert with power to act. It was decided to tear down the present building above the fifth floor and to add four new stories, so as to secure a uniform dimension of 75x175 feet, by adding the site of the 25-feet front house, No. 8 Dey street. The new structure will therefore be nine stories high, terminating in a square roof with heavy mouldings and cornices. The facades will be composed of brick and blue-stone trimmings,

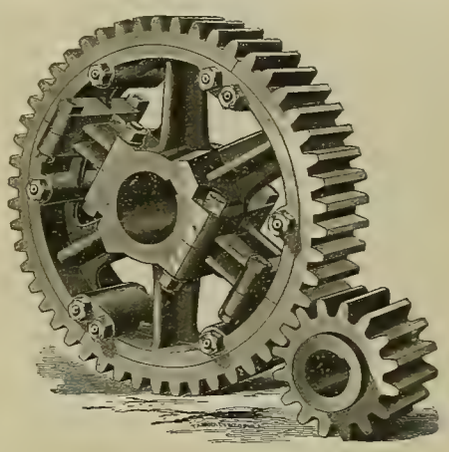


FIG. 5.—ELECTRIC RAILWAY GEARING—SPLIT GEAR AND PINION—PHOSPHOR BRONZE TEETH.

and instead of a tower there will be an iron flag-pole, on which the time-ball will be worked regularly at noon. The sixth floor is to be devoted to offices, while the seventh and eighth stories will be given up to the mammoth operating rooms, each 175x75 feet, with high ceilings and plenty of light and ventilation. The ninth floor will be utilized for a restaurant, kitchen, laundry and sleeping purposes. In one end of the new operating rooms suitable quarters will be assigned to the Associated Press, United Press, and the Press New associations, and on the Dey street side there will be an elevator for the express use of the army of telegraph operators. There will be no battery room in the new building as the power is to be furnished by dynamos. A new $5,000 switch-board is being built, and every improvement known to telegraphic art will be employed in the new operating rooms. The total cost of the improvements will not fall far short of $250,000.

Referring to the fire, Jay Gould said: "The building, when constructed, was understood to be as nearly fireproof as it was possible to make it. The floors, walls and stairways are all indestructible, and there was no more material for a fire here than in any large office building. The vast amount of furniture necessary to accommodate so many persons, together with the great quantity of paper that it contained, was fuel for the flames. The fire doubtless arose from the contact of several heavily charged wires.

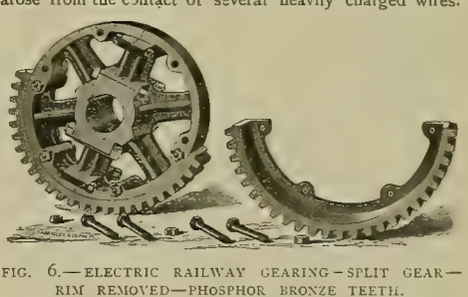


FIG. 6.—ELECTRIC RAILWAY GEARING—SPLIT GEAR—RIM REMOVED—PHOSPHOR BRONZE TEETH.

Nothing will be omitted, in the new arrangements which are to be made, that can possibly add to the safety of the building and of the persons who are daily at work here."

The prompt action of the company in securing temporary quarters and getting its lines in working order shows the vast resources of this corporation which is able for any emergency. The service was disabled less than 24 hours, and so far as the public knew everything was running smoothly at the expiration of 36 hours. The company took care of the business and put the messages through, though, of course, this was done only at the cost of great labor and expense on the part of the company, and no end of hardships. But the work was done, and the company is entitled to the thanks of the entire community.

The Ashland (Or.) Electric Light & Power company have closed a contract with the Edison company for a dynamo with a capacity to furnish 800 incandescent lights of 16-candle power. They are to be put in working order by Sept. 1. The company will commence with 250 lights at first and increase as business justifies.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Electric Light Plant in the *Pioneer Press* Building, St. Paul, Minn. Illustrated	53
National Electric Light Association	53
Underground Electric Light Company, Chicago	53
Nashville Electric Club	53
Electric Heating. Illustrated	54, 55
The Electric Motor in Chicago	54, 55
New Design of a Pole Top. Illustrated	55
Low Water Signal. Illustrated	55
Spokane Falls Electrical Society	55, 56
Thermal Cut-Out. Illustrated	56
Reckenzaun Motor Reversing Gear. Illustrated	56
Welding Dynamo. Illustrated	56
A Method of Localizing Partial or Dead Earth Faults in Insulated Conductors. Illustrated	56
Electric Railway Gearing with Wooden Teeth. Illustrated	57
Western Union Fire	57
Editorial	58
Brillie Continuous Current Meter Illustrated	59
Incandescent Lamp with Iridium Filament. Illustrated	59
Chicago Electric Road	59, 60
A Wrinkle in Pipe Welding. Illustrated	60
A Valuable Record	60
Frictional Clutching Device for Car Motor. Illustrated	60
Shall Gas Undertakings Supply Electricity? Yes. By Arthur F. Guy	60
Schoop Storage Batteries	60
The Book Table	60, 61
DEPARTMENTS.	
Correspondence	61, 62, 63
The Electric Light	63
The Electric Motor	63
The Telegraph	63
Electrical Patents	64

NUMBERLESS harrowing tales which have appeared in the newspapers within the last year furnish sufficient proof that coal-miners' wages cannot be materially reduced. The Pennsylvania coal companies unquestionably have realized this fact yet they have felt the need of cheapening production in order to meet the competition from the southern coal fields. Our Pittsburg correspondent states that the companies have hit upon the plan of utilizing electric motors as a means of solving the problem. They have come to the conclusion after a series of tests that the use of coal cutting machines operated by electricity will enable them so to cheapen production that they can meet the figures of the southern companies.

FROM time to time the WESTERN ELECTRICIAN has pointed out that there was a rapidly extending field for the introduction of electric heating apparatus. That this fact is now recognized will be appreciated after a perusal of this issue. A Minneapolis inventor who has been experimenting in this direction is now exploiting his apparatus in Chicago. The heater proper is a very simple device and is applied to a number of utensils in which heat is required, so to speak, in a small quantity and on tap. An iron wire conductor cased in a peculiar manner so as to secure the greatest efficiency in operation constitutes the essential portion of the device. In the article descriptive of this heater there is given a table showing the amount of current required by the utensils in which the device has been applied The cost of the current is also given. It will be noticed from this table that in many operations, when all things are taken into consideration, electric heat is not uneconomical. Unquestionably there is, as we have before stated, a field for such an appliance.

In another column is presented a description of the Brillie meter, a French invention. Our readers will doubtless be struck with the complicacy of this apparatus. From the amount of space covered by the description of the meter in the columns of the French journal from which we received our information, we are led to believe that the device is looked upon by our Gallic friends as one possessed of considerable merit. Without doubt the device is ingenious. Complicated machines usually are. We fear, though, Mr. Brillie would have considerable difficulty in introducing such a piece of mechanism into practical every day service. We do not wish to be uncharitable in thus passing judgment on a piece of apparatus of which we have but a limited knowledge, but a glance at American apparatus designed for a similar purpose convinces us that we are justified in believing that Mr. Brillie has yet to acquire one faculty, at least, which is oftentimes wanting in inventors and designers of machinery. We refer to that peculiar knack which enables some designers to eliminate all unnecessary parts and reduce an invention to its simplest possible form.

In another column is presented a description of a new style of electric car gearing which has recently appeared as a competitor against the now almost universally employed iron and steel or rawhide combination. The gear referred to is a wheel of wood and iron. An iron hub or body and detachable teeth of wood are employed. These latter gear with a wheel of plain metal. At first glance, doubtless, a number of our readers will shake their heads at the thought of using wooden teeth in connection with the high speed electric street car motor. Without attempting to pass judgment on the new competitor we simply state a few facts which street car men might perhaps overlook and which if remembered may lead to formation of a different opinion. The use of wooden teeth in gearing is not new. For years the larger number of our factories which are driven by water have transmitted the entire power required by means of gearing fitted with wooden teeth. In the combination which we describe the slow-running wheels are equipped with wooden teeth and a pinion of steel is used on the motor shaft. The advantages claimed for the wooden toothed gear are fully set forth in the article referred to and the description cites a few facts which cannot fail to be of interest to many.

IT is agreed on all hands that the electrical section of the World's Fair will be located at the most prominent position in the grounds used for the exposition. In the dispute over the Lake Front and Jackson Park it has been about decided that if the former site is used in part or in whole the electrical exhibit shall be placed there. This would be a location almost in the heart of Chicago and would be readily accessible. The matter came up at a special meeting of the Board of Directors of the World's Columbian Exposition last Saturday. The committee appointed at the executive committee's meeting Friday to formulate a resolution covering the various exhibits to be placed in close proximity to the agricultural exhibit, and also those to be placed on the Lake Front, reported. The report was adopted and will be presented formally to the legislature. The plan is to place on the Lake Front the art gallery, the government building, and another building containing the electrical display—three buildings in all—and use the present Lake Front grounds as an entrance ground. At Jackson Park will be placed the big machinery hall, the stock show, a mineral palace, an underground mining exhibit, a glass factory, the several state exhibits, Oriental villas, and such other novel and beautiful displays as may be offered later on.

The directors of the World's Fair on Monday last drew up a report in response to a request of the Illinois legislature that information as definite as possible concerning their plans be sent to Springfield. In this long document the directors make a rough classification of the exhibits to be made at the fair. It is interesting to note that three of the twenty-three classes are devisions of the electrical section. The classes are as follows: Electric propulsion of street cars, electric plants with power and appurtenances, and third telegraphy, telephones, phonographs, etc.

NOT a little matter has appeared in the daily press lately in reference to a rather amusing scheme proposed by Ignatius Donnelly, of Minnesota, for the prevention of violent electrical storms. The recent tornadoes which have caused such losses of life within the last year are assumed by Mr. Donnelly to be the results of electrical disturbances. This conclusion we are rather disposed to question. If a means can be found for reducing the difference of potential between the earth and the clouds, the day of violent storms, he asserts, will be at an end. Mr. Donnelly's magnificent scheme is outlined in the following quotation from an article from his pen: "Suppose the state government should order, say, in each county the construction of a great stationary balloon, elevated to the level of the storm clouds, and anchored to the earth by four metallic ropes, which would act as conductors, the whole communicating with some lake or river, and the balloon and the ropes armed with innumerable steel points pointing upward, would not this serve as a great conductor or lightning rod, so to speak, to carry the surplus electricity of the heavens to the earth and prevent its accumulation in destructive quantities? Would it not make an end not only of cyclones but of thunderstorms? These balloons would have to be kept in place only during the storm months. The balloon proper might be constructed in an elongated form, so that it would turn like a weathercock and thus always present the least resistance to the winds. One of the guy-ropes could be made hollow and the balloon thus supplied with gas to make up for the loss of that which escaped; and the balloon thus always could be maintained at the proper altitude. I shall not discuss how far this electricity factory could be used for practical purposes."

The plan outlined in the quotation by Mr. Donnelly would not be worthy of notice except as a sort of Munchausen proposition were it not for the fact that it is reported Senator Farwell proposes to introduce in congress a bill making an appropriation for the thorough testing of a Donnelly lightning escape. There is no doubt that such a measure would be promptly rejected if introduced when its silly features were explained to the wise legislators. The absurdity first consists in the idea of protecting a large area by what is practically a single conductor. A large city has scores of high buildings stretching up into the heavens and these afford as a whole a far better means for the discharge to earth than a single lightning balloon, but still thunder storms continue to invade municipal precincts. Lightning is exceedingly erratic. As like as not it would fight shy of the formidable-looking balloons and strike some insignificant object a mile away. A year ago in Chicago during a violent storm a discharge occurred which killed a lad fishing on one of the docks. He was surrounded by elevators which towered into the sky, which apparently would have afforded the best path to earth but the current took a different course. Unless Mr. Donnelly's balloons were so numerous that they touched each other throughout the district inflicted by electrical storms we fear they would not prove very effective. Mr. Donnelly's views on the authorship of the plays ordinarily credited to William Shakspeare are more reasonable than his ideas in regard to the tractability of atmospheric electricity.

Brillie Continuous Current Meter.

The watt-hour meter of Lucien Brillié is shown in the accompanying cuts. The device operates in the following manner. At certain equal periods of time a motor twists the spring of a torsion electro-dynamometer until the couple of torsion becomes exactly equal to the electro-dynamic couple. The angle to which it is necessary to twist the spring is then proportional to C E. A registering mechanism operates to make a record which is proportional to this angle, and as the units are registered in equal times the total record of the unit angles' is proportional to the energy delivered.

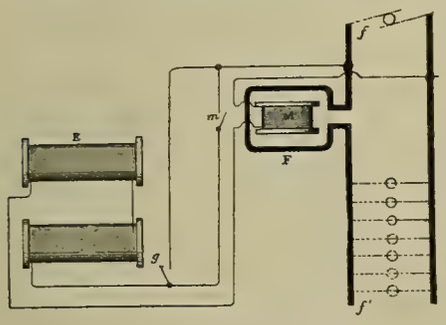


FIG. 1. BRILLIE CONTINUOUS CURRENT METER

In order that the reader may have a better understanding of the operation of the mechanism of this meter, which is quite complicated, reference is first made to Fig. 1. This diagram represents the electrical connections of the meter when it is arranged to record the energy delivered from a constant potential circuit. It may

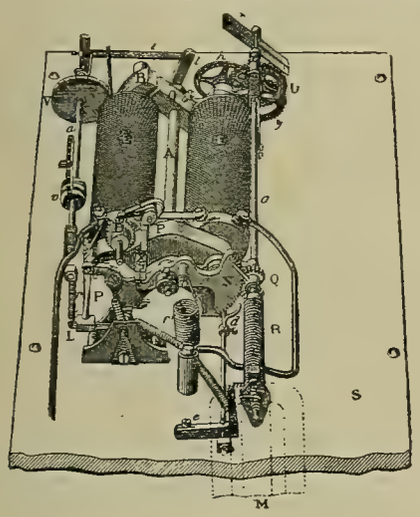


FIG. 3.

be mentioned that similar letters in the several cuts represent like parts. A study of Figs. 2 and 3 in connection with Fig. 1 will be found advantageous. Figs. 4 and 5 are enlarged views of those portions of the meter similarly lettered in the other cuts.

Figs. 2 and 3 are views of the working parts of the meter. The electro-dynamometer is composed of two stationary horizontal coils *F F*. (See also Fig. 1.) These are connected in series, as indicated in Fig. 1. Within the coils *F F*, is a movable coil *M*, of fine wire. This is in series with the electro-magnet *E E*. Both *E E* and *M* are thus in shunt to the main circuit. The coil *M* of the electro-dynamometer is mounted upon a knife edge, and can oscillate slightly. This slight movement is sufficient to separate two contacts *m*, of which one is carried by the coil *M*, and the other by the piece *e*, Fig. 2, which is itself susceptible of a slight displacement. The reason for this arrangement will become apparent later. The spindle *o'*, Fig. 3, is attached to one end of the torsion spring *R*, and is geared, as shown, to the sector *N*. This sector is connected through the shaft *A* with a soft iron armature *O*, which is pivoted so as to revolve between the curved pole-pieces *B*. The passage of the current into this magnet *E E* causes the armature *O* to turn, and thus twist the spring *R*. A regulating device *U* controls this movement, which continues until the current is interrupted. The break is caused at the point *m*, Fig. 2, by reason of a slight rocking motion of the coil *M*, at the moment when the action of the spring is equal to that exerted by the current.

In the regulating device *U*, Fig. 3, the first gear is attached to the spindle *o'*, at the end of which is the two bladed fan *Z*. One of the intermediate wheels, *y*, is mounted upon a frame *x*, which moves slightly up and down. In this movement one side of the frame *x* acts as a

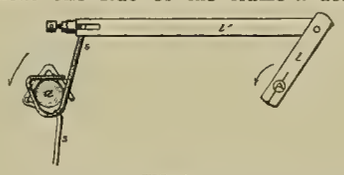


FIG 4.

brake upon the wheel *h*. The energy transmitted to *Z* is practically constant, and the speed is nearly uniform.

At the same time that the armature *O* twists the spring *R*, it operates the counting mechanism by means of the levers *l*, *s*, Figs. 4 and 5. The part *S*, Fig. 4, ends in a collar made of

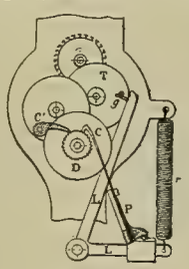


FIG 5.

steel wire, which surrounds a small grooved pulley attached to the prime mover of the meter. The collar is clasped around the pulley and engages with it when the spindle *A* turns in the direction of the arrow. It is not moved when *A* turns in an opposite direction. A second collar *s'* works in an opposite direction, and holds the pulley in position during the turning of *A*.

The meter registers every minute. The time is determined by a clock movement. This portion of the device is represented in detail in Fig. 5. The wheel *T*, which revolves every minute, carries a contact pin opposite a second pin *g* on the lever *L*. The contact serves to send the current into the shunt composed of the electro-magnet *E* and the coil *M*. The piece *P* of the electro-magnet, which is movable, works by means of the piece *P'*, Fig. 3, the lever *L*. The pin *g* is removed, and the clock-work continues in motion. In conclusion it may be stated that the operation of the meter every minute causes these changes: 1st. The establishment of a contact at *g*, Fig. 1; the attraction of the little armature which makes contact at *m*. 2d. The attraction of *P*, Figs. 2 and 3, which causes the rewinding of the clock work, and breaks the contact at *g*; at the same time the armature *O* begins to turn, but does not yet engage with the counting mechanism. 3d. The armature *O* continues its rotation, engaging the spindle *o'*, this movement being rendered uniform by the controller *U*; at the same time the spring *R* is twisted more and more, opposing in this way the electro-dynamic couple—a couple which increases constantly. 4th. At the moment when the two couples are equal, the coil *M* rocks slightly; the contact is broken at *m*. *P* is raised by the action of the spring *r* at the same time that the lever *L* brings back a pin upon the wheel of the clock work. 5th. The armature *O* returns to its first position, being actuated by the spring *R*. This returning movement which is regulated by the controller *a* does not engage the counting mechanism as a result of the arrangement of the collars *S S'*. The cuts are reproduced from *Revue Internationale de L'Electricite*.

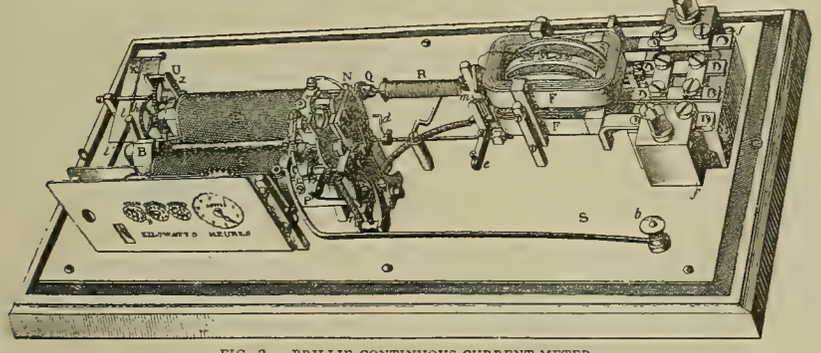
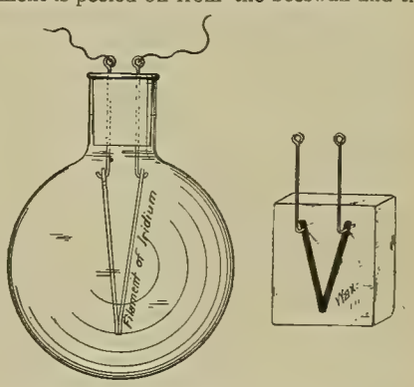


FIG. 2. BRILLIE CONTINUOUS CURRENT METER.

Incandescent Lamp with Iridium Filament.

In the lamp illustrated in the cut, a filament of pure metallic iridium is used. The method employed by L. N. P. Poland, the inventor, in the manufacture of the iridium filament is interesting, yet simple. The process is illustrated in the little cut to the right of that of the finished lamp. The block shown is of beeswax, or a similar substance. Upon the face of this the form of the filament is stenciled in plumbago. Through the ends of the stenciled filament pieces of wire are inserted into the beeswax. These are long enough to connect with the source of electricity, and suspend the block in an iridium plating-bath. When a film of sufficient thickness is deposited upon the stenciled design, the filament is peeled off from the beeswax and the plumbago brushed off the back. Iron wires are used as conductors. The filament is incandesced in the atmosphere, as it is practically non-combustible, or, for security against breakage, it may be incandesced in any suitable gas or in a vacuum.



INCANDESCENT LAMP WITH IRIDIUM FILAMENT.

Chicago's Electric Road.

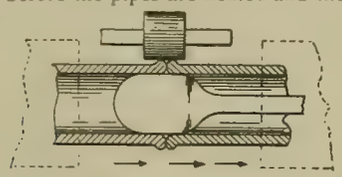
At a special meeting of the Chicago city council, July 25, the question of extending the time for the construction of the electric railway at South Chicago was considered and finally granted. Ninety days will be allowed the company to complete the road. The route as stated in the ordinance is as follows: Beginning at the intersection of Shaw and Eighty-ninth streets, thence west on Eighty-ninth street to Mackinaw avenue, south on Mackinaw avenue to Harbor avenue, southwest on Harbor avenue to Ninety-third street, west on Ninety-third street to South Chicago avenue, northwest on South Chicago avenue to Ninety-third street, southwest on Ninety-third street to Escanaba avenue, west on Ninety-third street to Stony Island avenue, north on StonyIsland avenue to Ninety-first street, west on Ninety-first street to Cottage Grove avenue, north on Cottage Grove avenue to Eighty-seventh street, east on Eighty-seventh street to

Stony Island avenue, and south on Stony Island avenue to Ninety-first street, completing the loop.

A Wrinkle in Pipe Welding.

The accompanying diagram illustrates a method of welding pipes by electricity, employed by Prof. Elihu Thomson. The method consists essentially, in bringing together in the manner shown the two sections of pipe either in a lap or butt joint passing an electric current of great volume across the joint to heat it to the requisite welding temperature, and completing the union of the parts softened by the current over a mandrel introduced beneath the joint.

A roller is applied externally to assist the union and shape the exterior. The mandrel is inserted before the pipes are heated and the roller



WRINKLE IN ELECTRIC PIPE WELDING.

is applied when the metal has been softened by the heat.

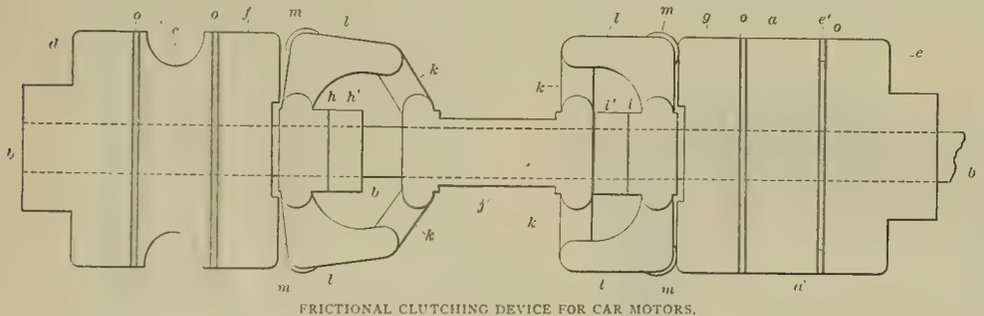
Prof. Thomson has patented this process.

A Valuable Record

The official report of the proceedings of the first phonograph convention has been printed, and last week a handsomely bound copy was presented Mr. Edison by H. D. Goodwin of Milwaukee, who reported the convention. Readers of the WESTERN ELECTRICIAN will remember that this convention was held at the Auditorium hotel, Chicago. At the time an excellent view of the members in session was presented in this paper. It will be remembered that at this meeting the practical application of the phonograph in reporting was demonstrated. The secretary repeated the words of every member into the phonograph and the fully charged cylinders were given to typewriters, who transferred their records to paper ready for the printer. In this way 398 pages of closely type-written copy, aggregating 40,000 words, was recorded first in the cylinders of the phonograph and then transcribed by the typewriters. Mr. Edison, it is scarcely necessary to say, highly prized this record.

Frictional Clutching Device for Car Motors.

The accompanying cut illustrates diagrammatically a method of applying friction clutches in connection with the electric car motor, which possesses several features of interest. The idea of the inventor, W. B. Clark, Chicago, is to utilize the power of the motor for braking purposes as well as for driving the car, and also to provide a device by the use of which the motor



FRICTIONAL CLUTCHING DEVICE FOR CAR MOTORS.

armature may be kept constantly in motion, and the car gearing connected to it at will.

The device is so simple as to require but little explanation. In the cut *b* represents the armature shaft; *e* and *d* flanged collars keyed firmly to the shaft; *oo* and *oo* fiber washers. On one side between the washers, *o* and *o*, is the motor pinion, *a*. On the other side of the toggle device between the washers, *o* and *o*, is the pulley or drum *c*, upon which is wound the brake-chain. The collars *f* and *g* are loosely keyed on the shaft, but are free to move endwise. The operation of the device will now be understood. Assuming the armature shaft to be always in motion, when it is desired to move the car, the sleeve *j* is jammed over to the right by a suitable arrangement of levers. The action clutches the armature gear between *o* and *o*, which are backed by the flanged collar *c* and collar *g*. When it is desired to stop the car the sleeve *j* is brought again to the middle position. To throw the motor on to the brake mechanism the sleeve *j* is forced over to the left.

Shall Gas Undertakings Supply Electricity? Yes [1]

By ARTHUR F. GUY.

The general feeling prevalent among gas managers is that the electric light cannot affect gas, and in proof of this they point out the fact that since the electric light has been introduced the consumption of gas has increased. This statement is perfectly true, because artificial illumination is ever on the increase, whether it be by gas, candles, or electricity. Another argument put forward by them is that the electric light is in its infancy. Now this argument must be combated, because the term infancy is applied not only to usage but to the science of electrical engineering. The first point, namely, the "infancy of usage," is, perhaps, correct; but the second is not. We will consider the former first. There are some people who fondly dream that in this miraculous age of invention and discovery some means will come to light whereby any amount of electricity can be collected for next to nothing —in fact, a gift from Dame Nature, such as from some yet undiscovered chemical compound, or some peculiar condition of matter—and consequently that all our present costly and elaborate apparatus for generating electricity will become obsolete. No greater philosopher's stone was ever imagined.

With respect to the electric light being in its infancy as regards use, it is this fact that has shaped the title of the paper, for now is the time for the gas undertakings to act; it will soon be too late, and even now they have lost many a rich prize in the electric lighting line. Companies have been formed all over England to supply electricity, and the pick of the provisional orders have been relegated to either local authorities or private electric companies. This point joins issue with the supreme question, "Shall gas undertakings supply electricity? Yes;" and the reasons that justify this answer will now be given.

Consider the present state of affairs: there is a demand for the electric light; this demand is limited, but in time to come—and no one can say how soon that may be—this demand will be enormous. There are numerous reasons why it would be both politic and advantageous for gas undertakings to supply electricity.

The managing body of a gas works consists of men of great organizing and administrative experience. The gas works from long establishment have obtained a certain prestige and influence in the district they supply. A manager knows his customers, and has acquired an insight into the weak and strong points of his district. The connection and vested interests pertaining to the gas suppliers are often numerous and deep-rooted. A gas undertaking has also the great advantage of easily raising capital, at a comparatively low rate of interest; whereas new electric companies require financing, and the financing invariably leaves its mark upon them in the shape of a diminished dividend and an abnormally large capital. Many gas companies have large surplus moneys in hand which could be invested in running the electric light at a profit to their shareholders. In the laying of electric mains they know exactly the position of their gas pipes, and so there would be none of that friction and petty annoyance that often arise when the electric light company comes on the scene. With regard to the erection of plant, where possible the electric light station should be located in or about the gas works. In some cases, no doubt, there might be a spare corner or outbuilding which might be made to accommodate the requisite machinery. At all events, the expenses incurred need not be so great as where a new site has to be acquired and a new building is specially erected and positioned by an electric light company. A large staff of men are employed at some gas works, some of whom are mechanics, and the assistance which these could render, both in erecting plant and maintaining same, would be of no small value. In the case of an electric light company, such men would have to be especially engaged, and paid at fixed salaries, whether busy or slack. Besides this, most of the office routine might be done by the existing clerical staff of the gas company. This, again, in the case of an electric light company, would mean specially engaged and paid clerks. An electric light company would require a board of directors, general manager, secretary, etc., all of which means a heavy draw upon the dividends, and this matter alone is sufficiently important to turn what might prove a good dividend into a bad one, or even none at all. In the matter of running expenses, there are numerous ways and means whereby a gas manager has the power of curtailing them. For example, the hot coke from the retorts can be utilized in starting the boilers, and some of the bye-products might be used as fuel.

Through being a large consumer of coal for making gas, steam coal ought to be obtained at much cheaper rates. The same refers to the purchasing of other material. The manager knows the best market for certain goods, and through long connection therewith ought to obtain advantageous bargains. The opponents of this paper will probably contend that if a gas works offer all these advantages it proves that it is badly managed, since, if well managed, there should be the strictest economy in everything, and not a man employed except his time be occupied fully, and not a spare inch of ground in the works but that it has its use. This would be true if the management were perfect, but that point is never reached. No claim has been made that these advantages exist to a large extent, for that would certainly imply waste in the management; but that *some* advantage must be gained from each of these points under consideration cannot be denied.

It is the numerous small savings that in the total make up a respectable sum; however trifling each may appear by itself, when they are all added up at the end of a year it is just possible that they may come to a sum that will turn the balance to the right side of the ledger. It was stated that owners of gas property have great facility of raising capital. Now, with regard to this point, and also the opening up of streets for the purpose of laying electric mains, it is requisite that they obtain the necessary powers first from Parliament and the Board of Trade, and in furtherance of this they occupy exactly the same position as any private individual or other company (for the second object they must first obtain consent from the local authorities.) The same holds true where the owners of gas works are the local authorities.

[1] Abstract of paper read before the London Gas Institute.

Schoop Storage Batteries.

A Chicago syndicate recently purchased the storage battery patents of Dr. Paul Schoop and has already commenced the manufacture of the accumulators. Among the patents transferred to the syndicate is that covering the gelatinous electroylte which possesses, it is claimed, peculiar advantages in street car work. It is proposed to make a thorough test of the batteries in this class of work. A car equipped with Schoop batteries is to be operated in Chicago. A motor which has been used for a year and a half on an overhead line will be employed. The patents also cover a peculiar shape of plate which secures it is claimed, a more uniform discharge of the cells. The principal patent perhaps transferred is that which relates to the process of making the plates which is described in the appended claims allowed by the Patent Office. It is claimed that it is radically different from those covered by the Accumulator and Brush patents. The claims are as follows:

1. The method of producing or manufacturing electrodes for secondary batteries, which consists in the deposition of mercury upon the lead plates forming the body of the electrodes, whereby an amalgam of lead and mercury is formed on the surface of the lead electrode, and subsequently dissolving out the mercury, so as to leave a spongy surface.

2. The method of producing or manufacturing electrodes for secondary batteries, which consists in, first, depositing a thin film of metallic mercury upon the surface of the plate; secondly dissolving, by electro-chemical action, the mercury of the amalgam; and lastly, charging the electrode thus produced in the usual manner.

3. The electro chemical method of dissolving the metallic mercury of the mercury and lead amalgam on a lead electrode in course of formation by reversing the electric current employed in depositing the mercury upon the plate in the first stage of the making of the electrode.

4. The method of producing a spongy surface on the lead plates or grids of secondary batteries, which consists in, first, depositing a film of metallic mercury upon the surface of the p ate by electro-chemical action; secondly, disassociating the lead and mercury formed by amalgamation of the two metals by reversing the electric current; and thirdly, removing all traces of the mercury by washing.

5. A method of producing electrodes for secondary batteries which consists in electrically incorporating mercury with the lead surface of the plate, and then subsequently discharging such battery by any means whatever so as to leave spongy surface.

The Book Table

EXPERIMENTAL ELECTRICITY. By Edward Trevert. Published by the Bubier Publishing company, Lynn, Mass. Price $1.

The idea of the author is to aid amateurs in constructing simple electrical apparatus. He gives practical directions for making batteries, electric bells, galvanometers and accumulators. The book is simple and doubtless will be of assistance to that growing class of persons who enjoy dabbling with home-made electrical apparatus. Probably those for whom the book is

designed would find some difficulty in constructing a dynamo or a motor in accordance with the instructions given by the author, who devotes a chapter to each machine. It is more than likely that the amateur mechanic who endeavors to construct a dynamo or motor with such limited instruction would find that he had rounded out his experience by considerable experimenting before his machine was in good running order.

CORRESPONDENCE.

New York Notes.

NEW YORK, July 26.—It has recently come to the knowledge of many people that the Western Union Telegraph company has been keeping time for them throughout the country by means of synchronized clocks which exactly agree with the astronomically correct time of the National Observatory at Washington. This department of the great system has been the last to receive attention since the destructive fire. The work of reconstruction is now entirely completed and all wires are in working order again.

During the reconstruction of the building the supply department is conducted at the Western Electric building; and the American District Messenger Department is to occupy the basement in 195 Broadway. It is reported that the Associated Press will occupy the sixth floor and the seventh and eighth floors will be turned into operating rooms, while the 2,000 wires will enter at the rear of the building through a specially constructed shaft, and then distributed in iron pipes so arranged as to be flooded with water at any time, and thus avoid any repetition of an accident from overloaded wires.

The construction of the Broadway Cable Road presents another serious question in its probable interference with the water mains, the gas mains, the subways, and possibly the steam pipes. The cable system will require an excavation on the average of 15 feet, which may necessitate a change in the location of much of the present underground construction. It is difficult to estimate the damages that may arise from this source, although Commissioner Gilroy has notified the different companies that the cable construction is about to proceed and the necessary preparations must be made by them to allow the work to go ahead.

Mayor Grant, Commissioner Gilroy, President Wilson, of the Health Department, and Corporation Counsel Clark last week gave much attention to the steam heating question and the attending dangers. The company expressed a desire to be heard and its arguments were fully considered. The present system is unquestionably not only dangerous on account of numerous explosions, but is working positive destruction to the underground conduits and pipes of all kinds.

The controversy between the Steam Heating company and the Department of Public Works since the revocation of all permits to open streets to repair steam pipes and make new connections has been at white heat during the week. Next Sunday the Steam Heating company will make examinations and temperature tests in order to obtain a difference, if possible, in the subway temperature from that recorded on a week day, claiming that the large steam boilers in office buildings affect the subway temperature. Mayor Grant, Commissioner Gilroy and President Wilson of the Health Board had a consultation over the situation upon the mayor's receipt of a communication from the Steam Heating company declaring that one of their workmen had been arrested and taken to the Tombs for attempting to make the repairs ordered by the Health Department, also saying: "And we further claim that we cannot be held responsible to the Health Department for the fulfillment and faithful performance of its orders while permits are refused us by the Department of Public Works."

The consultation resulted in the following letter from the mayor, which speaks for itself: "Under the laws and ordinances of the city of New York all work to be done which requires the opening or tearing up of streets must be done under a permit from the Department of Public Works. I am informed by the Commissioner of Public Works that your corporation was found opening the pavement in front of 41 Vesey street, without such permit and in flagrant violation of its obligations to the city. This reckless disregard of the rights of this municipality requires that some action be taken to prevent its recurrence, and I cannot interfere with the Department of Public Works in taking such action as may seem best calculated to accomplish that result. I desire further to say that I do not think you are called upon, as your communication states, to obey two masters, but that a faithful compliance with the laws and ordinances under which your charter was granted, and with the obligations which you have incurred to the city, would make it entirely unnecessary for the city authorities to take such action for the protection of the city's interests as you have complained of."

At an exhibition of the phonograph in London during the week, it is reported that Gladstone, listening to the remarks made by Gen. Sherman at a recent assemblage in New York, paid the following tribute to the American appreciation of him: "I am so accustomed to receiving notes of kindness from America that my vocabulary of gratitude has been exhausted. Therefore, in the simplest language. I thank the Americans for this notable assurance of their willingness at all times to accept words emanating from myself, and to attach to them a value altogether in excess of their real merits."

At the meeting of the Gas Commission Mayor Grant offered the following resolution, which was adopted: "Resolved, That the secretary is hereby directed to notify the several electric light companies that this board will not consent to permit the city lighting of electric lamps at rates in excess of the prices fixed in the late contracts which expired on April 30, 1890, owing to the fact that the appropriation for lamps and gas and electric lighting will not admit of lighting at rates in excess of the rates fixed in the late contracts." This means a sort of a compromise, and about 627 of the 847 electric lights, which figure at 35 cents a light, come within the bids of the companies and have been accepted by Commissioner Gilroy. The other 220 lights are still under discussion and New York ought to be ashamed of an appropriation less than it actually costs to produce electric light.

A new Edison corporation is reported under the name of the Edison Industrial Works with a capital stock of $1,000,000. Thos. A. Edison, Samuel Insull and Thomas Butler are the incorporators. One-half the capital stock is preferred and is to pay a dividend of 8 per cent. per annum before any dividend is declared on the common stock. Edison's many inventions outside of the electrical field will receive attention at the hands of the new company, and the many mechanical appliances which have been the result of both electrical and physical experiments, are to be manufactured. A gold mining and refining process is one of the industries to be created by the new company.

Clark Beers Hotchkiss died at Paul Smith's, Franklin county, on Thursday. Mr. Hotchkiss was born in Auburn forty-two years ago, and came to this city to become a banker. Up to 1871 he was connected with the American Exchange Bank. He conceived the idea of a messenger service, and in 1871 established the American District Telegraph company, and became active in its management. This company started the district messenger service in this country. In 1881 Mr. Hotchkiss took part in organizing the Mutual District Messenger and Telegraph companies He was made vice-president of both. Soon after he associated himself as partner with A. G. Day in the manufacture of Kerite telegraph cables and wires. This has been his chief business since, though he has remained vice-president of the other companies.

This great metropolitan city, as its residents take pride in calling it, is afflicted with a gas commission. This unique body persists in making the city ridiculous in the eyes of the rest of the world at regular intervals, but in this it resembles closely nearly all the other "commissions" which govern the town. The gas commission has brought itself into prominence lately by closing at sunset every evening Stuyvesant park, which is located in one of the most densely populated districts of the city. The reason is that the commission, desirous of posing as a "reform" board, has decided to reduce expenses and accordingly cut off the electric lights in the park, thereby effecting a saving of $2.80 per night. Truly this is a master stroke and should endear the commission to the great body of working people who are thus deprived of their only opportunity of securing a breath of fresh air. W. H. T.

Milwaukee, Wis.

MILWAUKEE, Wis., July 26.—O. E. Pritt, president of the Cream City Railway company, formally announces the sale of that line to the Villard syndicate. The sale is understood to be an absolute one, and the syndicate will take possession of its new acquisition on August 1st. The road was bought by Pittsburg people, a few months ago, from the Milwaukee gentlemen who built the line. The Pittsburg purchasers paid about $800,000 for the road, and the understanding is that the Villard syndicate is to pay them $950,000 in consolidated bonds secured by all the Villard interests in Milwaukee.

The purchase of the Cream City Railroad gives the Villard syndicate control of fully two-thirds of the street railway mileage of Milwaukee. The Milwaukee City Railroad, the largest system in the city, passed into the hands of the Villard syndicate on June 1st, and the Cream City Railway is second in size. Villard will put in the Sprague overhead system on both lines as soon as possible.

Electric cars will soon be used on all Milwaukee roads. The mule cars and the horse cars are going, and there is little prospect of the cable system ever being tried here. There is a little talk of using naphtha engines on one or two of the new suburban roads, but there is little chance of anything coming from it. The Cream City Railway will have several suburban lines of its own, when the proposed extensions to St. Francis, Layton Park, and out Oakland avenue are completed. The new work will do much toward increasing Milwaukee's street railway mileage. The indications are that within a year every part of the city, and the principal points in the county will be easily reached by street cars.

It is the impression of some that the Milwaukee & Whitefish Bay Railroad company will eventually purchase the Hinsey electric line, which connects the northwestern part of the city with the business section. The Whitefish Bay company is a very strong one. Charles F. Pfister, the president and principal owner, is a millionaire several times over, and a very enterprising one at that. His debut in the street railway business has created something of a sensation. He announces his intention of building the East and South side lines which Hinsey has had in contemplation for more than two years, and of building them without any unnecessary delay. He states that Hinsey is out of the field so far as the East and South lines are concerned, and declares that Hinsey has no interest whatever in his projects.

The trouble between Hinsey and his associate, Col. Hinckley, of Chicago, still continues, and they may come to the conclusion that a sale of their line is the best way out of the difficulty. The Hinsey road is part of the system which Mr. Pfister intends to build, and its sale to him, under all the circumstances, is not considered unlikely.

It really seems as though there are to be three suburban railways running from the West Side to Wauwatosa. One of them is already being built, the sum of $30,000 has been raised toward building another, which will run out from the end of Lloyd street, and for the third, which is to run along the Watertown plank road, a fight is being made for a franchise, and Millionaire Wells stands ready to put up the cash. Two of the roads are only a block apart, and there really seems to be no necessity for so many lines, though they might have business enough if operated by companies having lines in the city. On the South Side the contest for a franchise along the National avenue road, has virtually been decided, and the Milwaukee City Railroad will build not only to the Soldiers' Home, but to North Greenfield. The other companies drew out when they found that the Milwaukee City meant business. C.

Kansas City, Mo.

KANSAS CITY, Mo., July 26.—Charles B. Holmes and William Anthony, of this city, have closed the arrangements to build a dam across the Kansas river above Topeka, and supply electric current for power users in Topeka Work will begin at once upon the dam. The dam and the electric plant will cost $1,000,000. Sixteen hundred and eighty horse power at $35 per horse power per annum has been taken, and it is expected that at least 3,000 horse power will be taken by the time the work is finished, a year hence.

The work of putting in electric time service over the Union Pacific Railway company's lines was begun here last week by the Western Union Telegraph company under the direction of Robert Mitchell of New York. The service will extend from this city to Portland, Ore. Six weeks will be occupied in introducing the service. Clocks will be located at the end of each division.

The Kansas City Electric Light company last week closed a contract with the Kansas City Cable company for lighting its central power house at Ninth and Washington streets, and also at the Union depot. The cable company has heretofore been supplying its lights from a plant of its own. The same electric light company has put in a circuit for 27 arc lights for Pain's Siege of Sebastopol, now being given here.

A lawyer in Kansas City, Kan., last week, left an affidavit at the court house, and went away before he had sworn to it. The oversight was noticed by the clerk, who called the lawyer up by telephone and administered the oath to him over the wire. The seal of the court was then placed on the document and it was filed.

W. W. Smith secretary of the Missouri & Kansas Telephone company, returned last week from a trip to Denver. While there he observed the changes being made in the service with a view to improving the facilities. He found that the first thing that the Denver board of directors did after improving the arrangements and adding some underground conductor facilities, was to increase the rate to $10 a month for each instrument, or $120 a year Salt Lake City charges $80 a year, while Kansas City gets $72 a year

for each instrument. When the underground conductor work that has been asked for here has been put in, it is probable that rates will be raised in order to meet the additional expense. The details of the matter of a new building and of new facilities have not yet been settled. The company may put up its own building, or it may take a lease for 99 years upon one that may be built for it. The question has about settled down to these two propositions.

Two practical tests were made last week by the fire department of Kansas City, Kan., of the Kansas City fire and police alarm. One box was placed at a distance of one-seventh of a mile from the central station and one at 375 yards. Both boxes operated satisfactorily, and the runs were made in much quicker time than formerly.

The deal has been finally closed by a syndicate of eastern capitalists for the purchase of a large tract of valuable land near the town of Muncie, just west of Kansas City, Kan. It is intended to locate at this point extensive industries. The tract of land comprises 173 acres on the north side of the Kansas river, and thirty acres on the south side of the river. The company has been granted a charter with an authorized capital stock of $1,000,000, under the name of the Inter-state Water & Electric Power company. The directors of the company are John B. Colton, Nicholas McAlpine, David N Carlisle, John G. Johns and Robert L. McAlpire. It is the intention of the company to dam the Kansas river in order to furnish water power for an immense electric light plant, which is to be located on the recently purchased property. The projectors of the scheme declare that they can by means of water power furnish electric light to the two Kansas cities and the adjacent towns at a cost so much reduced that it will compel all the plants operated by steam to shut down or lower their prices very considerably.

On the day that the Western Union office was burned in New York, the Kansas City office, already one of the largest relay offices in the country, was simply overflooded with messages from all climes and in all languages. They included a message from Buenos Ayres to the Brazilian minister at Washington from the commander of a French fleet at anchor off the coast of Chili, and so on. The usual route would have been via New Orleans and New York.

The Kansas City Fire, Burglar Alarm & District Messenger company of Kansas City, Kan., has been incorporated with a capital stock of $60,000. The directors are A. M. Sloss, E. R. Wilder and E. F. Mullay of Kansas City, Mo; A. H. Cobb, H. McGrew and Winfield Freeman of Kansas City, Kan.

The Edison Electric Light & Power company has increased its capital stock from $100,000 to $150,000. The company's assets are $125,317.96, and liabilities $25,213.78.

C. S. Rusling of the Thomson-Houston Electric company reports the following sales in his territory: To the Wichita, Kan., City Railway company the electrical equipment for fifteen cars; to the Joplin, Mo., City Railway company the equipment for five cars.

The water works committee of the city council of Macon City, Mo, were in the city last week to inspect the operation of the electric light systems here. A combined water works and electric light plant to cost about $400,000, and to supply the city, which has 6,000 inhabitants, is being put in now by the municipal authorities under the direction of the Western Engineering company of this city.

Articles of incorporation have been filed by the Oak Street Electric Railway company. The incorporators are William B. Moorehead, James A. Forbes and Perry C. Phillips. The object of the company is to build an electric railway on Oak street, from the approach of the Winner bridge across the Missouri river to the southern limits of the city. The capital stock of the company is $50,000 in 500 shares of $100 each. At the Winner bridge the road will connect with the electric line running over the bridge into Clay county.

The annual convention of the Old-Time Telegraphers and the United States Military Telegraph corps has been postponed from September 10–12 to September 15–17, so as to avoid a conflict in dates with the convention of the National Telephone association, which will be held in Detroit, and many attendants of which will desire to attend the convention here. A large attendance is expected.

P.

Detroit, Mich.

DETROIT, July 26.—The Detroit Electric Light & Power company started on the fulfilment of its contract for the city lighting about thirty days ago, and has its stations now in complete working order. The generators and arc lamps are of the Wood type made by the Fort Wayne Electric company, the lamps being placed on poles throughout the city.

The Motor company, which recently gave asixty days' test of the new Shawhan street car motor on the Fort Wayne & Elmwood road has recently moved into its factory at the corner of Franklin and Dubois streets, a new building which is admirably adapted for its requirements. It reports orders on hand for cars from Dayton, O., and Grand Rapids, Mich., both of which will be shipped next week; also an order for a storage battery car which will soon be shipped to Portland, Ore.; and also a number of cars which are intended for the new electric road at Atlanta, Ga. The fine record made by the street car motor during the sixty days' run has attracted the attention of street car men. The company will soon place on the market a double armature generator for lighting and power purposes.

The business of the Detroit Motor company has increased so rapidly during the past year that the company has entirely outgrown its present quarters on Griswold street. It is now erecting a large factory at the corner of Cass avenue and the Michigan Central Railroad tracks. The factory will extend 100 feet on Cass avenue, will be three stories high and will have a frontage on the railroad tracks of 250 feet, one story in height. The building will be of brick, finished with stone trimmings and admirably arranged for the purpose of manufacturing motors. It will have excellent shipping facilities, being on the Michigan Central belt line, and will have a private side track.

The Detroit Motor company is making motors in all sizes, from small dental motors up to 30-horse power for heavy work. The company is also arranging to place on the market a new motor for street car purposes, and in its new building will have a court in which will be laid a track for experimental and exhibition purposes for this class of work.

About a year ago the Detroit Electrical Works sold their property, on the corner of Seventh and River streets, to the New Union Depot company, and will have to move their shops before the first of October. They are erecting a large factory at the corner of Woodward avenue and the Belt Line Railroad track, which, when finished, will be one of the most complete factories of its kind in the west. It will have a frontage of about 300 feet on Woodward avenue, by about 450 feet in depth, and is admirably arranged for all general electrical work. The power will be supplied by two large high speed engines which will drive large generators of the Rae type, and power will be distributed to all parts of the building by motors. With the exception of the driving belts from the engine to the generators, there will be no belts in the entire building. The Detroit Electrical Works are expecting soon to place on the market a line of motors of all sizes for power purposes, and when settled in their new factory will be able to handle their street car business better than ever before. They have recently re-equipped the Highland Park railroad at Detroit with two new cars designed after the latest improvements made by their electrical engineer, Frank B. Rae. This road has a single track with switches, and the motor wire is supported by brackets to a line of poles along the road.

The Detroit Electrical Manufacturing company is a new concern which has recently acquired the large business of the C. H. Decker company, located at Brush and Champlain streets. This company has largely increased the facilities formerly at the disposal of Mr. Decker.

The Commercial Electric company, which was started at 55 and 57 Gratiot avenue, a little more than a year ago, has been compelled to enlarge its quarters so as to take in the entire building of which it formerly occupied only a small part. This company is agent of the Fort Wayne Electric company, also city agent of the Detroit Motor company,

The Fisher Electric company has recently made a decided hit in the installation of lighting plants on the lake steamers. The work on the new large passenger steamer, Frank E. Kirby, is attracting a great deal of attention, and is considered one of the finest installations of its kind on the lake. The Fisher company is now installing a plant on the new steamer Maryland, and have under way a number of smaller contracts.

D.

Davenport, Ia.

DAVENPORT, July 26.—Another evidence of the popularity of electrical enterprises is shown by the formation of a new company with a capital stock of $100,000. Articles of incorporation of the Davenport Light & Motor company have been filed in the recorder's office. The incorporators are M. L. Marks, N. Kuhnen, Jr., A. J. Hirschl, R. T. Miller, Lee E. Cole, W. P. Bettendorf, L. H. Lyford, W. R. Lewis, N. Kuhen, Otto Albrecht and A. W. Vanderveer. Among the incorporators are some of the members of the Hawkeye company, which has established light and power plants in Montezuma, Bloomfield and Muscatine. The new company will not deal in material but will confine itself to the establishment of electric lighting and power plants throughout the northwest. A deal has already been closed by which such a plant will be established at Sigourney, Ia., and $10,000 of the capital stock will immediately be called in and partly or entirely expended on this plant. Other electric plants will be established by this company throughout the northwest, and it is expected that Davenport will become the center of electrical interest of this section of the country.

The first election of officers will be held Jan. 1, and until that time the following named gentlemen will serve as executive officers: President A. J. Hirschl; vice-president, M. L. Marks; secretary and treasurer, A. W. Vanderveer. The affairs of the company will be directed personally by Judge W. R. Lewis, who will act as superintendent and manager.

E. M. F.

Louisville, Ky.

LOUISVILLE, KY., July 23.—On the night of July 19, 150 men were put at work in Winchester, Ky., to lay the track for the electric street railway. The hasty move by night was to head off an injunction by the Boonesboro Turnpike company. The Turnpike company claims to control the middle of the street and declined to give the electric railway company the right to lay its tracks there. A law suit will probably ensue.

Within ten days the Green street electric railway will have been extended to the Eclipse base ball park. As stated already, the Central Passenger Railway company started to extend last fall and was stopped by an injunction.

The consolidated street car lines have about secured from the city the right to extend their tracks on Fourth street and out Third street boulevard to Jacob Park, about two miles from the city limits. The company is given six months to complete the line by the provisions of the proposed ordinance, and can use either mules, electricity, steam or cable Electricity will certainly be used, though, as mules could not furnish the rapid transit required. This line will connect with the lines on C and D streets

J. W. L.

Nashville, Tenn.

NASHVILLE, July 26.—Well informed men say that fully three times as many passengers are carried by the electric cars as patronized the mule cars, and the business is still growing. The fact that the companies are constantly increasing the capacity of their plants corroborates this estimate.

As previou ly stated the United Electric Railway company has under contract a large new power house, but it cannot be completed until next spring. In the mean time it has been decided to add a 30-horse power Thomson-Houston generator to the present plant. There is hardly room in the power house for it, but it is the best that can be done at present. The machines will be jammed closer together. The machinery is now run from 6 a. m. till 11:30 p. m. every day, and one generator is run all night to furnish lights for the car-sheds, shops, offices, etc.

Three members of the military company that assaulted an electric motor man have been found guilty and fined.

The only important building in the city that is not well lighted by electricity is the state capitol, an immense building, modeled after a Greek temple, which cost $2,000,000. The state convention was left in darkness two or three times this week, and at last night's session one of the delegates stepped off one of the upper porches which are unlighted and without railings or bannisters, and was horribly and fatally mangled. Similar accidents have occurred before and the public condemnation of the niggardly policy of the legislature in refusing to make appropriations to insure proper lighting of the capitol will bear fruit next session. It is hardly to be supposed that a legislature in this day will adopt any but electric lights.

The parties who were reported as soon to establish electric street car lines in Savannah, Ga., had another meeting in that city last week. There is no doubt they will begin active operations soon, but are not yet willing definitely to announce their plans.

The Capitol Electric company has completed its power circuit in the central portion of the city and July 23 the little motors were put to work and attracted a great deal of attention. The power circuit will be extended by the company as rapidly as demands are made for motive power. The probability is that there will soon grow up a great demand for electric motors, as a great many users of small power are only waiting to see a practical test.

The city government has been giving the electric companies some pretty plain talk recently. The city attorney was asked to give an opinion as to what remedy or recourse the city had in case of continued delay or failure upon the part of the electric light company to furnish the one hundred additional lights ordered several months ago. The written opinion of the attorney is quite long and recites among other points that under the grant the city can recover on the bond given by the company all damages that may arise from failure or unreasonable delay in complying

with its contracts and that the mayor and city council have the power to declare the entire grant forfeited. The Board of Public Works called on the electric light company yesterday and was assured that the lamps ordered will be put up just as soon as possible. A scarcity of cars and the crowded condition of the railroads have delayed the arrival of the poles which are to come from Alabama. The localities for the lights ordered were not made with reference to existing lines of wire and in some cases a half mile of new wire must be strung for a single lamp.

The petition of the Rock City Electric company was acted on yesterday by the Board of Public Works and a committee from the city council. They decided to recommend for rejection of the bill now pending asking for right of way for the street car lines by that company.

The United Electric company has decided to put in an additional engine to drive the new 30-horse power generator separately instead of driving it from the counter shaft.

The Electric club effected a temporary organization last night and will meet on the 31 inst. to perfect a permanent organization. Considerable interest was manifested and no doubt a large club will be formed. B.

Pittsburg, Pa.

PITTSBURG, July 26.—The experiments which are now constantly being made with electric mining machines in the Monongahela Coal Valley are proving very successful.

The discovery of new coal fields in Alabama has compelled the operators in Western Pennsylvania to cut down their price of that fuel in order to successfully compete with the Southern coal at Cincinnati, Nashville and New Orleans. This curtailing in the cost of production, however, always took place to the disadvantage of the miners; but now, the miners' wages have become so low, that any further reduction would not only drive them into some other employment, but it would naturally necessitate the operator to find a substitute for the miner. This substitute is admirably filled by the mining machine. Tests made in the first pool of the Monongahela coal field, where mining is considered more difficult, than in the region higher up the river, with the Michaels and the Hercules mining machines, have proved that the cost of production can be greatly reduced by the use of these machines. This led to the adoption of electric appliances in many mines and the business of the mining machine companies has grown very extensively.

The Michaels Mining Machine company not long ago began the erection of a large factory at McKeesport, Pa., and they are said to be filled with orders to supply their machines.

The Hercules Mining Machine company, which is a Pittsburg concern, is also doing a large business. The latter company has furnished a complete electrical equipment, consisting of a light plant, an electric motor for hauling and motors for the mining machines to mine number 1 of W. H. Brown & Sons. Both mining machines are operated with the Tesla alternate current motor of the Westinghouse Electric & Manufacturing company.

The five electric street railway corporations of Braddock, Pa., which sprang into existence with the expectations of running an electric railway from Braddock to Turtle Creek and Wilmerding, are still hoping that their expectations will realize. Inasmuch, however, as only one corporation can get the right of councils for this route, the council meetings of Braddock are just now made very interesting. A decision is to be made in the matter in two weeks.

Superintendent Mead of the Pittsburg Bureau of Electricity, has unearthed a city ordinance, according to which, no electric street railway is permitted to operate a current exceeding an e. m. f. of 800 volts. All the electric street railway companies have been notified of the existence of this ordinance, and they have been requested to operate their system within the limit of this voltage. E. H. H.

THE ELECTRIC LIGHT.

Trenton, Tenn., will have an electric plant for lighting the town.

Independence, Ore., has voted to establish an electric light plant.

Fall City, Neb., has adopted electric lights for street illumination.

Madison, Ga., is to have an electric light plant for illuminating the streets.

The city council of Macon, Ga., has voted $25,000 for electric lights for the city.

The Kensington (Ga.) Land, Coal & Iron company will put in an electric light plant.

An electric light plant will be erected at the United States Marine Hospital, New Orleans.

The Matthews Cotton Mill company, Selma, Ala., will replace its picking room outfit recently destroyed by fire, and will put in an electric light plant for purposes of safety as well as convenience.

Macauley's theatre, Louisville, Ky., is to be lighted by electricity. Gas is now the illuminant.

The Loomis Manufacturing company, Fernandino, Fla., will put an electric light plant in its fiber factory.

The Charlotte (N. C.) Electric Light company will add another engine and an arc light dynamo to its plant.

E. P. & S. Denmark, Quitman, Ga., have secured the franchise to put up and operate an electric light plant.

A plant is to be established by the Las Vegas, N. M., Electric Light company. About $100,000 will be the outlay.

The Lafayette, Ind., Electric Manufacturing company has been incorporated, and will expend $50,000 on a plant.

The Vanderbilt Steel & Iron company, Birmingham, Ala., contemplate putting in an electric light plant at its furnace.

The Snow Hill (Md.) Electric Light company has increased the capacity of its plant by the addition of two dynamos.

Bonds in the sum of $7,750 have been authorized at Slater, Mo., for the purpose of establishing an electric lighting plant.

An electric light plant is to be established at Tecumseh, Mich., by the Tecumseh Electric company, at an estimated cost of $50,000.

The Mason City, Ill., Electric Light company's plant was totally destroyed by fire July 25. The loss is estimated at $5 000.

L. N. Cox of Washington, D. C., will erect an electric light plant in Asheville, Tenn., with a capacity of 100 arc and 1,000 incandescent lamps.

J. E. Roddy of Anderson, S. C., and others, have incorporated the Anderson (S. C.) Electric Light & Power company, to furnish light and power to that city.

The Trenton, Mo., Thomson-Houston Electric company has been incorporated with a capital stock of $100 000; incorporators James Anderson, Robert M. Cook and others.

An increase in the plant of the Falls Electric Light company of Williamette, Ore., has become necessary. Three 1,500-light incandescent and 100 arc lights will be added immediately.

M Albertson and others Waycross, Ga., have incorporated the Satilla Manufacturing company to manufacture ice, and erect an electric light plant, gas works, etc. The capital is $50,000.

The Mather Electric company have been awarded contracts for isolated plants for the Davidson opera house, Milwaukee, and a new hotel at Tacoma, Wash. J. H. Reed of the Chicago office secured these orders.

An action has been instituted by "tax-payers" of Denver, Col., against the city and the Western Electrical Construction company to test the validity of an ordinance granting the company the franchise and contract for public lighting in Denver. It is alleged that the Western Electrical Construction company has no plant, that the price at which the contract was awarded was excessively high, and that there was fraud in the transaction. It is further claimed the Denver Consolidated Electric company, "an old and well equipped institution," proposed to furnish the light at a much lower figure, but the bid was not considered.

THE ELECTRIC MOTOR.

The first electric tramway in Europe on the Thomson-Houston system was opened in Bremen on the 22d ult. Three cars are employed, and others will be subsequently added. Each car carries two 10-horse power motors.

The Third street horse car system of Portland, Ore., will be transformed into an electric road. There are between 13 and 14 miles of road and it will be extended when electricity is substituted for animal power. The First street line will also be changed into an electric road. Both will adopt overhead wires.

The Savannah Street & Rural Resort Railroad company, the Savannah City & Suburban Railway company, and the Coast Line Railroad company have been granted permission to use electricity as a motive power. The first named company is making arrangements for equipping its line with the overhead system.

E. D. Latta has been chosen president, E. K. P. Osborne, F. B. McDowell, J. L. Chambers, E. B. Springs and W. A. Bland, directors of the Charlotte Consolidated Construction company, organized to purchase the Charlotte, N. C., Street Railway, convert it into an electrical railroad and extend its lines.

The Owosso Electric Railway company, with a capital stock of $50,000 was organized at Lansing, Mich., July 22. Its officers are H. L. Hollister, president; L. S. Hudson, secretary, and M. D. Skinner, treasurer. All are Lansing men, and President Hollister is president of the Lansing Street Railway system. The work of actual construction will begin very soon, the Owosso council last were granting the company a thirty years' franchise. It is also the intention of the company to connect Owosso and Corunna with an electric railway line.

George D. Capen explained at St. Louis last week that matters connected with the Lindell Street Railway were in first-class shape, and that the work was being pushed forward with unabated energy. "We'll be ready," said Mr. Capen, "to run electric cars on Delmar avenue, from Grand avenue to King's highway, in ten days. We are waiting now simply for more power, as the track is in readiness. Our present station, represented by engines of only 250-horse power, will be sufficient for the purpose, but by the middle of September, with an increase of power, we shall begin to operate one-half of the entire road, beginning down on Third and Washington avenues. The electric motor is as far ahead of the cable as is the cable ahead of the bobtail car. In further evidence of the improvements made by the Lindell Railway company it may be cited that it is grading Finney, from Grand to Taylor avenues, some 7,000 feet, with red gravel, thus transforming that thoroughfare into a boulevard that will go far to reconcile the residents in that portion of the city with double tracks and an electric road passing in front of their domiciles.

THE TELEGRAPH.

A dispatch from Columbus, O., July 23, says: The Western Union office here adjoins the Neil House, and an alarm of fire at 1:30 o'clock this morning called the entire department to the hotel, and for a time created intense excitement. A switch-board in the District Telegraph office, which is located in the same room as the Western Union, caused the trouble, having caught fire presumably by the crossing of electric wires. No damage further than the destruction of the switch-board was caused.

Attorney General Miller has begun an action in the United States Circuit court at St. Paul against the Northern Pacific Railroad company, Western Union Telegraph company, and the Northwestern Telegraph company, to annul the contracts between these companies. It is claimed that the defendants have failed to fulfill the provisions of the acts of Congress of July 2, 1864, and April 10, 1869, in which the railroad company was granted valuable concessions from the United States in lands to the amount of twenty alternate sections through any state. One of the provisions of the act was that the railroad should erect and maintain a telegraph system. Subsequently the Northern Pacific made contracts with the Western Union Telegraph company, and the complaint alleges that the contracts were beyond the powers of the railroad to make or the telegraph companies to receive and were induced by improper and corrupt considerations, and were against public policy and in violation of the rights of the United States under acts of congress. The object of the proceeding is to wholly forfeit the rights claimed by the Western Union Telegraph company under franchises alleged to have been derived from the Northern Pacific Railroad company. The telegraph franchises in question extend over 2,189 miles of railway. The proceeding also denies the right of the Western Union Telegraph company to succeed to the rights and franchises of the Northwestern Telegraph company of Kenosha, Wis., the United States Telegraph company, the Atlantic and Pacific Telegraph company; the Independent Telegraph company, the Pacific Telegraph company, the Overland Telegraph company, and a number of others the names of which are not specified. The complaint alleges that the Northern Pacific had no right to enter into the contracts with telegraph companies, that it was a breach of public trust and a violation of the Northern Pacific charter rights. The contracts are all declared unlawful because the Northern Pacific railroad company is not by and through its own corporate officers and employes maintaining and operating for railroad, commercial, and other purposes telegraph lines, but on the contrary is in all ways disregarding the provisions of the act of Aug 7, 1888, requiring it to operate its own lines.

Miscellaneous Notes.

The *Electric Railway News and Stock Exchange Review* is the name of a new Boston venture which made its appearance last week It says it "has a prospective circulation of 50,000 copies."

The Chicago Novelty & Electrical company has been organized at Chicago to manufacture and deal in novelties and electrical goods; capital stock, $50,000; incorporators, Force Bain, Matthew Burton and J. W. Hutt.

Commenting on the bad telephone service in London the *St. James Gazette* says: "There is one change, however, which would not improve the service, and that is for the Government to take it over The telephone would at once become stationary, like the telegraph."

There is no warmer or more consistent friend of electricity than this journal, which notes with regret that some unthinking people in electrical circles continue, to the chagrin of both gas and electrical promoters, to harp on the "dangers" of the use of one or the other kinds of illuminants Both are exceedingly dangerous agents when improperly handled, a fact thoroughly understood by the more intelligent users —*Progressive Age.*

Personal Mention.

A. M. Morse, of English, Morse & Co., was in Chicago this week.

Paul Bossart of the Street Railway department of the Detroit Electrical Works, was in Chicago this week.

C. F. Annette, general manager of the Rocky Mountain Bell Telephone company of Salt Lake City, was in Chicago last week.

S. Dana Green, manager of the Central District United Edison Manufacturing company at Chicago, has been appointed assistant to the president of the company and will go to New York immediately. John F. Beggs of New York will succeed him.

Business Mention.

H. A. Cleverly of Philadelphia is prepared to fill orders for contract work of all kinds in the electrical specialty line.

The Empire China Works of Greenpoint, N. Y., report a very large business in switch bases, cut-out boxes, circuit breakers and other insulators of hard porcelain.

The Baxter Electric Motor company of Baltimore, Md., reports that the demand for its motors the last two months has so increased that it has been compelled to double its force of hands and run machinery day and night. It is at the present time several weeks behind its orders, and shipments for the present month have far exceeded those of any other month during its existence. "This steady demand," the company says, "for the Baxter motor is the best testimonial we have."

Chadbourne, Hazelton & Co., of Philadelphia, have sold to the Wenstrom Consolidated Dynamo & Motor company of Baltimore, Md., their patent noiseless gearing for electric street railways. This gearing will be manufactured by the Wenstrom company at their Baltimore factory. Chadbourne, Hazelton & Co. will be the general selling agents for these gears for the United States. The firm has sold the patents for an electrically actuated elevator to the same company, which will manufacture the elevators. Chadbourne, Hazelton & Co will be the general selling agents for the United States.

William J. Hammer, consulting and constructing electrical engineer, has opened an office at 533 Temple Court, New York. Mr. Hammer has been identified with electrical interests for twelve years and has had a wide experience in electrical work. He was Mr. Edison's private assistant at the Menlo Park laboratory and represented Mr. Edison at the Paris Exposition in 1889. He was electrical engineer of the English Edison company, and in conjunction with E. H. Johnson established the first central station for incandescent lighting in the world, as well as the elaborate Edison display at the Crystal Palace Electrical Exposition in 1882. He was chief engineer and electrician of the German Edison company at Berlin, 1883 and 1884.

The Triumph Compound Engine company of Cincinnati has just completed a 250-horse power engine on an order from the Cincinnati Electric Light company. On last Saturday Messrs. Mackey and Card, the engineers of the electric light company, took a dynamo and connected it to the engine at the works of the engine company. They tested the current from the dynamo with a voltmeter and the engine with a tachometer. It was found that the regulation was within 1½ per cent, between full load and no load, and the variation in speed upon the throwing off of the load suddenly was almost instantly recovered. There were all together nine experts of different kinds gathered on the occasion and the electricians who were conducting the test for the electric light company expressed themselves as highly pleased with the results and the engine is now being placed in their plant.

The Great Western Electric Supply company, of 190-192 Fifth avenue, Chicago, has the exclusive agency for the United States for electroliers made in the shape of different kinds of animals. The elk head electroliers at their Chicago salesrooms have already attracted much attention. The company is building some special racks for showing its stock of colored and cut-glass shades, of which it has one of the largest and finest assortments in the country. In response to the description of the Pattee lamp hour recorder which appeared in the WESTERN ELECTRICIAN two weeks ago, letters are now received from all parts of the country. This shows the need of a simple meter. The specialties put out by the firm are set forth in a half dozen circulars, all uniform in size and neatly gotten up in different colors. The series is being added to week after week and will supplement the preliminary catalogue now in the hands of the printer.

The success met by the Interior Conduit & Insulation company of New York has borne out the estimate made of its utility by its projector, Edward H. Johnson. Not only are many of the new buildings in the East in course of construction equipped with it, but it has also been specified by architects in other new buildings throughout the country, among which are the Board of Trade building, Toronto; the Boston building, Denver, Col; the Bell Telephone building, Boston, Mass.; New Jersey Central depot, Seventh Ave. Music Hall, German Club, etc. Its underground system has received a recognition seldom awarded a new article. It is carrying the alternating system of the Ft. Wayne Jenney company at Detroit with gratifying results. There will be employed at Minneapolis and St. Paul over 1,000,000 feet of this conduit for feeders. The tube, although made of paper, is wonderfully strong; tests made at Columbia College by Prof. Woolson showed it had a tensile strength of 2,400 lbs. to the square inch.

Lieut. F. Jarvis Patten, electrical engineer of Barclay street, New York, writes to the Accumulator company of 44 Broadway, New York, as follows: "I have used your storage batteries constantly since November last at my laboratory here, as well as in Philadelphia. I have used the 15 M cell of your most recent and improved form for driving the distributor motor in my multiplex telegraph system; also for the past month I have used 60 cells of your smallest size battery, originally designed for medical apparatus only, in lieu of about 125 cells of ordinary gravity battery for telegraphic transmission over the 100 mile circuit I use daily between New York and Philadelphia. With reference to the first lot, large size, used for motors, I am pleased to inform you that notwithstanding very irregular use, these cells have given me thorough satisfaction during the eight months I have had them in use, being more reliable for a constant e. m. f. than the dynamo circuit I use for charging them. The line battery to small cells, occupying 6 cubic feet of space, takes the place of more than 100 cells of gravity and require far less attention than the latter, and so far as observed, give better results "I consider your improved forms of storage battery far superior to any I have seen in use, and with proper care in their handling, as to charging and discharging, they are an exceedingly convenient and reliable source of current."

Electrical Patents.

Issued July 22, 1890.

432,512. Electric Stop Motion for Looms. David E. Coughlin, Milford, N. J.

432,521. Electric Cut-Out. Stephen D. Field, Stockbridge, Mass.

The invention relates to safety catches for electrical circuits of various kinds, wherein the object is to provide a means whereby abnormal currents flowing over the circuit will cause an interruption therein, and thus secure the safety of any apparatus which may be included in the circuit, which otherwise might become injured by the passage of too great a quantity of electrical energy.

432,547. Telephone Exchange. John A. McCoy, Medford, Mass.

432,561. Brush Reverser for Electric Motors. Anthony Reckenzaun, London, England.

432,571. Conduit System for Electric Railways. Nicholas Seibert, Malden, Mass.

432,577. Dynamo Electric Machine. Henry W. Spang, New York, N. Y.

The invention has relation to generators employing two armatures and having the pole pieces arranged in oblique relation to each other; and it consists in so constructing and arranging the armature and pole pieces that the former shall revolve within the inductive field developed by lines of magnetic force emanating from the ends of the pole pieces and the adjacent regions of the field bars.

432,581. Frog for Overhead Wires. Elihu Thomson, Lynn, Mass.

432,618. Electrical Communicating System. Alfred G. Holcombe, Long Island City, N. Y.

432,619. Call Box for Electrical Signaling Systems. Alfred G. Holcombe, Long Island City, N. Y.

432,623. Electric Railway. Rudolph M Hunter, Philadelphia, Pa.

The last claim reads:

"The combination of a source of electric supply, a traveling vehicle, an electric motor carried thereby, a shunt circuit upon said vehicle and receiving electricity from the same source as the motor, electric lamps in said shunt-circuit, a variable resistance in said lamp shunt-circuit, a second circuit forming a shunt around the lamps, and an electric device, in said second circuit, to actuate or regulate the resistance in the first or lamp shunt-circuit."

432,629. Electric Metal Working Apparatus. Hermann Lemp and John Tregoning, Lynn, Mass.

432,630. Forming or Shaping Metals by Electricity. Hermann Lemp, Lynn, Mass.

432,644. Current and Switch Controlling Mechanism. Edwin W. Rice, Jr., Lynn, Mass.

The invention relates to the controlling apparatus for the driving power of an electrically propelled car, the object being to so arrange the apparatus that no neglect on the part of the attendant to perform his work in the proper manner will result in permitting the car mechanism to get beyond control and thus cause possible accident or injury.

432,645. Station Box for Watchmen's Electric Time Detectors. James E. Richards, Cedar Keys, Fla.

432,646. Motor for Electric Railways. Michael H. Smith, Halifax, County of York, England.

432,651. Method of Working Metals by Electricity. Elihu Thomson, Lynn, Mass.

The improvement consists in locally treating the object by surrounding the same with the desired treating material, while the object is locally heated by the passage of an electric current of large volume.

432,652. Welding or Other Dynamo. Elihu Thomson, Lynn, Mass.

432,653. Method of Welding Pipes by Electricity. Elihu Thomson, Lynn, Mass.

432,654. Electric Meter. Elihu Thomson, Lynn, Mass.

The object of the invention is to secure simplicity and effectiveness in the apparatus, as well as adaptability for operation with continuous or alternating currents.

432,655. Dynamo Electric Machine. Elihu Thomson, Lynn, Mass.

We give the last claim:

"In a dynamo machine or motor, the combination, with an iron core having fixed energizing coil or coils continually traversed by exciting current, of a series of projections extending radially outward from a central revoluble polar portion of the mass of iron energized by such coils, all such projections being of the same polarity and continually polarized, and a fixed magnetic extension from an opposite pole of said core, carrying a series of fixed coils arranged in the periphery of a circle around said polar projections and presented to the same."

432,656. Manufacture of Bands, Rings, Etc., by Electricity. Elihu Thomson, Lynn, Mass.

432,657. Electric Lighting of Railway Trains. Illius A. Timmis, London, County of Middlesex, England.

432,670. Conduit Electric Railway. Byron Jennings, San Jose, Cal.

432,672. Method of Making Secondary Battery Plates. William P. Kookogey, Brooklyn, N. Y.

The invention consists, in general, of a pocket or envelope of thin sheet lead, containing active material and having its walls pierced or perforated to allow of circulation in combination with a rigid frame of lead situated within the pocket.

432,673. Electric Railway. Frank Mansfield, Melrose Mass.

432,674. Electric Railway. Frank Mansfield, New York, N. Y.

Of the fifteen claims we give the first:

"In an electric railway of the class described, an insulated main conductor provided with normally disconnected insulated branch conductors having movable contact ends, a guide-slot midway the rails, into which said branch conductors project, and a motor car having a flexible pick-up plow or lifter traveling in the slot."

432,675. Electrical Railway. Frank Mansfield, New York, N. Y.

432,681. Battery Cell. Henry E. Waite, New York, N. Y.

432,694. Apparatus for indicating Races. George H. Chappell, New York, N. Y.

432,707. Electric Motor. Henry Humbert, Brooklyn, N. Y.

The object of the invention is to produce an electric motor which will be simple and inexpensive in construction and be easily repaired.

432,710. Filament for Incandescent Electric Lights. Lawrence N. P. Poland, Cincinnati, O.

432,724. Automatic Adjuster for Telegraph Lines. Courtland P. Carr, Chicago, Ill.

The invention provides a device which automatically cuts off for an instant every main battery on the line whenever any key on the circuit is opened.

432,727. Method of Electric Riveting. Mark W. Dewey, Syracuse, N. Y.

432,745. Electric Lighting System. Edward T. Cooke and William H. Mackay, St. Louis, Mo.

432,748. Armature for Dynamo Electric Machines. Nathan H Edgerton, Philadelphia, Pa.

432,752. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

432,753. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

432,823. Magnetic Separator. George S. Finney, Chicago, Ill.

The invention relates particularly to that class of magnetic separators in which are employed a magnetic wheel and an endless belt of non-magnetic material surrounding the wheel and serving to support the material while being treated.

432,826. Electric Light Shade. John H. Goehst, Chicago, Ill.

432,834. Method of Forming Secondary Battery Plates. Henry G. Morris, Philadelphia, Pa.

The mode consists in first forming a grid with partitions tapering to a thin edge and forming throughout the grid cells without any intervening supports for the active material, then spreading the active material over the entire plate, so as to fill the cells, and finally simultaneously compressing the active material and the thin edges of the partitions, whereby the active material is compressed in the cells without material reduction in the area of the exposed faces of said bodies of active material.

432,858. Telegraph Pole. Charles M. Brush, Great Bend, Pa.

432,883. Support for Telephone Hearing Trumpets. Simon Lebenberg, Berlin, Germany.

432,884. Electric Gas Lighter. Joseph H. Lehman, Philadelphia, Pa.

432,894. Rheostat. Thomas J. Parrish, Nevada, Mo.

432,896. Drill-Hole Magnet. Charles S. Porter, Ivanhoe Furnace, Va.

432,927. Automatic Lubricating Device for Electric Motors. Samuel L. Barriett, Brooklyn, N. Y.

432,932. Heating by Electricity. Watkins L. Burton, Richmond, Va.

432,944. Conduit Electric Railway. Byron Jennings, San Jose, Cal.

Claim six reads:

"A trolley frame consisting of the metal plates with the interior and exterior insulating surfaces, the axles fixed to said plates and projecting outwardly, having the trolley wheels adapted to turn thereon, in combination with the inclosed oil chambers within the trolley frame, and passages extending through the axles and connecting therewith so as to lubricate the trolley wheels and axles."

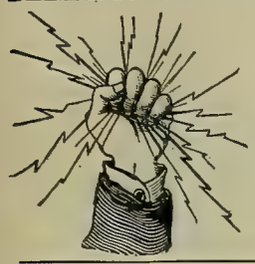
432,949. Arc Lamp. Austin H. Lucas, Pittsburg, Pa.

The invention consists in a lock mechanism operated to lock the second carbon rod in an elevated position by the upward movement of the first carbon rod when trimming the lamp, and operated by the first carbon rod when it reaches the lower limit of its movement, to release the second carbon rod and permit of its being fed in the usual manner.

432,962. Ship's Binnacle. Samuel W. B. Diehl and John Gibson, U. S. Navy.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

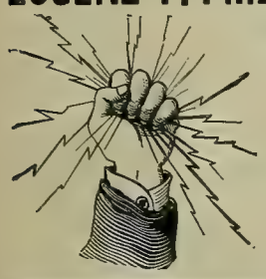
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS

MAKE ANYTHING IN BRASS.

4 LASALLE AVE CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:

W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

The Board of Councilmen

of the City of Hopkinsville, Ky., will, August 14, 1890, receive and consider sealed bids for the erection and operating of an Electric Light Plant in said city—Arc and Incandescent—of sufficient capacity to supply the citizens for next two years, and after expiration of two years, when the contract with the Gas Company will expire, for lighting the streets, to supply both streets and citizens.

The grantee to have the exclusive rights of the streets for ten years.

The council reserving the rights to reject any and all bids.

The population of Hopkinsville is about six thousand.

H. R. LITTELL,
City Clerk.

July 14, 1890.

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,
61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

THE SUNBEAM

MAINTAINS ITS RATED CANDLE POWER.

SEND FOR PRICE LIST.

SUNBEAM INCANDESCENT LAMP CO.,

Corner Randolph and Canal Sts., CHICAGO, ILL.

FIBRONE

Is the recognized **BEST SUBSTITUTE** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES

Also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We claim to manufacture **the very material** wanted by the Electrical Trade. Send for estimates and prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

OKONITE

TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

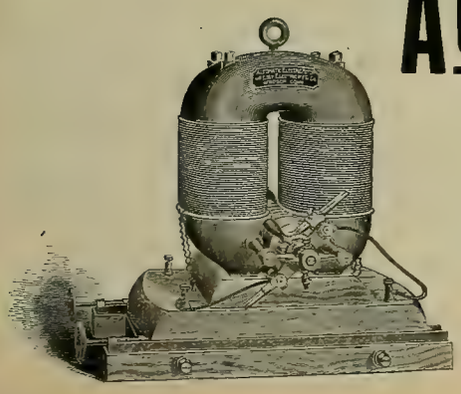
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

THE CURTIS STEAM PRESSURE REGULATOR

Has been in general use now about seven years, and has from the first taken the lead of all others, and stands unrivalled to-day for its reliability and durability. It is used wherever the pressure of steam or any other fluid NEEDS TO BE REDUCED AND CONTROLLED on Steam Heating and Drying, Electric Light Plants, Marine Engines, Railroad Car Heating Steam, Pumps, Natural Gas, Air and Water, in the United States, and in the leading countries of Europe, and is sold and endorsed by the trade universally.

The Curtis Regulator Co., 90 Beverly Street, Boston, Mass.

GENERAL AGENCIES.

NEW YORK, 109 Liberty st. CHICAGO, 218 Lake st.

PHILADELPHIA, 2035 N. Front st. MINNEAPOLIS, 210 Third st.

ELECTRICAL WOOD.

Telegraph
Telephone
Electric Light } CROSS POLES ARMS

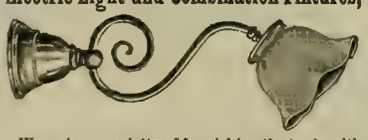
C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. Correspondence Solicited.

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

Magnetic Vane Ammeters and Voltmeters.

The New Station Instrument for Direct Currents.

Adopted and used Entirely by the Mather Electric Co.

Special Sizes made under Contract for Central Station Use.

QUEEN & CO., Makers, PHILADELPHIA.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

FOR SALE.

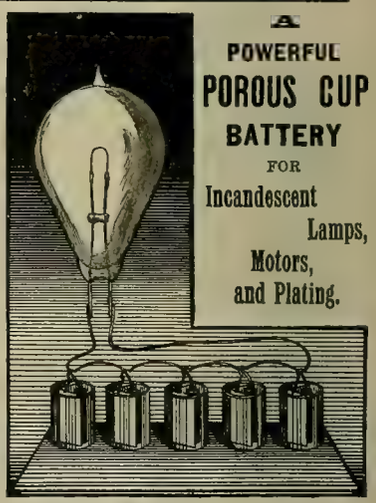
One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ROSE POLYTECHNIC INSTITUTE, TERRE HAUTE, IND.—A SCHOOL OF ENGINEERING.

Well endowed, well equipped departments of Mechanical and Civil Engineering, Electricity, Chemistry, Drawing. Extensive Shops & Laboratories. Expenses low. For catalogue address C. A. Waldo, Lib'n.



A POWERFUL POROUS CUP BATTERY FOR Incandescent Lamps, Motors, and Plating.

E. M. F. full 2 volts Battery will last from two to four months, according to work required.

Price for Cell	$1 25
Incandescent Lamps, each	1 00
2 Cells and 1 C. P. Lamp	3.50
3 Cells and 3 C. P. Lamp	4.75
4 Cells and 4 C. P. Lamp	6.00
5 Cells and 6 C. P. Lamp	7.00

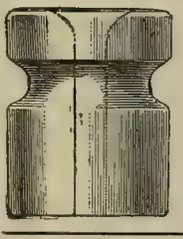
Battery has been in successful use for ten months, and guaranteed as represented.

E. K. GLASS,

CITY HALL,

RICHMOND, IND.

Electrical Supplies of All Kinds.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

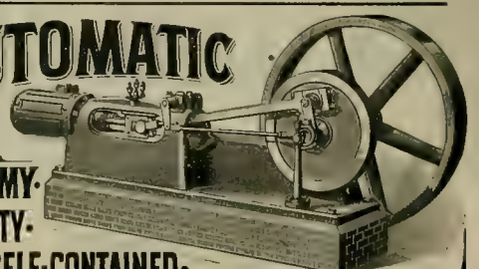
HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

THE RICE AUTOMATIC



GUARANTEED ECONOMY.

REGULATION · DURABILITY ·

8 TO 300 H.P. SIMPLICITY · SELF-CONTAINED ·

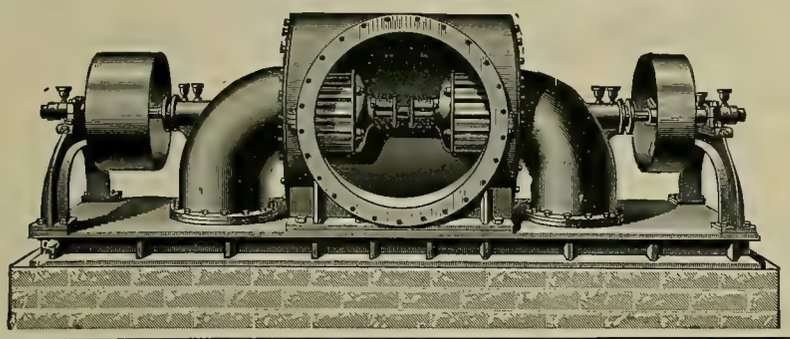
PAIR & TANDEM · COMPOUNDS · THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

WILLIAM S. BATES,

PATENT LAWYER,

204 Dearborn Street, CHICAGO.

17 YEARS EXPERIENCE IN THE PATENT OFFICE AND THE COURTS.

WM. S TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

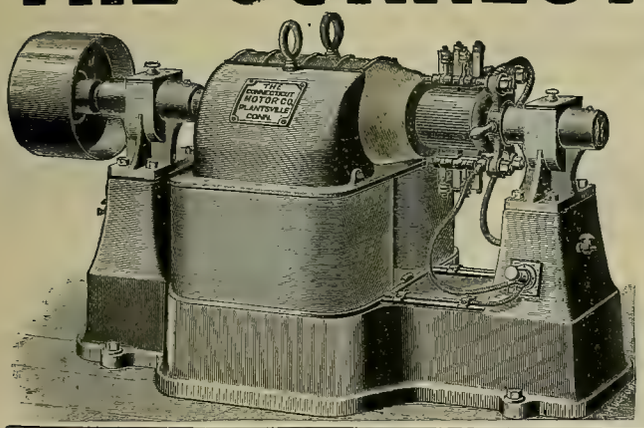
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 N. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

THE SPERRY ELECTRIC CO.,

D. P. PERRY, Vice-President and General Manager,

—MANUFACTURERS OF THE—

SPERRY IMPROVED SYSTEM

—OF—

ARC LIGHTING,

HIGH OR LOW TENSION.

WE GUARANTEE:

1. The new Sperry apparatus free from repairs for twelve months.
2. That the new Sperry Improved Dynamos can be coupled in series with perfect safety.
3. That any number of lamps from one to capacity of dynamo can be cut in or out of circuit, singly or in groups, with perfect safety, and without sparking at the brushes.
4. To absorb power in exact proportion to number of lights burning.

WE BELIEVE:

1. The new Automatic Sperry Dynamos and Lamps surpass in efficiency those of any other make.
2. That there is greater economy in operating the new Sperry System than any other.
3. That our automatic regulation has no equal; no rheostat, no wall boxes, no solenoid or dash-pot.
4. That if you will visit our factory we can show you the best arc lighting apparatus in existence.

We invite correspondence with electrical engineers, Intending buyers, and interested people everywhere.

THE SPERRY ELECTRIC CO., 195 to 207 South Canal Street, CHICAGO ILL.

MATERIAL AND WORKMANSHIP OF THE BEST.

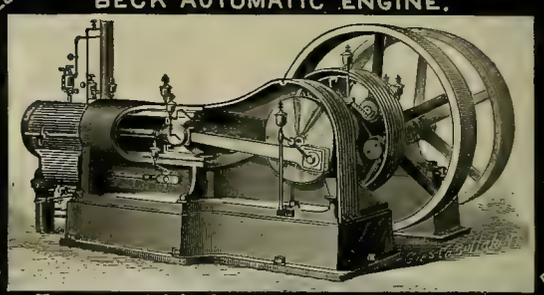
BECK AUTOMATIC ENGINE.

ECONOMY UNEXCELLED

REGULATIONS PERFECT

HOT BEARINGS UNKNOWN

PRICES MODERATE



TAYLOR MFG CO. CHAMBERSBURG, PA.

COMPLETE STEAM PLANTS A SPECIALTY.

Cleverly
1018 CHESTNUT ST.
PHILA.

"Improved" Automatic Burner.

PATENT LIFT-OVER PENDANT BURNER.
AUTOMATIC BURNER KEYS.
SPARK COILS.
DESK PUSH BUTTONS.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE EMPIRE CITY ELECTRIC CO.

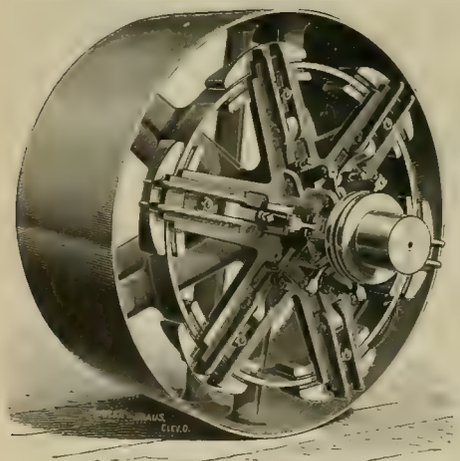
15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.



COPYRIGHTED BY H.W. HILL.

HILL

Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

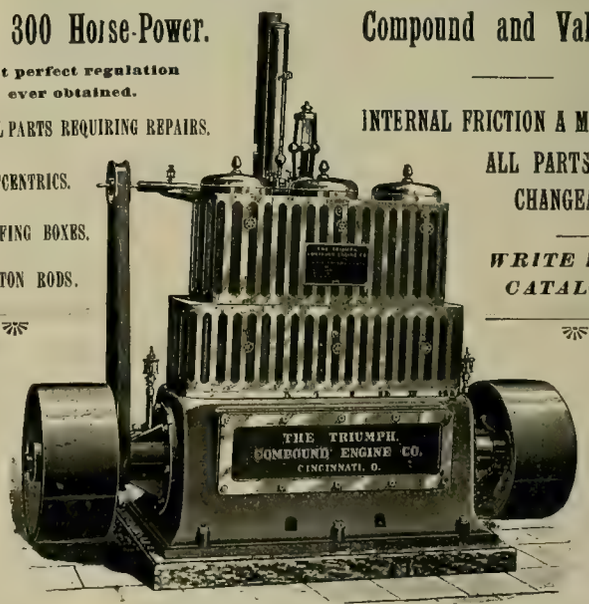
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

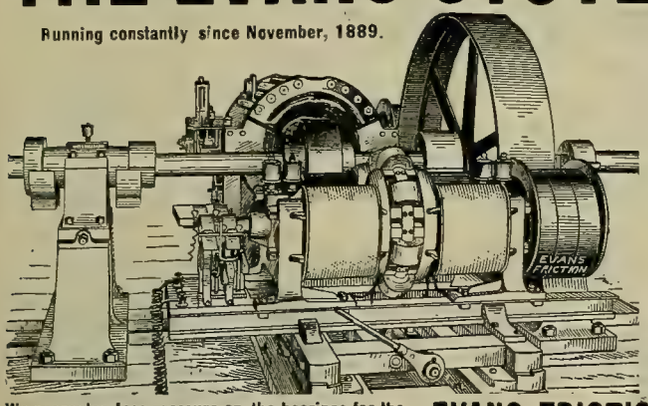
THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

Running constantly since November, 1889.



We guarantee less pressure on the bearings for the same power than with ordinary belting.

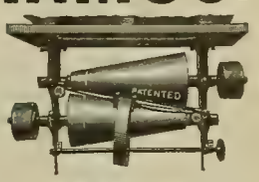
JAMESTOWN ELECTRIC LIGHT AND POWER COMPANY,
JAMESTOWN, N. Y., Feb. 1, 1890.

EVANS FRICTION CO., 85 Water St., Boston, Mass.:

GENTLEMEN:—I take pleasure in replying to your request that I should give you my experience relating to the use of the Evans Frictional Pulley for the driving of dynamos. On the 14th day of November last, we commenced the use of your pulley on a Thomson-Houston L. D. Arc Dynamo, and after two and one-half months trial I can assure you the test has been most satisfactory to us. We have recently placed a No. 7 Brush Dynamo on the opposite side of the same fly wheel; both machines are running perfectly. The great advantage derived is in being able to throw any machine in or out of gear without interference with other dynamos running from same shaft. It has many other advantages to recommend it, namely: there is positively no slipping of belts, economy of space, also economy in cost of belts. The bearings have *less pressure* than those operated by the usual method. I consider your system a success, and were we to build another station, we would place an Evans Friction Pulley on each and every dynamo. I have much pleasure in recommending your system to the management of all Electric Light and Power Stations.

CHARLES W. GRANT, President,
Jamestown Electric Light and Power Co.

ADDRESS THE
EVANS FRICTION CONE CO., 85 Water St., BOSTON.



Also manufacturers and patentees of Cone Pulleys (as per cut) which have been in successful operation for over three years, transmitting from one to fifty H. P.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT
IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP
FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt
ALL LEATHER
NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.
BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER

BRANCHES: 161 Summer St., Boston, Mass.; 225 Pearl St., New York City; 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St. Louis, Mo.

DR. GASSNER'S
DRY BATTERY
FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3½ in.
17.	"	7½ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD W LKINS

TRADING AS

PARTRICK & CARTER,

Manufacturers of and Dealers In Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

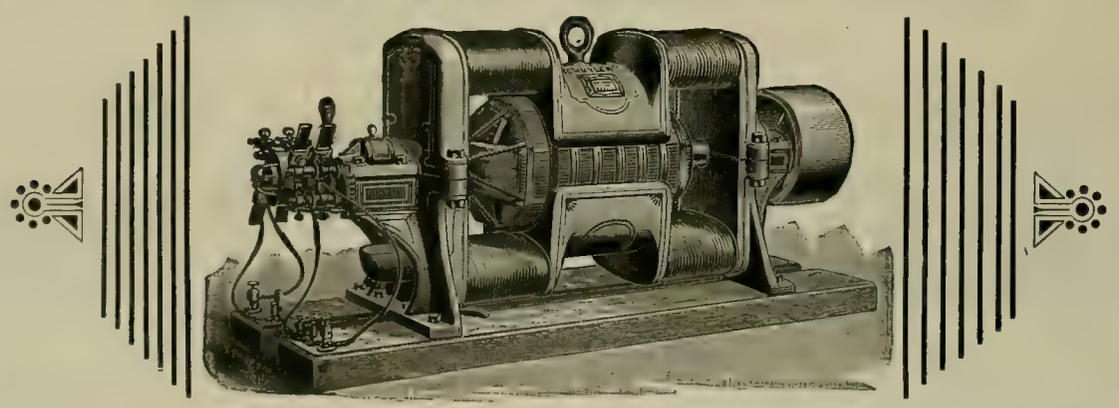
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S
Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

OKONITE
TRADE MARK.
WIRES, CABLES, TAPE and CORD
FOR
PROMPT SHIPMENT.

HOGGSON'S
IMPROVED
Door Spring.
Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

WHEN YOU BUY A MOTOR

From ANY Manufacturer or Dealer,
State that you WANT IT SUPPLIED WITH the
Whittingham Automatic Switch.
Send for Catalogue.
Automatic Switch Co.,
No. 8 Keyser Building,
BALTIMORE, MD.

GONDA

The Standard Open Circuit Batteries of the World.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

AXO

TRADE
GONDA
MARK.

THE ONLY
Genuine Leclanche Batteries
Made or Sold in America.

LECLANCHÉ BATTERY CO., 149 West 18th St., NEW YORK.

WESTERN ELECTRIC CO.,

We are the Exclusive Western Agents for the Sale of
A. G. Day's Kerite Wires
For Telegraph, Telephone, and Electric Light Use.
PRICES ON APPLICATION.

CHICAGO. NEW YORK.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
FOR
ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

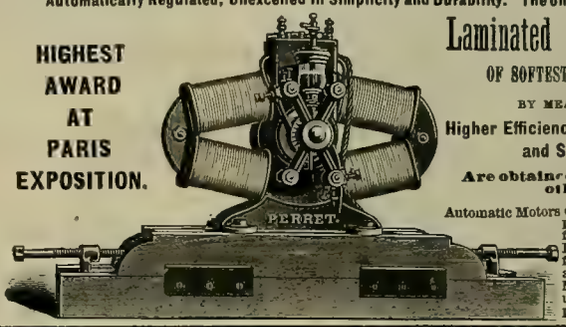
79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

SAFETY SEAMLESS RUBBER COVERED WIRE
IS THE BEST.

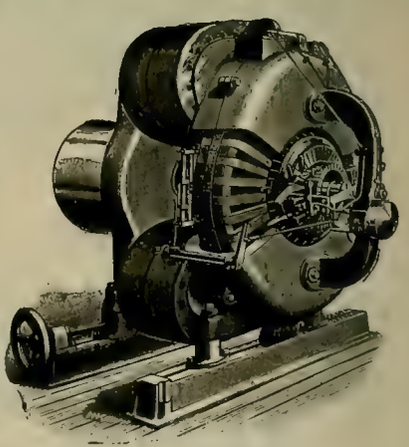
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

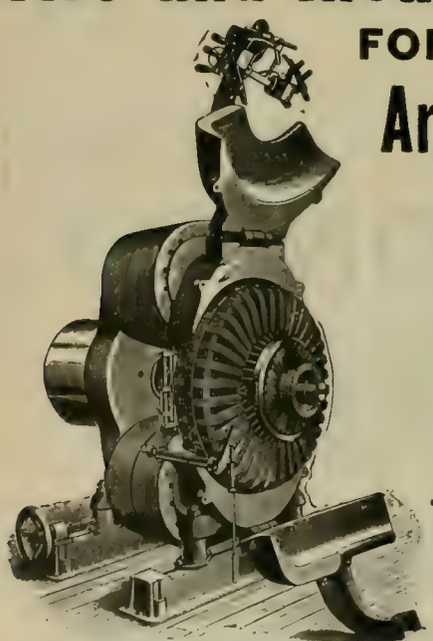
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

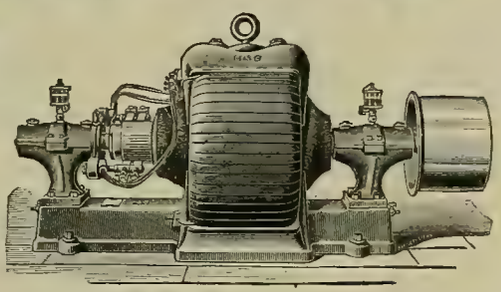
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 8,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

ELECTRICAL BOOKS.

Send For New and Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

POND ENGINEERING CO.

707 and 709 Market St., St. Louis.
427 "The Rookery" Chicago.
31 Waterworks Building, Kansas City.
319 Ramge Building, Omaha.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

Erected Ready for Service.

SPECIALTIES:-The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, etc.

SEND FOR LATEST CATALOGUES.

GEORGE P. BARTON,

LAW OFFICE,
225 DEARBORN STREET,
CHICAGO, ILL.

Patent and Trademark Cases.

C., B. & Q. R. R.

—IS THE—

Best Appointed Line

—FOR REACHING THE—

West, Northwest and Southwest.

JUST ISSUED from the PRESS!

WHIPPLE'S

Electric, Gas & Street Railway

FINANCIAL REFERENCE DIRECTORY

FOR 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

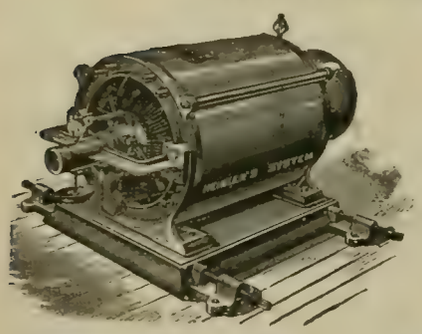
CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

THE HEISLER PATENT LONG DISTANCE
INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. **CORRESPONDENCE SOLICITED.**

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

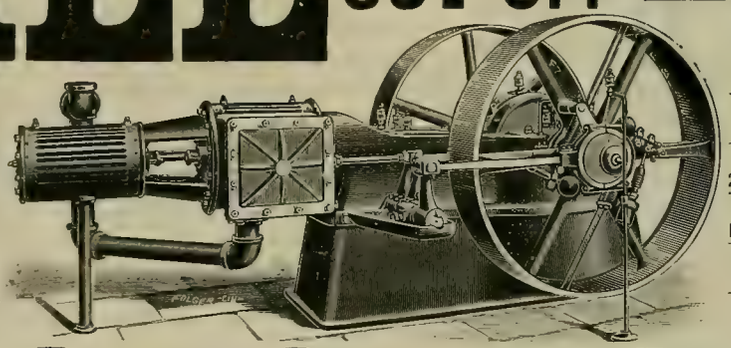
BALL AUTOMATIC CUT OFF ENGINE

Standard.

Cross Compound.

Triple Expansion.

Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER,
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Build'g, CHICAGO, ILL.

OMAHA ENGINEERING COMPANY,
Sheeley Building, OMAHA, NEB.

KANSAS CITY ENGINEERING CO.
KANSAS CITY, MO.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

BERGMANN & CO.,
ELECTRIC LIGHT, COMBINATION
AND
GAS FIXTURES,

ADAPTED TO ANY SYSTEM OF INCANDESCENT LIGHTING.

ALL APPLIANCES FOR THE EDISON ELECTRIC LIGHT.

Illustrated Catalogues, Designs and Estimates Furnished on Application. Correspondence Solicited.

Office and Works, 292-298 Avenue B, } **NEW YORK** { Show Rooms, 65 Fifth Avenue.

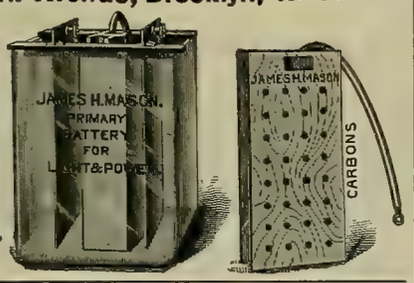
T. W. WILMARTH & CO., 227 State Street, CHICAGO, ILL.

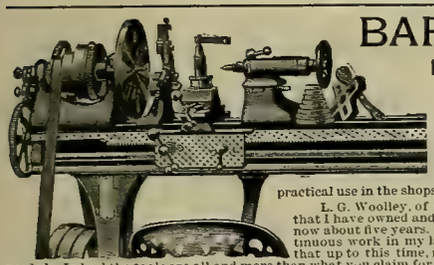
AGENTS FOR OUR FIXTURES IN THE NORTHWEST.

PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.
Guaranteed as represented.
These Batteries are in practical use, and giving perfect satisfaction.





BARNES' FOOT
POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.
ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

SPRAGUE
ELECTRIC RAILWAY
SYSTEM.

More than one hundred different street railways in operation or in course of construction.

MORE THAN 175
SEPARATE ORDERS
From Street Railways for Electrical Equipments.

The Sprague Electric Railway System has been proved to be the most

DURABLE,
RELIABLE,
ECONOMICAL,
CONVENIENT.

Sprague
ELECTRIC RAILWAY & MOTOR
COMPANY,
16 and 18 Broad St., NEW YORK.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1879.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the **ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES** by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully endorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL. 403 Sibley Street.

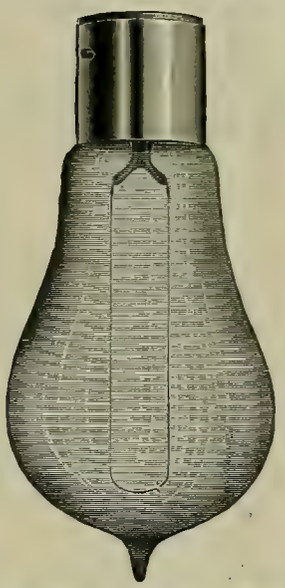
THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,
ALL CANDLE POWERS,
ANY VOLTAGE,
ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT CO., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER CO., Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

GRIMSHAW WHITE CORE
WIRES AND CABLES.

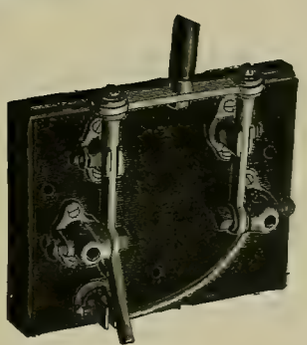
=FOR=

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

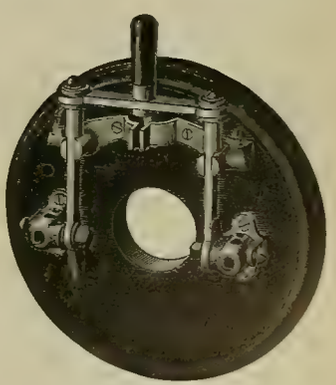
Switch-Board Cables,
Grimshaw White Tape,
Grimshaw Black Tape,
GRIMSHAW SPLICING COMPOUND.

McLennan Switch.

Paiste Switch.



Arc Lamp Wall Switch.



Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.,* CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.,

171 RANDOLPH ST.,

C-H-I-C-A-G-O.

MANUFACTURERS OF

BARE AND INSULATED

WIRES AND CABLES

AND

GENERAL ELECTRICAL GOODS.

Catalogues or Quotations upon Application.

NO CHARGE MADE CUSTOMERS FOR EXPERT ADVICE.

A large and well assorted stock of Shield Brand and Habirshaw Wires constantly on hand.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

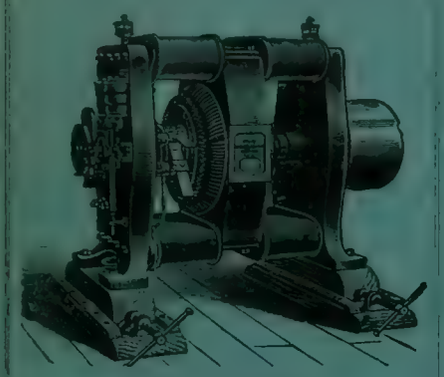
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



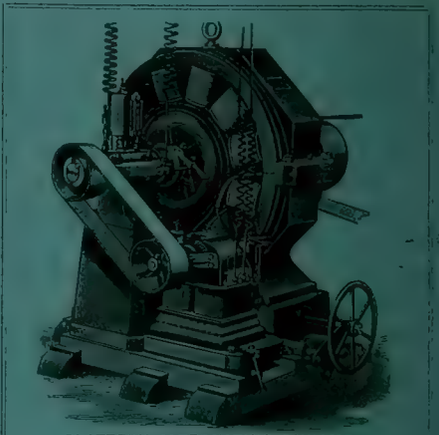
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK,	115 Broadway.
CHICAGO,	185 Dearborn St.
PHILADELPHIA,	907 Filbert St.
PITTSBURGH,	533 Wood St.
DETROIT, MICH.,	57 Gratiot Ave.
SAN FRANCISCO,	35 New Montgomery St.
TORONTO, CAN.,	138 King St. W.
DALLAS, TEX.,	McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

The Consolidated Electric Storage Co.,

MANUFACTURERS OF

THE JULIEN

ELECTRIC STORAGE BATTERY.

Exclusive licensees for the whole of the United States Of the Storage Battery Patents of Charles F. Brush [lately owned by the Brush Electric Company], and sustained by the Circuit Court of the United States.

Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

BATTERIES FOR LIGHT AND POWER,

Sold at Prices so Low as to Defy Competition.

For Agencies and Licenses apply at the Company's Office at

120 Broadway, NEW YORK CITY.

All other inquiries, more especially those in relation to Purchase of Batteries, should be addressed to the Philadelphia Office of the Company.

926 Drexel Building, PHILADELPHIA, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, AUGUST 9, 1890. No. 6.

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE.

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { BAKER, BALCH & CO., Seattle, Wash. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufactures can be found at our Agencies.

AN INVITATION BY CABLE

MANUFACTURERS.

To Visit The Stockton Hotel, CAPE MAY.

We will be there during the National Electric Light Convention, Commencing August 19th, 1890, with samples of Wire and Cables.

GEO. WILEY.
FRED. DEGENHARDT.

STANDARD UNDERGROUND CABLE CO.,
PITTSBURGH, PA.

ROOT'S WATER-TUBE BOILER.

ROOT SECTIONAL SAFETY BOILER.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

ELECTRIC PLANT BOILER.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,
28 Cliff Street, New York.

BRANCHES: BOSTON, PHILADELPHIA, NEW ORLEANS, DALLAS and CHICAGO.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use.

Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York. / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

THE EDISON MACHINE WORKS,

MANUFACTURERS OF

Weatherproof Wire. Insulated Iron Wire. Magnet Wire. Rubber Covered House Wire.
Annunciator Wire. German Silver Wire. Office Wire. Flexible Brush Holder Cable.
Gas Fixture Wire. Arc Lamp Cords. Tinsel Cords. Flexible Cords.
Telephone, Telegraph and Electric Light Cables.
PARAGON TAPE.

JAMES F. KELLY, General Sales Agent. - 19 Dey Street, NEW YORK.

WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave., CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment. Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	[illegible]
Waterhouse	222	.....	222
Heisler	.....	500	500
Remington	159	[illegible]	459
Sperry	[illegible]	.....	130
Excelsior	90	.....	90
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,167
Edison	.....	13,858
American	1,537	[illegible]
United States	632	6,141
Schuyler	1,166	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,003
Van Depoele	450	.....
Waterhouse	[illegible]	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	100	.....
Excelsior	205	30
Hochhausen	70	.....
Weston	158	.....
Fuller	10	.....
Reliance	30	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%

	Arc.		Incandescent.	
	T. H. System.	All other Systems	T. H. System.	All other Systems.
Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Increase	5,843	4,402	36,229	40,652
Percentage of increase	52 7-10%	43%	410%	86 3-10%

PHŒNIX GLASS CO

OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES **SHADES**

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

THE HAWKEYE
ELECTRIC MFG. CO.,
DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station
AND
ISOLATED PLANTS,
ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

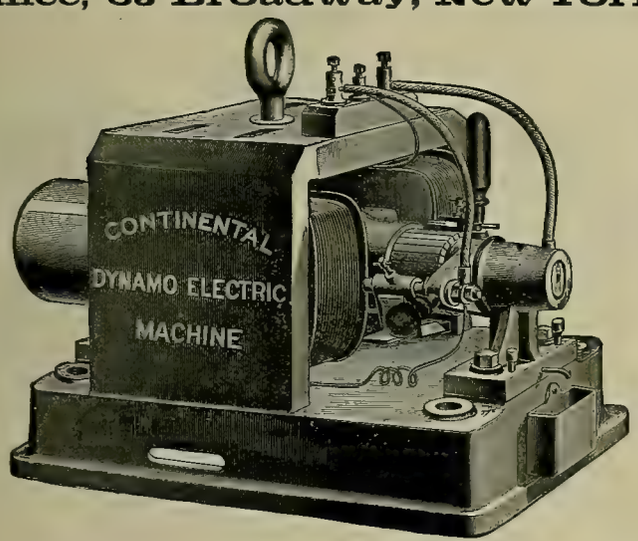
Licensee of the ***Renowned Perkins Incandescent Lamps,*** Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

CONTINENTAL DYNAMO CO.
DYNAMOS AND MOTORS,
Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

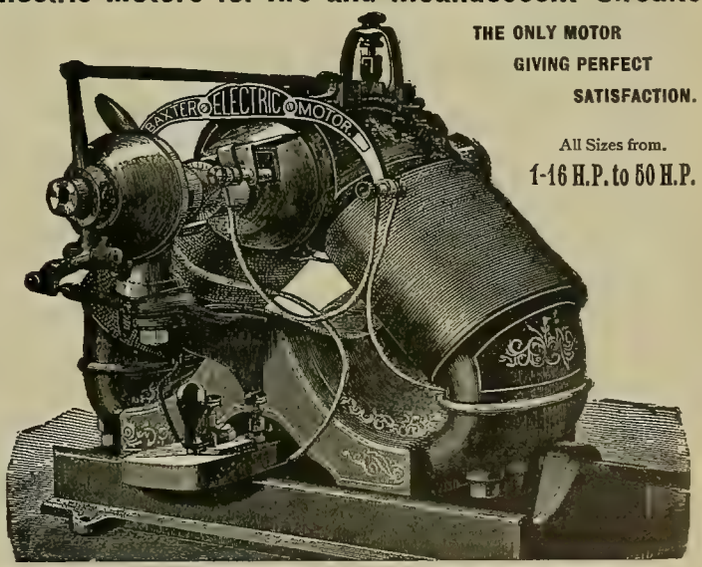
Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, Journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

To Arc and Incandescent
POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,
MANUFACTURERS OF
Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

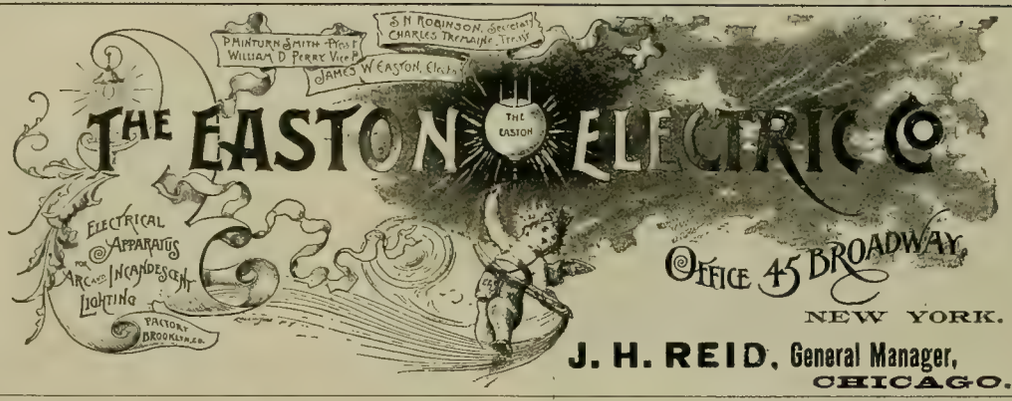
THE BAXTER ELECTRIC MOTOR CO.,
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



WESTERN ELECTRIC CO.,

WE ARE THE EXCLUSIVE WESTERN AGENTS FOR THE SALE OF

A. G. Dav's Kerite Wires for Telegraph, Telephone, and Electric Light Use.

PRICES ON APPLICATION.

CHICAGO. NEW YORK.

You Will Oblige

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

OHIO STATE UNIVERSITY,

COLUMBUS, OHIO.

Civil, Mechanical, Mining and Electrical Engineering. SEND FOR INFORMATION.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 10 AMPERES.

ADVANTAGES OF THE CROSBY DRY BATTERY FOR OPEN CIRCUIT WORK.

THE CROSBY DRY BATTERY is the **best Open Circuit Battery in the market.** It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing **more work** than any other. In addition to this, it is the **most reliable, most compact, most durable** and **simplest** cell yet discovered. It is so constructed that **it is not destroyed** or seriously injured by **short circuiting,** and we are prepared to prove at any time that its **power** of **recuperation** is proportionately greater than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks, and all the uses to which Open Circuit Batteries may be put, **it has no equal,** whether it be compared with **Liquid** or **other Dry Batteries.** We guarantee **depolarization, absence of offensive crystallization and perfect cleanliness.**

The Crosby Battery is the only Dry Battery sold **semi-charged (To charge it only a small quantity of pure water is necessary) It does not work until wanted.**

The preference as **between Liquid and Dry Batteries** should always be given to the latter, provided the amount of working power required and a constant current can be obtained. **No form of Dry Battery** has as yet been placed before the public, **except the Crosby Dry Battery,** which will do the work of Wet Batteries and **give a constant supply of Electricity sufficient for reliable Open Circuit work at all times.** The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with which their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance, and easily broken and injured. **The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids,** and, after once being properly connected, **requires no attention whatever,** while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.

The Crosby Battery is **not affected by temperature;** whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for **Open Circuit Work.** If, however, through an accident, it becomes **Short Circuited, it recoups itself.** This cannot be said with equal truth of any other Dry Battery known.

The Crosby Dry Batteries are manufactured in **different sizes and forms,** to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in **the Crosby Dry Batteries varies from one to ten amperes,** according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

CYLINDRICAL.

SIZE IN INCHES.

	Height.		Diam.
No. 3	7¼	x	2½

RECTANGULAR.

SIZE IN INCHES.

	Height.		Width.		Length.
No. 2	5	x	1½	x	4½
No. 3	9	x	1½	x	8

TELEPHONE.

SIZE IN INCHES.

	Height.		Width.		Length.	Price.
Long Distance	7½	x	2½	x	4¾	**$2 00**
Telephone	7½	x	2	x	4¾	**1.50**

N. B.—OTHER SIZES AND SHAPES TO SUIT PURCHASERS.

[COPY.]

OFFICE OF FLEMMING'S ELECTRO MEDICAL INSTRUMENT MANUFACTORY,
No. 1009 ARCH STREET, PHILADELPHIA, March 8, 1890.

CROSBY ELECTRIC COMPANY, New York.

GENTLEMEN:—The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan. 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29, when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan 30; 7.30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing.

Very respectfully, (Signed) OTTO FLEMMING.

THE CROSBY ELECTRIC CO., Judge Building, Fifth Ave. & Sixteenth St., NEW YORK.

GREAT WESTERN ELECTRIC SUPPLY COMPANY.

190 & 192 Fifth Avenue, CHICAGO, ILL.

ELECTRICITY IN MINES

REQUIRES EXTRA INSULATION.

SIMPLEX WIRE AND SIMPLEX PAINT

Give in Every Respect a Superior Insulation.

SIMPLEX WIRE

Weather-Proof.

Water-proof.

Its tough, compressed insulation resists abrasion.
Its pure caoutchouc gum will not harden.
Its even, seamless surface prevents leakage.

STANDS THE TESTS.

Use Simplex Wire in the dampest place in your mine plant or where it is most liable to abrasion.

Get a sample, put it into a bucket of water, connect the wire with one pole of a high potential dynamo, and the bucket with the other; see how Simplex Insulation stands practical tests.

SIMPLEX INSULATING PAINT.

Insures thorough Insulation in all mine work.

For Moldings, Cut-Outs, Etc.

Use it freely when installing your mine plants, and the gain in insulation and safety will well repay you.

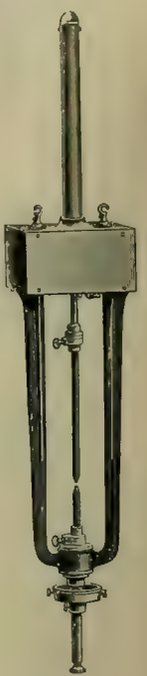
CATALOGUE IN PRESS.

THE

ONLY COMMERCIAL ARC LAMP

FOR

INCANDESCENT CIRCUITS.



Burning two in Series on Circuits of 100 to 120 Volts.

WILL USE EIGHT AMPERES OF CURRENT.

WE ARE PREPARED to furnish SERIES LAMPS for any PRESSURE, CONSTANT POTENTIAL.

These Lamps, when burning TEN IN SERIES, on 500-VOLT CIRCUITS, use 8½ amperes, and give a CLEAR, STEADY LIGHT.

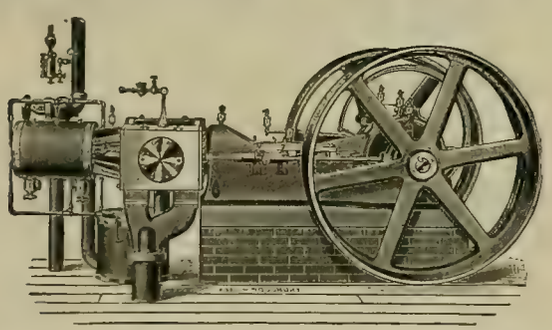
We guarantee our Lamps, Electrically and Mechanically.

PLEASE STATE SYSTEM AND VOLTAGE USED. ADDRESS

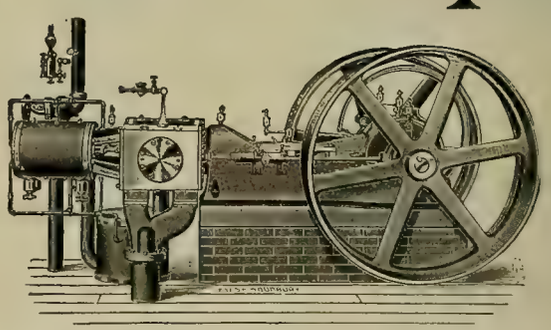
ELECTRIC CONSTRUCTION & SUPPLY CO.,

18 Cortlandt Street, NEW YORK.

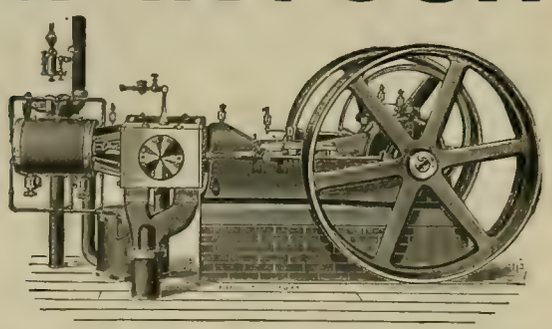
None so Good, None to Equal.



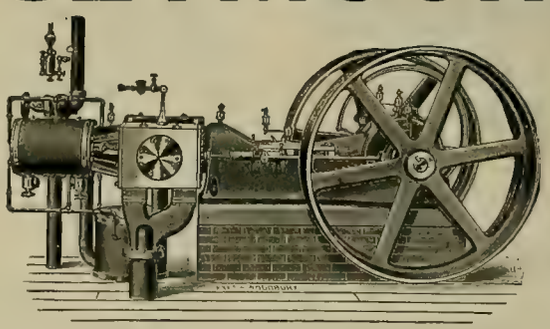
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

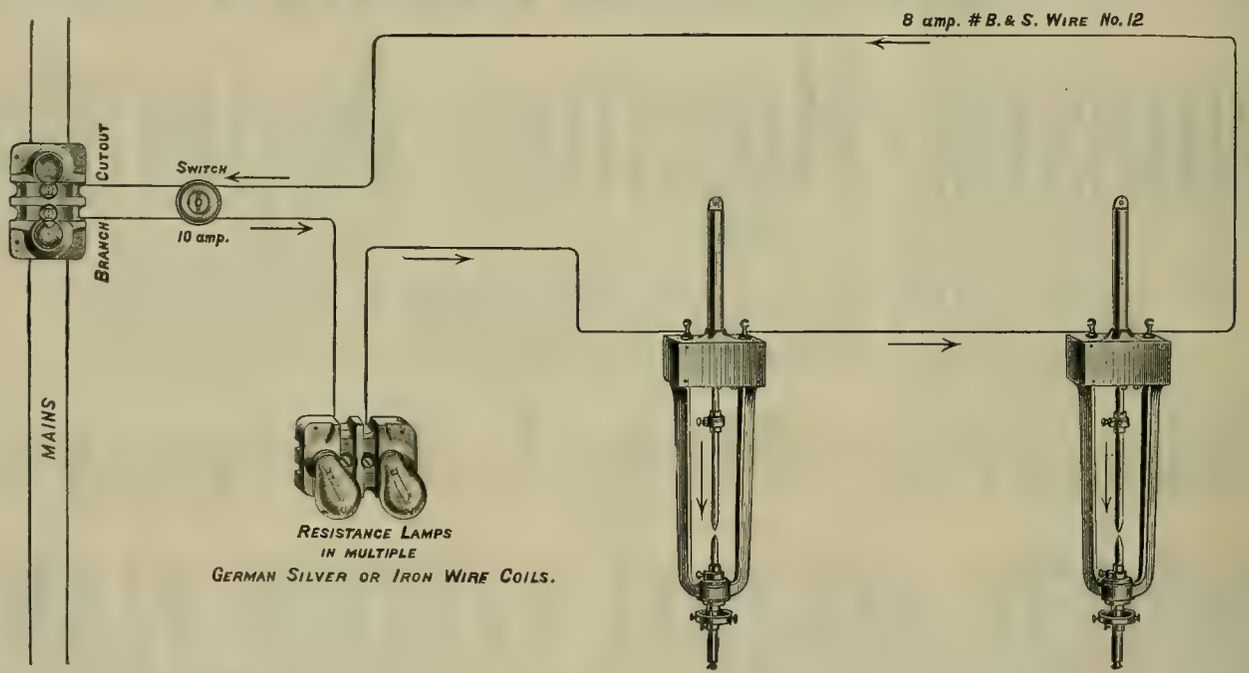
We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

EDISON

GENERAL ELECTRIC CO.,

EDISON BUILDING,
BROAD ST., NEW YORK CITY.

LIGHT & POWER DEPARTMENT.



ARC LIGHTING FOR INCANDESCENT CIRCUITS.

WIRING DIRECTIONS:

In installing these lamps, a branch cut-out should be put in at the mains. and the wire of the leads to the arc lamp should be of a size sufficient to carry the current, 8 amperes, with the usual drop in practice for multiple arc work.

A ten ampere fuse should be used in the cut-out. Place in the positive lead, leading to the arc lamp, a resistance of about one ohm for each ten volts above 90 volts, the amount used by the two lamps in series.

For short runs we use No. 12 B. & S. wire, and for longer runs in proportion All the joints should be securely made.

The current passes through the lamp from the top or positive carbon to the bottom carbon, and the direction of the current can be told by the carbons; that is, the hottest one at its point being the positive carbon. Should the lower carbon be the hottest, when current is turned on the lamp, simply reverse the connections where the current enters the lamp. and the desired result will be produced.

For inside lighting we furnish specially made incandescent lamps for resistance, and use a branch cut-out wired so that the two resistance lamps are connected in multiple, their resistance being of the proper amount, according to the voltage of the circuit on which lamps are connected.

For outside lighting we use a resistance best suited to the position in which the lamps are to be placed, and have a hood, specially designed, containing a resistance which is interchangeable, and can be adapted to varying voltages. The hood is so connected up that, when the lamp is hung within the hood, both lamp and resistance are in the circuit.

The alignment of the lamp should be carefully looked to, the fixture carrying the lamp should be well guyed, and porcelain insulators should be used between the fixture and the hood carrying the lamp.

A ten ampere switch to control each pair of lamps should be placed in the most convenient position.

CHIEF EXECUTIVE OFFICE, EDISON BUILDING, 44 BROAD ST., NEW YORK CITY.

DISTRICT OFFICES:

Chicago, Rialto Building. San Francisco, Chronicle Building. New Orleans, Cotton Exchange. Denver, Col., Masonic Building. Portland, Oregon. Toronto, Can., Bank of Com. Building.

FACTORIES:

New York City. Schenectady, N. Y. Harrison, N. J. Hamilton, Ontario. Sherbrooke, Quebec.

ST. LOUIS ELECTRICAL EXHIBITION,

Sept. 3,--Oct. 18, 1890.

Parties desiring space at the coming exhibition should apply **AT ONCE**, as the number of applications already received occupies nearly all the available space.

FREE SPACE, FREE POWER AND FREE FREIGHTS

Are offered to all, and an attendance of over one million people is assured.

GOLD MEDALS Will be awarded by a competent committee, and everything done to advance the interests of Electricity. All the leading manufacturers have secured space, and the exhibit will surpass anything of the kind ever seen in America.

WRITE FOR PARTICULARS TO

FRED. H. WHIPPLE,

GENERAL MANAGER, DETROIT, MICH.

BERGMANN & CO.,

ELECTRIC LIGHT, COMBINATION

AND

GAS FIXTURES,

ADAPTED TO ANY SYSTEM OF INCANDESCENT LIGHTING.

ALL APPLIANCES FOR THE EDISON ELECTRIC LIGHT.

Illustrated Catalogues, Designs and Estimates Furnished on Application. Correspondence Solicited.

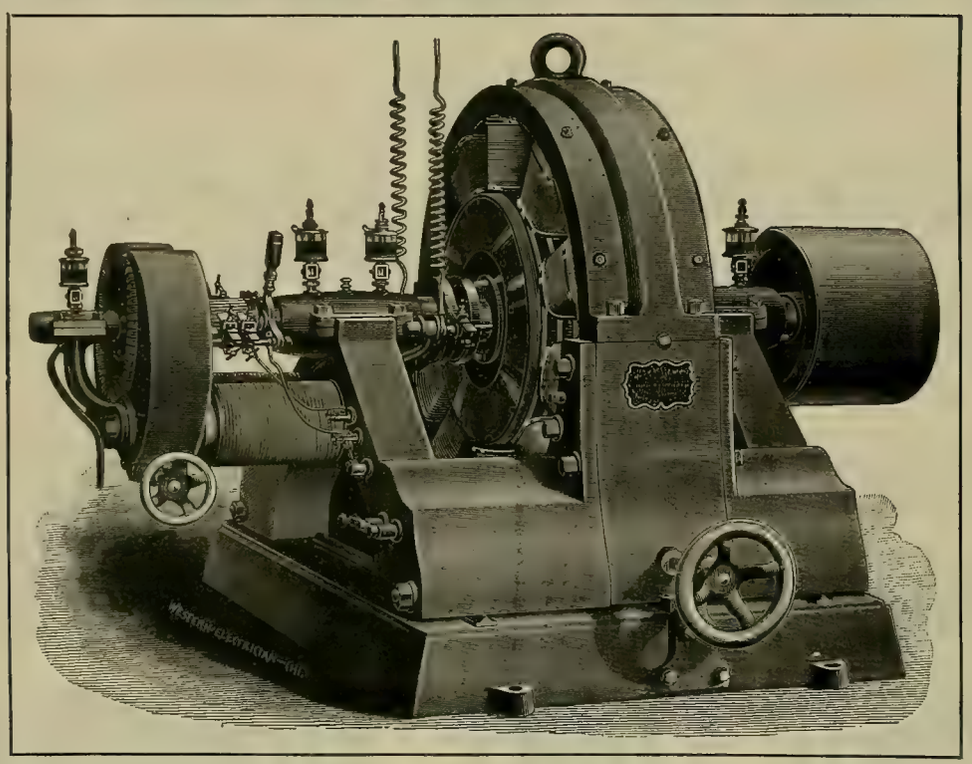
Office and Works, 292-298 Avenue B, } **NEW YORK** { Show Rooms, 65 Fifth Avenue.

T. W. WILMARTH & CO., 227 State Street, CHICAGO, ILL.

AGENTS FOR OUR FIXTURES IN THE NORTHWEST.

THE BEST OF ALL

THE NATIONAL
TRANSFORMER SYSTEM
OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts.,
Seattle, Washington.
THOMAS WOLFE, Southwestern Agent,
Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.,
141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.,
1517 Larimer St., Denver, Colo.

CHAS. M. BLANCHARD, Agent,
Girard Building, Philadelphia, Pa.
L. N. COX, Agent,
16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent,
Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts.,
531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

AUTHORITIES TALK.

Sir Wm. Thomson, F. R. S., and Dr. John Hopkinson, F. R. S.

— VERSUS —

Mr. Bottomley and Mr. Harber.

Sir WILLIAM THOMSON, F. R. S.

The University, Glasgow,
June 19th, 1890.

I have tested the insulation of two specimens of Okonite Wire sent to me recently, and have found thoroughly satisfactory results for all ordinary temperatures and potentials.

The thickness of the Okonite in these specimens was 1.8 millimetres (.072 of an inch), and its insulation resistance held good up to **7,500** volts. After the passing of current through it at this very high potential for some time, I found the insulation resistance for ordinary potentials only reduced from 6,700 (its original value) to 4,500 megohms per statute mile at 16° Cent.

I am well acquainted with Dr. Hopkinson's tests of December, 1886, which were submitted to me early in 1887, and I know the results of his recent tests of the same specimens, showing no deteriorations, but actually an improvement, in the insulating quality after three-and-a-half years' keeping.

I have also seen the published certificates of many practical men of different dates from March, 1886, to December, 1888, which give trustworthy evidence of the practical success of Okonite Wire for telegraphs, telephones, and electric light and power.

With this evidence before me, in addition to my own electric tests and examination of the insulating material in respect to toughness and other mechanical qualities, I believe Okonite to be a very valuable material for the insulation of electric conductors in a large variety of practical uses.

(Signed.) WILLIAM THOMSON.

Dr. JOHN HOPKINSON, F. R. S.

Westminster Chambers,
5 Victoria Street, S. W., June 19th, 1890.

In December, 1886, I made a series of careful and somewhat elaborate experiments upon Okonite Wire, and fully reported upon the same. My report, of which I append a copy, was as complete as it could be at the time. One point it was then impossible to determine, and that, practically, the most important point of all, namely, the question of the durability of the insulation.

It is almost impossible, in most instances, to judge of the suitability of any particular insulating compound for wires **until it has stood the test of time for some years.** It so happened that samples of Okonite Wire that I tested in 1886 had been left with me, and have remained in my possession ever since, parts of the same having been used in my laboratory and for various other purposes.

I have now again tested these samples, and append the tests, together with the results obtained in 1886. In the case of A and C, the test is after one minute's electrification; in the case of B_1 and B_2 the test is a mean during an interval from one-half minute to five and one-half minutes from first electrification; the temperatures are practically the same, viz.: 15°5C. in 1886, 15°C. now. Samples A and C have been immersed in water for five days, B_1 and B_2 for a shorter time. B_1 is a sample which had been twisted in 1886 for the purpose of ascertaining whether the material would stand mechanical disturbance. B_2 had six kinks made in it for a similar purpose.

A, in 1886	6,180	A, now	7,000	...	Megohms per statute mile.
C, in 1886	7,590	C, now	11,680	...	do. do. do.
B_1 in 1886	5,435	B_1 now	11,740	...	do. do. do.
B_2 in 1886	4,750	B_2 now	13,700	...	do. do. do.

In my last report I stated that I was most favorably impressed with the qualities of the wire, both on account of its high insulation and mechanical reliability. Tests on the samples proved that the **insulation was practically perfect,** both for high and low potentials, and that the insulation would stand very rough handling and a considerable temperature, without injury, and indeed with but slight reduction of its insulation resistance. I can now add that the **result of time has shown** that not only is the insulation excellent when made, and that it will stand mechanical disturbance, **but that for a term of three-and-a-half years it is perfectly durable, and remains as good as at the first.**

(Signed.) J. HOPKINSON.

Buy the wire that stands the test of the highest authorities in the world and is ordered in 1,000,000 feet lots by the largest buyers.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable System.

LOOK OUT!!

FOR

NOVELTIES

IN

ELECTRICAL SUPPLIES

DISPLAYED BY THE

SAWYER-MAN ELECTRIC CO.

AT THE

CAPE MAY CONVENTION.

DIRECT CURRENT ARC LIGHTING

THE Westinghouse Electric COMPANY, PITTSBURGH, PA.

No further need for Double Carbon Lamps. The problem solved by this company.

One pair of carbons one inch wide and three-eighths of an inch thick, with a single mechanism, will run eighteen hours.

All Double Carbon Lamps may be improved and simplified.

The substitution of a single flat carbon will effect great economies and greater certainty of operation.

The Westinghouse Electric Company is prepared to grant licenses for the use of this valuable improvement on reasonable terms.

Lamp experts can be sent to overhaul your lamps at moderate expense. Send sample of double lamp you desire to have made over.

CORRESPONDENCE SOLICITED.

THE WESTINGHOUSE ELECTRIC COMPANY, PITTSBURGH, PA.

Boston, New York, Cincinnati, Chicago, St. Louis, San Francisco, Portland, Dallas, Charlotte.

BURNLEY DRY BATTERY

PATENTED January, 1890.

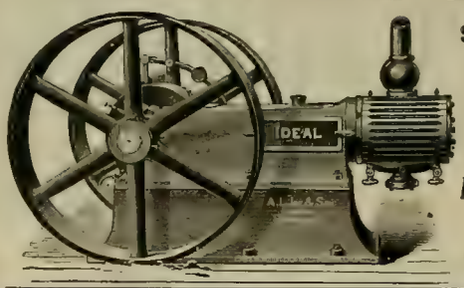
STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:—Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

THE IDEAL ENGINE.



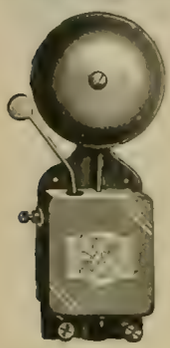
Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street

HAZAZER & STANLEY,



ELECTRICAL HOUSE FURNISHINGS,

32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

Messrs. Hazazer & Stanley.

GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

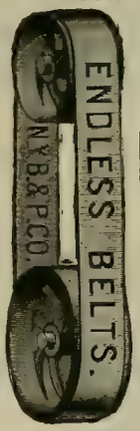
Yours truly, *CHAS. E. GOODRICH, Electrician, 503 Eighth Avenue.*

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
ST. LOUIS, 907-911 N. Main St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 13?1 and 1313 W. 12th St.
RICHMOND, 1206 East Main St.

WHAT IS CANVAS JACKET?

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

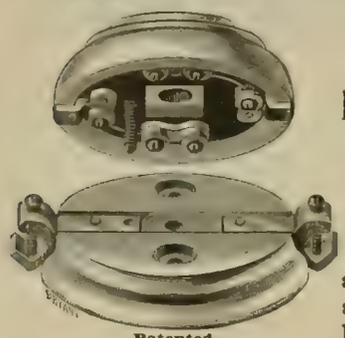
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.



DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

Patented.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.

Kept in Stock and for Sale by all Prominent Supply Houses.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co

MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

—THE—

Celebrated P. AND B.

ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

59 Maiden Lane, - NEW YORK.

Western Electrician.

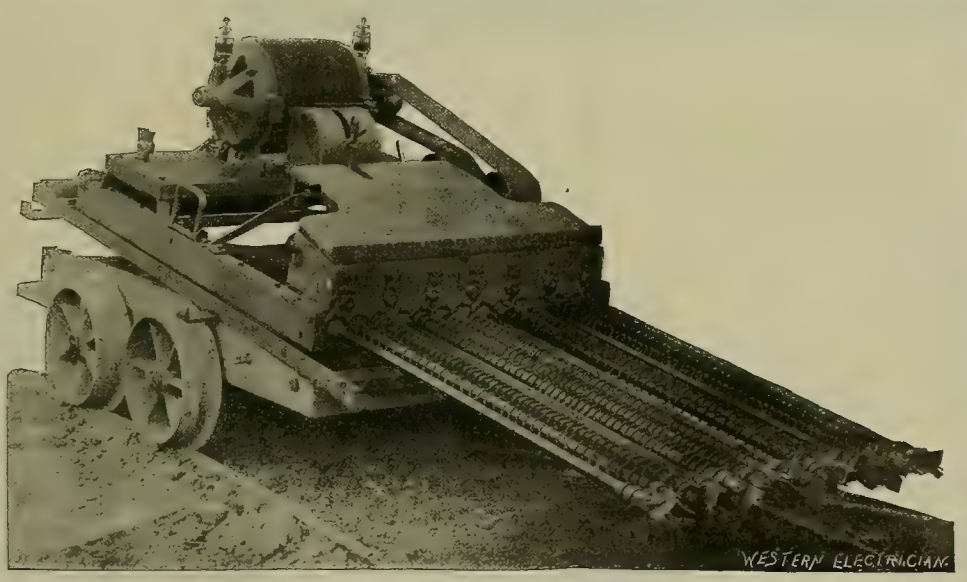
EVERY SATURDAY.

Vol. VII. CHICAGO, AUGUST 9, 1890. No. 6

Alternating Current Motors for Mining Work.

The Willock mine, belonging to the Monongahela Gas Coal company and situated in the first pool of the Monongahela coal region is now operated with a complete alternating current motor plant. The machines furnish power in the production of coal, the working of the pump and also in the operation of an enormous ventilator which keeps a constant draught of pure air in the mine. In addition the mine is illuminated by the alternating current system.

The cut represents the Hercules mining machine equipped with the Tesla alternating current motor of the Westinghouse company used in the mine. This is the first mine in the Pennsylvania coal region where the alternating current system is utilized extensively. A correspondent of the WESTERN ELECTRICIAN who recently visited the mine was much indebted to John Werner, the mine foreman, a man who is himself a mechanical genius of no mean standing. During a conversation with him, he said: "I believe that electric mining has no greater prospects anywhere than just in the coal fields of Pennsylvania. The reasons for this are so many that I hardly know where to commence to enumerate them. Coal mining in Pennsylvania was never such a poor trade as it is now, in fact it is so bad that a native born American will have nothing more to do with the work. The result has been that the business has fallen into the hands of foreigners of the very lowest class, such as Hungarians, Poles and Italians. Then again the price of coal has gone down to such an extent, the result of course of competition, that it is impossible to get any intelligent men who will do the work for the small wages a miner is able to make. This condition of affairs caused the coal operators to hail the application of electricity to a coal mine with great satisfaction and I believe that it will not be long before every mine in the country will be operated by electricity. The advantages afforded by electricity in the operation of a mine are so manifold that its use is bound to become general. For instance, where a coal digger was able to earn on the average $2.25 per day, the machine miner makes $3. Why? because while the operator pays the miner less for the production of each ton of coal, the man can produce so much more with the aid of his machine that he can make better wages now and the work is less laborious. The operator pays the coal digger $0.79 per ton of coal, but the production of each ton with the aid of electricity costs him only $0.49, so you see there is a pure gain for the operator of $0.30 for each ton."



ALTERNATING CURRENT MOTORS FOR MINING WORK.

The electric plant consists of a thirty horse power quarter phase generator of a capacity sufficient to carry seven motors when cutting coal, at the limit of the capacity of the coal company. The generator is self-acting, self-regulating, and so wound that as the load increases, the e. m. f. rises. By the aid of a hand rheostat, the adjustments can be so made that the falling off in the speed of the engine and the drop in the line may be compensated for and a very close approximation to constant e. m. f. at the motors is obtained. After the hand rheostat is once adjusted, it is unnecessary to make further adjustments for the self-regulating devices are automatic. Three wires from the collector at the end generator shaft pass from the switch-board and main line switches directly into the mine. On the switch-board is a direct reading voltmeter and an ammeter. The e. m. f. at the motor is 300 volts, in this installation.

Where the distance becomes very great, a higher e. m. f. may of course be used. The mine is wired with high class rubber covered wire and the insulation of each wire is practically continuous from the time the wire leaves the main switch in the power house until it reaches the end of the circuit. At the entrance of each room and also at convenient points through the mine, switches are located and safety catches inserted. This insures safety from short-circuiting and also allows any portion of the circuit to be cut off from the generator without interfering with the work in other parts of the mine. From the switch in the room to the coal-cutting machine the current is carried by a three-wire cable. This cable is highly insulated and covered with a protecting braid, so that though it is frequently allowed to lie on the damp floor and even in pools of water, yet no inconvenience is noticed arising from this. It is necessary only to have a jaw switch at the motor with which the circuit can be opened and closed. No regulator of any kind is used. The only auxiliary apparatus connected with the motor, with which the operator of the machine has anything to do, is the switch to turn the current on and off. The motor is completely covered and there is no possible chance of getting a shock through careless handling, it is claimed.

The gas light committee of the San Francisco Board of Supervisors has awarded the city contracts, the price paid the California Electric Light company being for each mast of 16,000 candle power, $4.40 per night, and 55 cents per night for each mast of 2,000 candle power.

Chicago & Lake Shore Electric Railway Company.

The Chicago & Lake Shore Electric Railway company has been incorporated to construct and operate an electric road for carrying passengers and freight from Chicago to Fort Sheridan by C. H. Remy, George O. Fairbanks and F. L. Brooks.

The plans of the company have not yet been completed, but it is probable that operations will be begun at an early day. The company is capitalized at $1,000,000. Ground will first be broken on the North Side, Chicago, it is believed, and then the work of construction will be pushed ahead. The line proposed extends to the northern limit of Fort Sheridan, 25 miles from Chicago, and it will therefore be seen that the enterprise is one of more than usual magnitude.

Electric Fountain at Chicago.

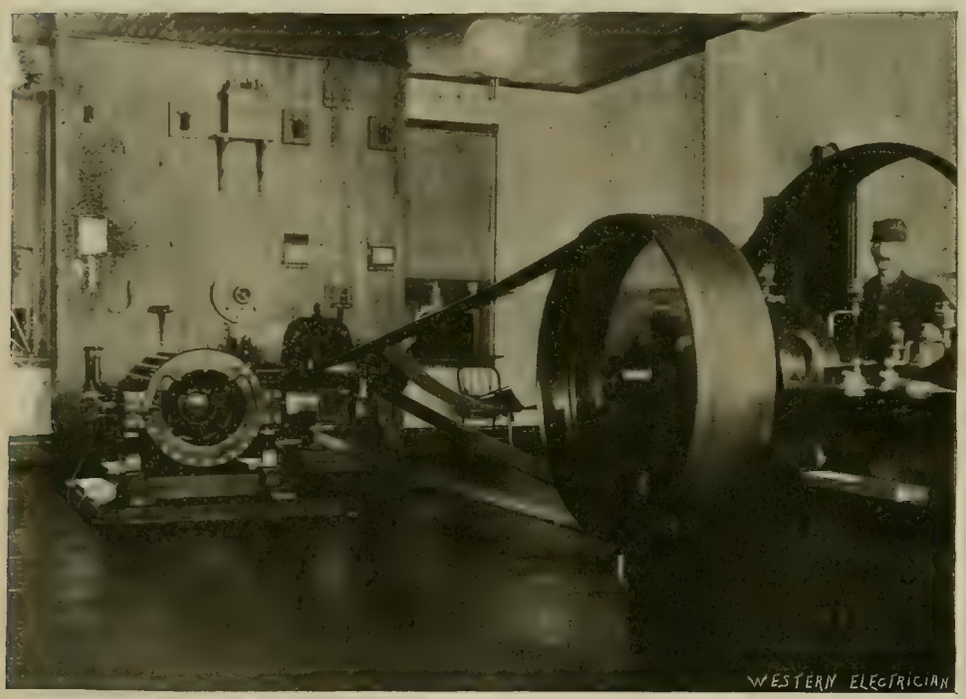
Another interesting feature has been added to the wealth of attractions at Lincoln Park, Chicago. It is an electric fountain presented the city by Charles T. Yerkes and constructed at a cost of $50,000. The fountain was recently completed and when tested proved thoroughly satisfactory. The electric and steam plants have not yet been completed, however, but it is hoped everything will be in readiness within a couple of weeks. The generating station will be at the greenhouse and the wires leading to the fountain, which is near the Grant monument, have been placed underground. Eight 4,000, candle-power arc lamps will be placed in the fountain. The dynamo and lamps are of the Brush type. As the fountain will only play at night the water pressure, it is thought, will be sufficient to throw the stream to the height of seventy-five feet. The fountain, with its electric light effects, will be one of the most beautiful in the world.

Smoke Nuisance in Chicago.

The Chicago Edison company has decided to make arrangements at an early day to burn hard coal instead of soft coal in its Adams street station, thus leading in the movement to abate the smoke nuisance which has so long afflicted the city. This is a practical step and deserves commendation. Smoke consumers, so-called, have failed in Chicago, and they have been thoroughly tested, it is claimed. The only hope for relief seems to be in the general adoption of the electric motor in the business districts to supplant the numerous steam engines When electric motors are used to hoist elevators, operate machinery, etc., on the scale they should be the city will not be constantly under a cloud. True, the motor field is being developed rapidly but the people of Chicago generally have not begun to realize the necessity of making the change to electric motors.

Dynamo Room of the Livingston, Mont. Electric Light Company.

In the accompanying cut is given a view of the dynamo room of the Livingston Electric Light company of Livingston, Mont. The two generators are of the Thomson-Houston make. The alternator is of 650 lights' capacity, and the arc machine has a capacity of twenty lights. The compound condensing engine, which operates the dynamo, is of the make of McIntosh & Seymour.



DYNAMO ROOM OF THE LIVINGSTON, MONT., ELECTRIC LIGHT COMPANY.

Electric Heating.

In the illustration presented herewith is given a view of the pressing room in the factory of F. P. Seavey & Co., clothing manufacturers, Minneapolis. Nine pressing irons heated by electricity are used. One of these irons is attached to a pressing machine worked by a treadle. Before electricity was used for heating, the iron was provided with a hollow shell, into which fitted a heated slug. Considerable time was lost in changing slugs; this time is now saved, and the fact that the temperature is constant has greatly increased the serviceability of the apparatus. Before the electric irons were installed in the factory ten operatives were needed to do the work which now rarely requires more than six hands; at the same time the capacity of the factory has been increased nearly 20 per cent The plant was installed by the Carpenter-Nevens Electro Heating company of Minneapolis.

C. E. Carpenter, the inventor of the irons which are used in the factory, writes as follows in regard to some of the defects which had to be overcome in the design of irons:

Many difficulties have attended the development of a successful electric heater as applied to sad irons, soldering irons and similar utensils. Prominent among these difficulties to be overcome, has been the deterioration or burning-out of the resistance used. Another difficulty consisted in placing the resistance upon a surface which alone was to be heated. The resistance must make good contact for the conduction of the heat evolved, and yet the injurious effects of the linear expansion of the wire or the metal used, must be avoided, otherwise friction with expansion and contraction would result. It was also found difficult to pass sufficient current through the resistance to raise the temperature high enough to keep the surface plate or body hot when using. All of these difficulties have been overcome in the following manner: By using the "zig-zag" wire resistance a large amount of wire can be made to cover almost completely a surface without bringing any portion into contact with any other portion, and so produce a short circuit. By this means also magnetism and self-induction are also practically avoided, as well as the injurious effects resulting from the expansion of the wire, which is very slight. The elements in contact are sufficiently elastic to admit of this expansion without friction. To avoid burning out the resistance, it has been necessary to prevent the wire from attaining that critical temperature at which the conductivity of a metal is altered resulting from a molecular change produced by the combined action of high temperature and the electric current. This danger has been avoided by improving the conductivity for heat of the electrical insulating element between the wire and the surface of the body to be heated, so that the difference in temperature between the heater and the heated surface shall be as small as possible. The wire cannot reach, therefore, such a temperature that deterioration takes place, without first heating the working parts of the apparatus far more than is necessary for practical use.

To improve the conduction of heat of the electrical insulator between wire and plate, it is necessary that the joint formed between the different elements should fit as closely as possible, which is accomplished by the use of a compressing plate, as illustrated and described in the last issue of the WESTERN ELECTRICIAN, where screws passing through the compressing plate engage threaded sockets in the body to be heated. A further advantage is gained by the use of pressure in promoting the conductivity for heat. By the use of a metal such as iron, the electrical resistance of which increases with an increase of temperature, the apparatus is made quite self-regulating, so far as temperature is concerned; since when the working parts are cold the resistance cannot become much heated until the plate itself becomes hot, which reacts upon the resistance, raising its temperature, which in turn increases its resistance and checks the flow of current.

It has long been thought by practical electrical engineers and others, that electric heating could not be economical with the present method of producing current. While there is twice as much heat in gas and other means of heating as electricity, the electric heater is still economical, from the fact that, if properly constructed, all of the electrical energy supplied to such apparatus can be used in doing useful work, while with gas, for example, this is not the case. This fact will be appreciated in considering the great loss in the heating of such utensils as sad irons. For example, in laundries where gas is quite generally used for this purpose two irons are used with one operator. The surface of these irons is radiating heat, the one losing heat for this reason while being heated, and the other losing heat from the top and sides, principally by radiation while in use, and by conduction in evaporating moisture in the material ironed. It will be seen therefore, that there are two radiations and one conduction, or three losses, which in ordinary practice are nearly equal. In the electric iron where the top and sides of the iron do not become heated, two of these losses have been eliminated, a result which makes it more economical. The same fact may be stated regarding the use of soldering irons, especially where the heat is confined to the point of the iron.

Great saving is also found in the use of the iron for baking griddle cakes; the electric iron which consists of a very thin plate under which the heat is distributed almost perfectly and equally. It very quickly heats the surface plate when required for use. In the use of gas for this purpose, it becomes necessary to use a plate of considerable thickness for conducting and distributing the heat equally throughout the plate, as gas does not equally heat it. The plate must be kept heated constantly so as to be ready for use between certain hours, in hotels and restaurants, but the electric iron is always ready at a moment's notice and only takes current when in actual use. The use of iron wire in good contact with the plate, so that the plate becomes heated rapidly to the temperature required, adds materially to the convenience of this apparatus as well as the economy.

ELECTRIC HEATING.—VIEW IN A PRESSING ROOM.

The Parrish Electric Light, Power & Heat company has been incorporated at Nevada, Miss.; capital stock, $120,000. Samuel Brown is president, and Eugene Parrish secretary.

Contact Device for Electric Railways.

A novel method of making contact with the overhead conductor of an electric railway is represented in the illustration. The arrangement is the invention of Frank J. Sprague. For making contact Mr. Sprague employs two arms in the form of rollers instead of the ordinary trolley wheel. The rollers, Fig. 1, are placed above the car in proximity to each other and in

FIG. 1. CONTACT DEVICE FOR ELECTRIC RAILWAYS.

a substantially vertical position, as shown. Fig. 2. These arms or rollers are free at their upper ends, and at their lower ends are supported by springs. They are free to move on their supports, and are so situated that when the car is in operation they extend up one on each side of the overhead conductor and both in contact with it. The conductor is clasped between the rollers, and by it they are both inclined away from each other to some extent and meet it at an angle, so as to make an underneath or upward pressure contact. A cord is attached to each roller, as indicated, and extends to within reach of the motor man. The advantage claimed for this

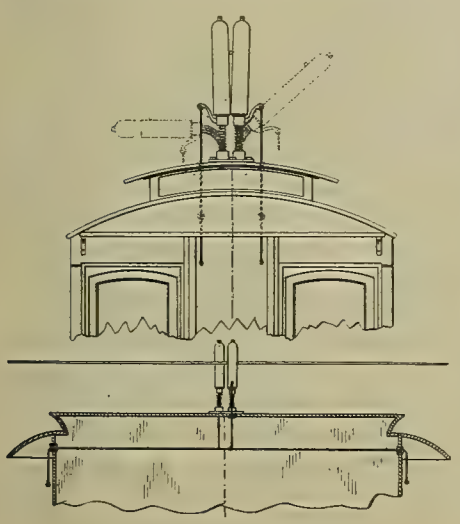


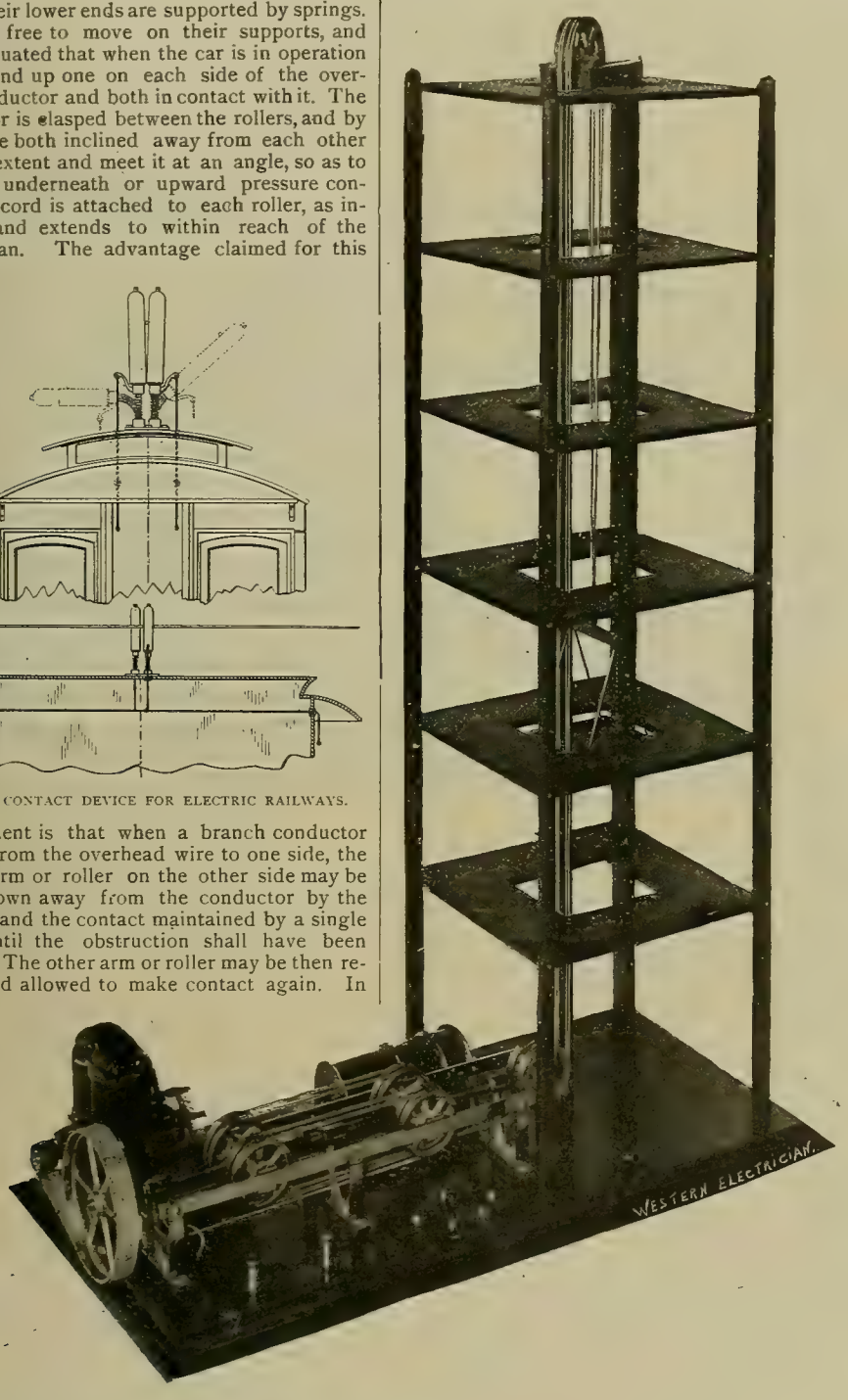
FIG. 2. CONTACT DEVICE FOR ELECTRIC RAILWAYS.

arrangement is that when a branch conductor extends from the overhead wire to one side, the contact arm or roller on the other side may be drawn down away from the conductor by the operator and the contact maintained by a single roller until the obstruction shall have been passed. The other arm or roller may be then released and allowed to make contact again. In passing switch-plates interpolated in the conductor either or both of the rollers may be drawn down by hand, so that they pass under the switch-plate, making an underneath contact, or being flexibly mounted, they may themselves be depressed by the pressure of the switch-plate, so as to pass beneath the same.

Electrical Elevator.

The accompanying cut illustrates a model of an electrical elevator which contains some interesting features. The machine was designed with a view of obtaining a perfectly smooth quick motion directly from an electric motor, without the intervention of an hydraulic system gearing or belts.

The simplicity of the machine is seen at a glance. The traveling sheaves run to and fro on a revolving screw, which is geared to an electric motor of ample power. The motion of the car is controlled entirely by the motor. This is started by a switch in the car. The safety devices on the car are the same as ordinarily in use on the best makes of elevators, and an extra safety device on the traveling nuts prevents the elevator from going too far up or down in the hatchway. It is perhaps needless to point out that should anything happen to the motor or machinery, it is evident that any weight on the car cannot revolve the screw. The screw-shaft is mounted on three pillars of cast iron. The uppermost part of these contains the bearings for the shaft. From the center of the screw to the ends the threads are respectively right and left handed. Mounted on the ends are sliding nuts, each of which has two horizontal arms at right angles to the shaft. On these arms are placed the traveling sheaves, generally two double grooved sheaves on each side, over which the ropes are wound. The ropes are securely anchored to the pillars farthest away from the elevator, and then pass through the hatchway to the car.



ELECTRIC ELEVATOR.

The electric motor is a series wound machine made reversible, and of ample power. The motor is geared directly to the screw shaft, and is of a low-speed type. It is under perfect control of the operator in the car. The motor switch, it may be mentioned, is similar to the device used for controlling the speed of electric railway cars, and is connected with the stopping and starting rope. Chadbourne, Hazelton & Co., Philadelphia, are handling this elevator.

Detecting Irregularities in Railroad Tracks.

The apparatus illustrated in the cuts was designed for the purpose of facilitating the detection of irregularities in railroad tracks. The device is attached to a car which is run over the tracks that it is desired to inspect. At points

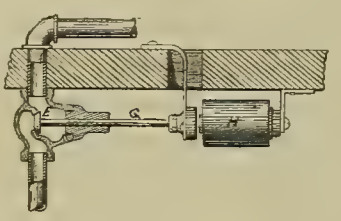


FIG. 1. DETECTING IRREGULARITIES IN RAILROAD TRACKS.

where one track is higher or lower than the standard a valve connecting with a vessel containing some liquid coloring material such as paint is opened and sufficient fluid escapes to mark the spot. The track repairers following the car will have their attention called to the faulty points by the paint spot.

From a bar on the car are suspended two electro-magnets which are located near two valve stems. When the current from the bat-

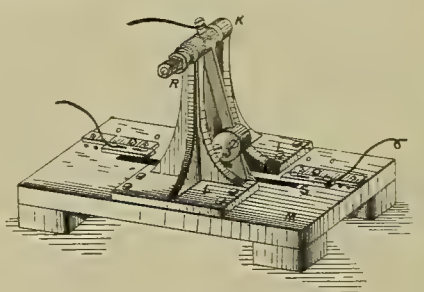


FIG. 2. DETECTING IRREGULARITIES IN RAILROAD TRACKS.

tery in the car enters the coils the ends of the valve stem in proximity to the magnet are attracted and the valves are opened. In Fig. 1 *H* is the electro-magnet, *G* the valve stem and *E* the valve. The magnets are connected to a circuit maker and breaker illustrated in Fig. 2 which consists of a pendulum or vibrating bar *J* suspended on a short shaft *K*, journaled in bearings in upper ends of two opposite brackets *L L*, mounted on a base-piece *M*, made of non-conducting material, and having a longitudinal slot *S* in it, through which the end of

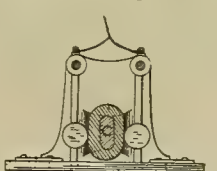


FIG. 3. DETECTING IRREGULARITIES IN RAILROAD TRACKS.

pendulum *J* depends and moves, and at opposite ends of the slot at one side are metallic pieces *O O*, with which pendulum *J* will contact if sufficiently vibrated. The pendulum *J* is connected by wire *P* with a battery, and the pieces *O* are respectively connected by wires, so that if the pendulum comes in contact with either plate an electrical circuit is established through the armature and battery so long as the contact between the pendulum and plate continues. The pendulum is suspended in insu-

lated bearings, so that there is no electrical communication between it and the brackets, and its shaft *K* is extended through one of the bearings and has a coiled spring slipped on it and retained by washers and nuts *R* on the threaded end of shaft *K*, as shown. This spring acts to pull the shaft outward and cause pendulum *J* to bind in its bearings, so that it does not vibrate too freely, and nuts *R* permit the tension of the springs to be regulated.

Two pendulums may be used as shown in Fig. 3, and this is the more preferable arrangement.

These two pendulums swing side by side, and

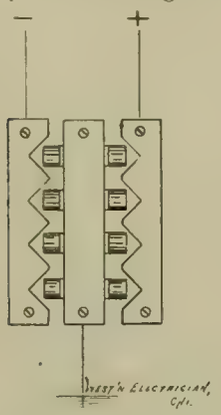


FIG. 1. PERCUSSION CAP LIGHTNING ARRESTER.

are prevented from striking together by means of an impact cushion *C*.

The operation is briefly as follows: The apparatus mounted on the car is carried over the road at a fixed and uniform rate of speed. Owing to the mounting of the pendulum it can only swing in a plane perpendicular to and transversely of the track. Experiment has determined the fact that when so arranged the pendulum or pendulums will remain at rest and perpendicular to the plane of the track so long as the latter is mathematically and practically correct for the speed at which the car is moving, even when rounding curves. When, however, one side or the other of the car is elevated or depressed by irregularities in the track-rails, one pendulum moves by gravity toward the lower side of the car, and if the irregularity of the track-rails is so great as to cause the pendulum to move into contact with one of the plates *O* an electric circuit is established from the battery through one of the electro-magnets, which, as described, causes the opening of a valve in a pipe leading from the fluid-reservoir on the car, and permits the escape of fluid upon the ends of the cross-ties at that side of the track which is too low. As soon as the

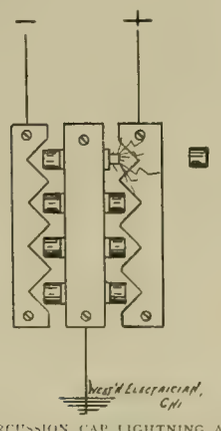


FIG. 2. PERCUSSION CAP LIGHTNING ARRESTER.

pendulum moves back into a vertical position the circuit is broken, and the flow of liquid ceases, as the valve is closed by counteracting springs or the action of the escaping fluid thereagainst. The inventor is John Bolan Grover of Marietta, Ga.

Percussion Cap Lightning Arrester.

The accompanying diagrams illustrate a novel modification of a comb lightning arrester, recently invented by J. J. O'Connell, electrician of the Chicago Telephone company. In this arrester ordinary percussion gun caps are employed to break the arc which often follows the static discharge. The heat produced by the current when an arc is formed explodes the cap. This action blows out the arc. The caps are placed on the teeth or nipples of the center piece, as shown. This piece which connects with the ground is raised a little above the two outside combs to facilitate the insertion of the caps. Mr. O'Connell states that he has put this arrester to a practical test, and that it has worked admirably. Figs. 1 and 2 show the simplest form of the arrester. In Fig. 2 one of the caps is at the point of explosion.

Figs. 3 and 4 show an improved modification of the invention. Fig. 4 represents the device in action. In this form of arrester the percussion caps are placed upon insulated nipples. Resting upon each cap, as represented, is a metallic flap or hinged-piece. This piece connects with the ground. The line connections are little pointed metal rods set close to but not touching the caps on the nipples. To provide for a succession of discharges the arrester may be fitted with any number of flaps and nipples. The action of the device may be explained in a few words: The static discharge jumps the small air space between a metal point and one of the row of percussion caps. This action starts an arc at this point, and the heat thus produced explodes the cap. As this explosion throws up the hinged-flap, and as the nipples are insulated, the ground connection is broken and the arc is thus extinguished. After the explosion the flap falls back into place again.

National Electric Light Association.

Appended is a list of topics prepared by the committee on papers of the National Electric Light association for the convention at Cape May August 19th. The name following the topic is that of the member who has been asked

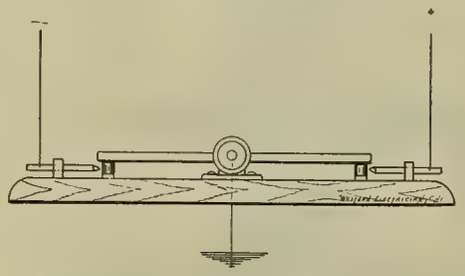


FIG. 3. PERCUSSION CAP LIGHTNING ARRESTER.

to prepare a paper or open the discussion on the subject. The list follows:

Electrical Industries and the World's Columbian Fair—J. P. Barrett, Chicago.

Electric Light as Supplied to Steam Railroads—W. H. Markland, Altoona, Pa.

Standards of Economy in the Generation of Power and Steam under best Conditions--Editor of *Power-Steam*, New York.

Triple Expansion High Speed Engines for Central Station Work—E F. Williams, Beloit, Wis.

The Model Boiler-Room and the Duties of a Fireman—Jarvis B. Edson, New York.

Ferranti Station, London, Eng.—Caryl Haskings, Lynn, Mass.

The Proper Care and Management of Alternating Currents—T Carpenter Smith, Philadelphia.

Distribution of Energy by Alternating Currents and Transformers, and the Proper Method of Proportioning Conductors—A. H. Rohrer, Lynn, Mass.

The Proper Basis for Determining Electric Motor Rates—H. L. Lufkin, New York.

Actual Cost of Furnishing Arc Lighting (1,200 Candle Power and 2,000 Candle Power Lamps) Under the Best Possible Conditions—J. C. Ayer, St. Louis.

Municipal Ownership of Electric Lighting Plants—M. J. Francisco, Rutland, Vt.

Accidents in Electric Lighting Stations and Plants—Prof. Charles R. Cross, Boston.

Care and Labor in Electric Light Stations, and Its Value—A. J. DeCamp, Philadelphia.

How Can the National Electric Light Association Best Serve the Interests of Central Station Companies?—C. R. Huntley, Buffalo, N. Y.

The reports of the following committees will be considered by the convention:

Committee on National Insurance Rules—George Cutter, chairman; Committee on Electrical Data, A. J. DeCamp, chairman; Committee on Copper Tariff, Charles A. Brown, chairman; Committee on Underground Conduits and Conductors, Joseph E. Lockwood, chairman; Committee on Revision of Constitution, M. J. Francisco, chairman; National Committee on Legislation, Allen R. Foote, chairman; Committee on Relations between Manufacturing and Central Station Companies, Marsden J. Perry, chairman; Executive Committee, C. H. Huntley, chairman; Finance Committee, John A. Seely; Secretary and Treasurer's Report, Allen R. Foote.

At each session of the convention a call will be made for the proposal of questions and for the introduction of resolutions to be considered at subsequent sessions.

Members desiring to take part in the discussion of any subject stated or proposed, who send their names to the secretary previous to the time appointed for its consideration, will be called upon by the president, and be given time before the subject is opened to the convention. By this means every member can secure recognition and time to express his views fully on any subject that may come before the convention.

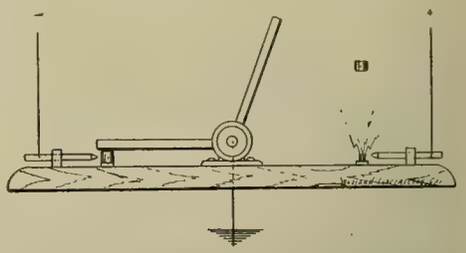


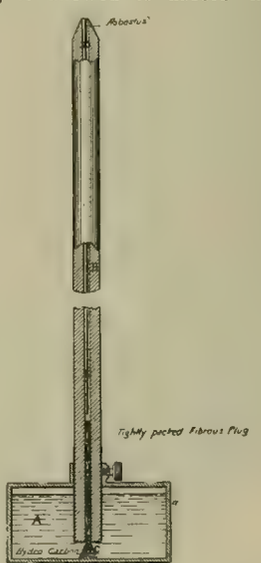
FIG. 4. PERCUSSION CAP LIGHTNING ARRESTER.

An announcement of an order of proceedings will be made for each day on the preceding day. The subjects and reports will be taken up in the order there named, and will be held under consideration until finished. Each afternoon session will be prolonged until the calendar for the day has been cleared.

The last session will be an executive session to be attended by active members only. The matters to be brought before this session include the secretary and treasurer's report, the report of finance committee, the report of executive committee, the report of committee on revision of constitution, the election of the executive committee, and the selection of next place of meeting.

Hydrocarbon Vapors in Arc Light Carbons.

An improved electrode for arc lamps is illustrated in the cut. L. Sanderson of Dublin, Ireland, the inventor, some months ago patented an improvement in electric arc lighting, which may be briefly described as consisting in supplying hydrocarbon vapor to the arc through a hollow electrode, and from a tightly-fitting fibrous plug at the cool end of this electrode. The plug is allowed to absorb hydrocarbon



HYDROCARBON VAPORS IN ARC LIGHT CARBONS.

liquid. A minute quantity of vapor finds its way into the vacant space in the electrode beyond the plug. It here becomes highly heated and in this stage enters the arc. By this means the light is, it is claimed, very greatly improved. A difficulty has, however, been experienced. It is that carbon is sometimes deposited at the point of the electrode where the arc is exhibited, and the passage of the vapor is impeded. To overcome this trouble here Sanderson inserts a

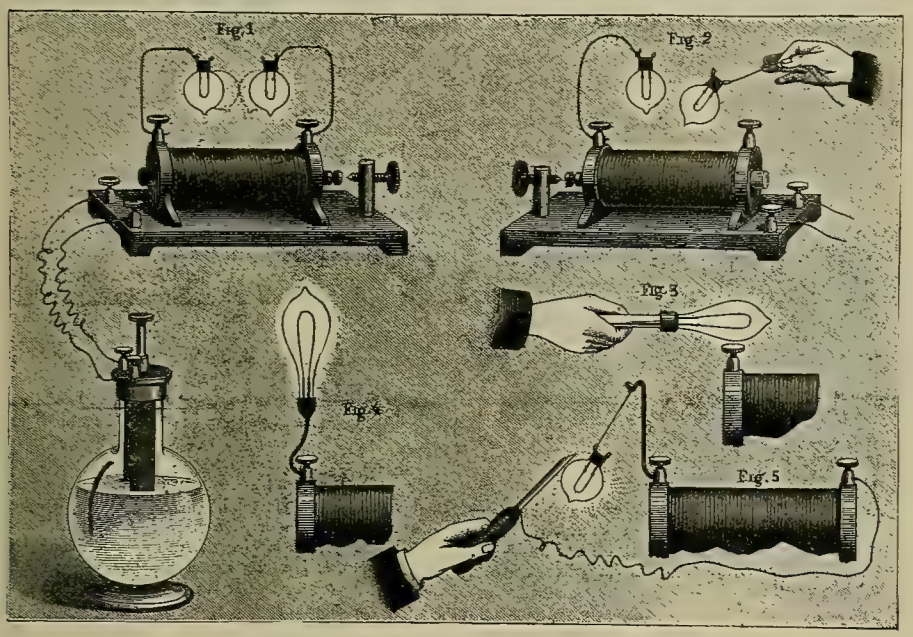
thread of asbestos or like mineral fiber into the void space in the electrode beyond the tightly-fitting plug, but so, nevertheless, as to leave the space freely open. This thread does not act as a wick. In fact, the fibrous plug prevents any liquid passing to it, and the thread need not be in contact with the plug. The thread, indeed, is entirely inactive except at the point of the electrode where the arc is displayed, and here it operates to prevent the growth or "mushrooming" of the carbon.

In the illustration *A* is a vessel containing hydrocarbon oil, or it may be a hydrocarbon such as vaseline, which when cold is solid.

B is the hollow carbon electrode, and *C* is the tightly-packed fibrous plug, which allows only a small quantity of hydrocarbon to be vaporized within the electrode. This electrode is used in conjunction with a second electrode of carbon, which may be either hollow or solid.

D is the asbestos thread. It does not fill the passage in the electrode, and offers no appreciable obstruction to the flow of the hydrocarbon vapor.

Illuminating gas may be supplied to the hollow electrode in place of the hydrocarbon liquid. Gas has the same tendency as hydrocarbon vapor to cause deposition of carbon at the point of the electrode so as to clog the passage through it, and this is prevented by placing an asbestos thread in the passage. The use of a thread is not essential. All that is required to prevent the clogging of the aperture at the point of the electrode is that a few fibers of a refractory material other than carbon should be there present. No deposition or mushrooming of the carbon then takes place.



EXPERIMENTS WITH A RUHMKORFF COIL AND INCANDESCENT LAMP.

The Calumet Electric Road, Chicago.

Frank Rae of Detroit has secured the contract for the equipment of the Calumet electric road, Chicago. The contract calls for one generator, three motor cars and trucks and two miles of roadbed, to be completed by October 1. When this is finished the work will be continued until the entire route is equipped. The Detroit Electrical Works will do the construction work, and the Rae system will be installed.

The complications which have retarded the work on the Calumet electric railroad are being removed. The city council has passed an ordinance extending the time in which the first section of the road, from the works of the Illinois Steel company in South Chicago to Stony Island avenue, must be laid, and J. J. Harvey, the president of the road, has agreed to the conditions exacted by the council. Two blocks of track on Ninety-third street and about a block on South Chicago avenue have been laid, and work on the eastern portion near Calumet Heights and Dauphin Park has been steadily carried on. Operators in the Morgan Park district expect cross lines to be run from this line east to tap the country lying in the vicinity of Washington Heights and Fernwood.

Experiments with a Ruhmkorff Coil and Incandescent Lamp.

The following description of several interesting experiments with a Ruhmkorff coil and incandescent lamps is taken from an article by J. Laffargue in *La Nature*:

If two bent wires, each supporting an incandescent lamp, are attached to the terminals of a Ruhmkorff coil, it will be noticed that the two lamps will be attracted toward each other at the moment that the current is passing, Fig. 1. The phenomenon is especially marked when the lamps are distant from each other about .12 to .2 inch. The supports must be very flexible. A No. 18 B. & S. copper wire insulated with rubber, it is stated, is well adapted to the purpose. It is important that sparking between the lamp sockets be avoided. A single lamp may be suspended and the other held in the hand. The attraction takes place as before. A lamp placed upon a terminal of the secondary becomes luminous, Fig. 3. It is sufficient to bring the lamp near to a terminal to secure a lively glow; Fig. 4. If a lamp is suspended by a flexible wire, Fig. 5, and some point like that of a knife blade which is connected with the other terminal be touched to it, an attraction is established and a constant glow is observed. Of course these experiments may be modified at will.

The above described experiments were recently repeated by C. H. Rudd of the Western Electric company, Chicago. The apparatus used by Mr. Rudd consisted of a ½ inch induction coil, a Grenet cell and two 110-volt Sawyer-Man lamps. All connections were made with bare copper wire, about No. 14 B. & S. gauge. It may be mentioned that with the one Grenet cell the coil gave a disruptive discharge of about 5-16 of an inch, and a clean spark of about 3-16 of an inch. A rough estimate of the e. m. f. of the secondary was 5,000 volts. The experiments were made in a book vault with the apparatus on a dry white pine shelf and the experimenter standing on a cement floor. The atmosphere was dry. The first test was as follows: The coil was set in action with the secondary circuit entirely open, that is, with no wires in the binding posts. The experimenter standing on the cement floor, touched one binding post with his index finger. Under these conditions he experienced no difficulty in drawing a spark and receiving a smart shock from the one terminal of the coil. This first experiment proving conclusively the well-known fact that so-called insulators are after all merely conductors of high resistance, indicated that there should be no difficulty, if proper conditions could be secured, of performing the other experiments. The next test was with the lamp held in the hand and brought into contact with one binding post. This was not successful. It may be here stated that whenever the experiments were made with the lamps and *one* terminal of the secondary coil with the operator standing on the cement floor and having no direct connection with the other binding post, the results described by Laffargue were not obtained. When, however, one terminal of a lamp was attached by means of the bare copper wire with one binding post and the globe of the lamp was placed in contact with the other binding post, a glow, or what might be described as a "brush discharge," was observed. This phosphorescent effect which closely resembled that obtained by rubbing the head of a sulphur match with a moistened finger, was seen at the point of contact between the globe and the screw of the binding post. The light at the point of contact was, of course, reflected from a number of points of the polished glass globe. This should be noted, as Laffargue fails to state at what point in the lamp the glow appears.

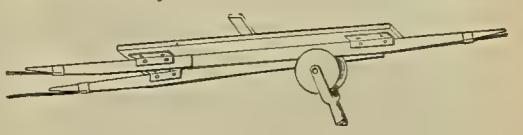


FIG. 1. SWITCH FOR OVERHEAD ELECTRIC RAILWAY.

Mr. Rudd concluded that if the greatest care was taken to secure the highest possible insulation between the coil and the experimenter the glow would be less pronounced, but he believes that inductive action would take place where conduction ceases; in other words, after securing the highest insulation, the effect, he thinks, might be due to a condenser action. This action in such experiments as these, it may be noted, is of more importance than might at first be supposed.

Switch for Overhead Electric Railway.

An overhead switch for electric railway work is shown in the accompanying cuts. In Fig. 3 is given a plan of the appliance. *A B* and *C B* represent the two tracks.

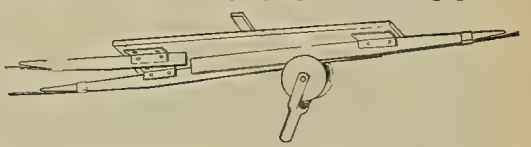


FIG. 2. SWITCH FOR OVERHEAD ELECTRIC RAILWAY.

In Fig. 1 the car is traveling along the track *A B*. When the trolley wheel reaches the point *E*, it opens a space wide enough to allow the trolley wheel to pass. After the wheel has passed, the fin springs back into its original position. When the car is traveling on track *B C*, as shown in Fig. 2, the fin *E D* is passed over to *E C*, allowing the trolley wheel to pass along the track *B C*. Practical experience has demonstrated that it is practically impossible for the trolley wheel to jump the track, no matter at what speed the car may be running. The base on which the fins are placed is galvanized sheet iron, and the fins, or more properly the switches, are made of saw blade steel. The trolley wires are fastened by clamps to the ends of the switches, and do not necessitate soldering. The whole is supported by guy wires, fastened to lugs extending at right angles to the switch, as shown in Fig. 3. The switch is introduced by the Illinois Electric Material company, Chicago.

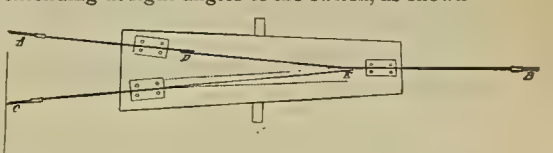


FIG. 3. SWITCH FOR OVERHEAD ELECTRIC RAILWAY.

Fan motors are becoming indispensable in sick rooms during excessive hot spells. George A. Redman of the Brush Electric Light company, Rochester, N. Y., cites two interesting installations of this kind, made necessary by a recent hot spell in the Flower city. An invalid who found it necessary to have some one fan her constantly, had a large fan placed over her bed. It was operated by a C. & C. motor in another room. The other installation was in the room of a man who had a broken knee cap. A fan-motor was put in his room, and he found life quite endurable. In both cases the installations were successful.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Alternating Current Motors in Mining Work. Illustrated	65
Electric Fountain in Chicago	65
Smoke Nuisance in Chicago	65
Chicago & Lake Shore Electric Railway Company	65
Dynamo Room of the Livingston (Mont.) Electric Light company. Illustrated	66
Electric Heating. Illustrated	66
Contact Device for Electric Railways. Illustrated	67
Electrical Elevator. Illustrated	67
Detecting Irregularities in Railroad Tracks. Illustrated	67, 68
Percussion Cap Lightning Arrester. Illustrated	68
National Electric Light Association	68
Hydrocarbon Vapors in Arc Light Carbons. Illustrated	68, 69
The Calumet Electric Road, Chicago	69
Experiments with a Ruhmkorff Coil and Incandescent Lamps. Illustrated	69
Switch for Overhead Electric Railway. Illustrated	69
Editorial	70
The Taunton Dynamo. Illustrated	71
Triplex Electric Pump. Illustrated	71
East Cleveland Electric Road	71
For Electric Railways. Illustrated	71
Who Is the Inventor? (Communication from Thomas D. Lockwood)	71, 72
Power Station of the Knoxville Street Railway Company. Illustrated	72, 73
Complimentary Dinner to S. Dana Green	73
Dr. Oliver Wendell Holmes and the Electric Train	73
What Constitutes a Dangerous Electrical Current? By Nelson W. Perry, E. M. Part I.	73, 74
DEPARTMENTS.	
Correspondence	74, 75
The Electric Light	75
The Electric Motor	75
Electrical Patents	76

IN this issue is illustrated a novel lightning arrester in which ordinary percussion caps are used for breaking an arc following a static discharge. It is stated by the inventor of the device that its operation in practical service has proved satisfactory.

WE give a selection from Dr. Oliver Wendell Holmes' poem on the electric train in this issue. The rhyme is not in the best vein of the autocrat of the breakfast table. The poem appears to be "spun out." No one will deny however that the idea of identifying the trolley poles as "witches' broomsticks" is a humorous and ingenious conceit.

IN another column is presented a list of the topics which it is proposed to discuss at the convention of the National Electric Light association at Cape May, August 19th. If the literary programme as thus arranged is carried out the association meeting will prove of a highly interesting and instructive character. It will be noticed that among the topics to be considered is "Electrical Industries and the World Columbian Fair" by City Electrician J. P. Barrett of Chicago. According to all reports there will be a large attendance at the convention, and the delegates are promised a thoroughly enjoyable time.

IN the WESTERN ELECTRICIAN of July 26th appeared an article entitled "Who is the Inventor?" The cuts which accompanied the article were photographic reproductions of drawings of patents which had just been issued to two inventors. The first claim of each patent was also given. The drawings and the claims were so nearly alike that we thought at the time that it would be difficult for any to tell to whom the invention really belonged. At the same time we stated that the issue of patents to two inventors for apparently the same thing seemed to indicate a looseness in the working of the Patent Office. In the present issue appears a communication from Thomas D. Lockwood in regard to the question "Who is the Inventor?" Mr. Lockwood thinks the Patent Office was justified in issuing two patents. For his reasons our readers are referred to Mr. Lockwood's communication. Suffice it to say that we are not convinced that the patents do not cover the same invention.

IN this issue an account is given of some highly interesting and suggestive experiments with the induction coil. Up to within a short time ago the action taking place in the dielectric in proximity to conductors carrying currents has received, comparatively speaking, but little attention. Our most practical experimenters have for the most part confined their investigations to phenomena which may be said to be more particularly related to the conducting medium proper than to the surrounding insulation. The experiments referred to, although perhaps possessing no novelty to many, suggest most forcibly the fact that effects which at first sight are attributed to conductive action may be in reality, in part at least, due to induction. It is known that induction may take place through a dielectric, and we say a current is induced into a second conductor. We know also that if a circuit be made from one electric body to another the second body is electrified. Just how close is this relation it is difficult to say. The study of the action of alternating currents upon the adjacent dielectric is daily becoming of more importance, and it is just such simple experiments which, if often repeated and closely studied, lead us to a clearer and more perfect understanding of the subject.

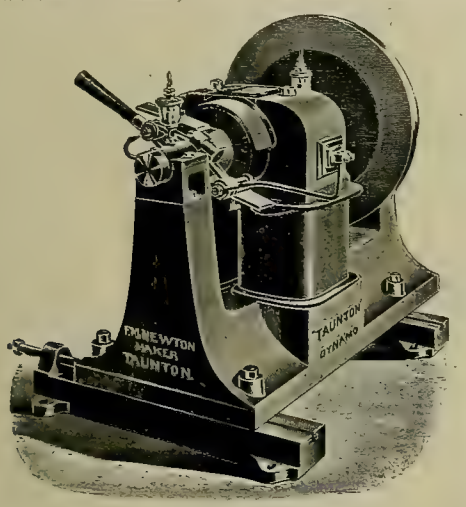
NELSON W. PERRY in this issue discusses in an interesting way the question, What constitutes a dangerous current? It will be noticed that in all the instances of which he speaks, persons were shocked by electric currents as a result of gross carelessness. Wires carrying electric currents seem to possess a fascination for a great many persons. They are apparently harmless, and a desire to find out whether the danger of coming in contact with them has not been greatly exaggerated seems to possess persons whose intelligence ought to convince them of the hazardous nature of making experiments with conductors. An electrical engineer in charge of a lamp-testing room recently stated that he expected each one of his men to receive a smart shock before becoming a cautious, careful workman. This matter of pointing out that electric wires should not be handled by ignorant persons is threadbare, yet the topic must be treated for a considerable time yet, apparently, before two facts are generally realized; first, that electric conductors are safe if let alone; second, that they are dangerous if ignorant persons institute experiments with them. When these ideas are generally understood there will be an end of most of the foolish talk about the dangers of electric lighting and accidents will be of very infrequent occurrence. Mr. Perry speaks of the shocks of varying intensity which might be received on an electric car; it is of course thoroughly understood that passengers could not receive such shocks. This fact while perfectly patent to a reader familiar with the operation of electric cars may not be as well understood by some who read Mr. Perry's paper and therefore should be emphasized. In discussing what constitutes a fatal current of electricity Mr. Perry assumes one ampere as a quantity which if passed through the vital part of the human body will cause death. We do not imagine any one will say that Mr. Perry has fixed upon a figure that is too low. Electricians, we imagine, will insist that one ampere is far too high. G. E. Fish for example in an article in the WESTERN ELECTRICIAN some months ago stated that a series of experiments had led him to believe that two-tenths of an ampere constituted ordinarily a fatal current. Mr. Perry does not believe that the resistance of different persons differs as widely as one would naturally conclude who has compared the statements of experts on this subject during the last year or two. Mr. Perry fixes upon 1,000 volts as a fair average, and states that in his belief the resistance to the electric current varies no more widely in human beings, than their susceptiblity to the power of a poisonous drug.

DURING the last few weeks in which the appointment of an expert to take charge of the electrical section of the World's Fair has been a topic of interest in Chicago, there has been considerable inquiry relative to the duties connected with the office. "Tell us what the office is to be and we can tell who will be the best man to fill it," has been a frequent remark. At the present time we think it absolutely impossible to find any answer to this important inquiry. In the discussion in which the electrical fraternity has engaged in regard to the appointment two points have been emphasized. In the first place it has been urged that the expert who is to take charge of the electrical section must be a practical man, well fitted by experience to organize a magnificent exhibit. He must not be a scientist only, it has been stated, but a man of practical experience who is qualified thoroughly to arrange to the best advantage an enormous power plant. There are others who emphasize another point. The expert who is at the head of the electrical section they say need not be a "practical" man; that is, experience in the actual operation of plants need not be a qualification; but he should be pre-eminently a representative of the highest electrical talent in America; his name should create the same confidence in an American exposition that Sir William Thomson's would inspire if used in connection with an English World's Fair. He should be, it is urged, a man who is cognizant of the last word in electrical science and thus be able to meet on their own ground the ablest electricians of the world. The "practical" duties it is stated, could easily be delegated to men abundantly able to discharge the duties of electrical engineers. These are the two views of the case which one hears presented vigorously when members of the Chicago fraternity discuss the appointment of an expert. No one will deny that each side makes a strong point. But it may be stated that the duties of the expert may not comprehend both the practical and the scientific side. It is possible that when all the authorities of the Columbian Exposition reach the electrical section they may determine to appoint two men to take charge of the department. The directors of the World's Columbian Exposition, the local corporation, may make one appointment which would probably be that of a practical man, while the national commissioners may make a second selection. There would then be no difficulty in selecting representatives of both the practical and the scientific side of electrical engineering. It has been suggested that at the present time the discussion of the appointment is premature. We do not think so. Too much thought cannot be devoted to a subject of such interest to the electrical world. The WESTERN ELECTRICIAN and the electrical fraternity of Chicago want to see the best man in the position, whoever he may be. The free discussion of the matter ought to be, we think, of assistance to the directors of the World's Columbian Exposition in the selection of the right man or the right men.

The Taunton Dynamo.

The dynamo shown in the cut was recently exhibited in the Royal show at Plymouth, England, where it was driven by an oil engine. It was designed by T. Hawkins. The machine is shunt-wound and gives 30 amperes at 90 volts at 1,180 revolutions per minute.

The field magnets are made of wrought iron, bolted to the bed plate where the cross-section has been increased, and the armature has one



TAUNTON DYNAMO.

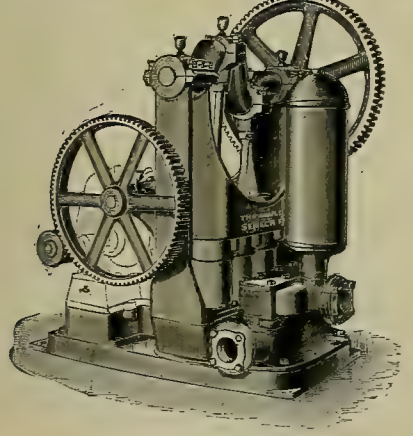
layer of wire wound drum fashion. There are only two turns of wire per commutator bar.

There is no lead to the brushes, and the work can be increased 50 per cent. above full load without sparking; in fact, there is no need for a rotating brush holder, and the makers intend discarding it.

The bearings are long, fitted with white metal, and have sight feeding lubricators. The cut is reproduced from the London *Electrical Review*.

Triplex Electric Pump.

The illustration presented herewith represents a type of triplex electric pump, recently placed on the market by the Goulds Manufacturing company, Seneca Falls, N. Y. The machine is a compact combination on one bed-plate of a motor and pump. By the use of a triplex pump the makers claim to obtain a practically unvarying resistance to the action of the motor, and thus reduce the wear and tear in the last-named portion of the combination. A number of these triplex pumps, it is stated, are in operation rais-



TRIPLEX ELECTRIC PUMP.

ing water for house tank supply, elevator service, etc.

East Cleveland Electric Road.

The Cleveland *Leader* has recently made a number of severe attacks against the East Cleveland Railroad company, alleging that it had caused a number of serious accidents by careless operation of its electric cars. H. A. Everett, president of the company, made the following statement in regard to the matter to the representative of the WESTERN ELECTRICIAN:

"The two days of the Barnum season we carried 70,000 passengers without injury to any one, except one boy, who was a trespasser on the car, stealing a ride, and jumped under another motor car. The *Leader* articles are almost entirely made up from misrepresentation of the facts, alleging that invariably all accidents happen from the trail car, when as many have happened from single motors. They purposely suppress any of the reports in regard to the fatal accidents from horse cars. Within the last year, in the summing up of accidents which they stated the other day, there is not one single case but what contributory negligence can be proved against the parties injured, save to the one, the Murray Hill accident on our road, which resulted in the breaking of one man's leg

"In a year the electric motors have carried about 12,000,000 passengers, and this is the only case that I know of wherein there was not contributory negligence. They purposely stated the other day that a servant girl on Prospect street, was laid up in the hospital for four weeks from injuries, caused by coming in contact with the trolley wire. That statement is absolutely false; and we proved in court from the girl herself that she was not laid up for four hours.

"The claims which they set up of horses having been killed by the current will not bear examination, as the horses have been killed as soon as a slight burn has shown on them, and in all events no horses have been killed from the current from our wires. We have knocked down a couple of horses, but no particular injury was done to either of them.

"The motor cars in this city have taken off from the streets 2,500 horses, and of course any one can appreciate what a great sanitary benefit that is. The motor cars are running fully twice as many miles per day as were run by horse cars on the corresponding day a year ago."

For Electric Street Railways.

In the accompanying cut is shown a new electric headlight as it appears attached to the bonnet of a car. It consists of a plated copper reflector like that of a locomotive headlight, fitted, however, with an incandescent lamp. The reflector forms the body of the lamp and is fitted with a hinged door to exclude dust and dirt. The stand by which it is affixed to the car bonnet has an adjustable joint, as shown in cut which makes it possible to direct the rays of light at any angle of deflection desired, to illuminate the track ahead. A switch under the bon-

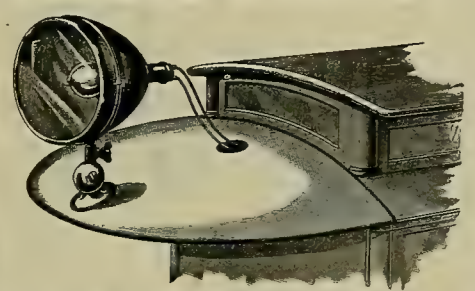


FIG. 1. FOR ELECTRIC STREET RAILWAYS—HEADLIGHT.

net, which cannot be seen in the illustration, cuts out the platform lamp while the headlight is used. The number of lamps on the car therefore is not increased. The headlight is made by the Steam Gauge and Lantern company of Syracuse, N. Y.

Figs. 2 and 3 illustrate the means provided for changing batteries, under the storage battery system of the United Electric Traction company of New York, whose cars on the Fourth avenue line are now coming into regular service again. The rack and its mechanism have been worked out by J. O. Chamberlain of the company.

Fig. 1 is a side view, while Fig. 2 shows the rack as seen from the end. The rack may be seen at the stables of the Fourth avenue line, which are located at Eighty-fifth street and Madison avenue. It consists of two standards containing shelves, ranged one above the other, of suitable capacity to hold the cells of batteries. These standards are parallel to each other but separated by sufficient space for the car to come between them and to permit of the operation of an elevator or double platform which corresponds in size to the shelves, and travels up and down from the bottom to the top of the rack between it and the car. Above the car, as it stands between the racks, there is a platform on which are placed two small electric motors which move the lifting platforms by means of mechanism designed by Mr. Chamberlain. It should be added that there is an elevator on the outside of each of the racks which rises and falls with the platform which holds the cells and carries the man who handles them.

In operation all the shelves, except one, being filled with batteries, the car coming in from its trip, is run between the racks, and its cover panels, which are hinged at the bottom, being let down on either side, thus forming a bridge from the car to the lifts, the batteries are run out on top thereof, and the lifts being raised sufficiently to bring the lower shelves to position, which hold a freshly charged set of batteries, these are run into place in the car. Then the lifts convey the exhausted cells to the vacant shelves where they are deposited and are immediately in circuit to be recharged. The lifts then being brought even with any of the shelves from which the operator may choose to take the battery, are reloaded and lowered to the ground for the next car, the change, it is said, requiring about three minutes. The floor

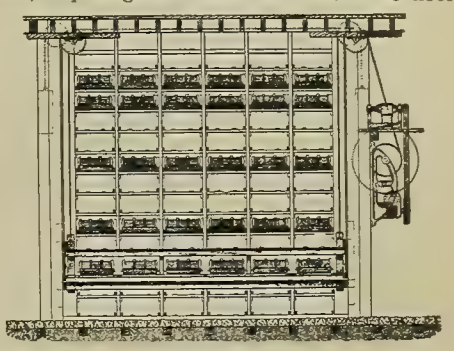


FIG. 2. FOR ELECTRIC STREET RAILWAYS.—STORAGE BATTERY RACK.

space occupied by these racks is about twenty-four feet by seven feet on each side of the car, and as they contain cells enough to do the work of 130 to 150 horses, they may be fairly said to represent the stall room these horses would require, which is about 6,000 square feet. The cuts are reproduced from the *Street Railway Journal*.

Who is the Inventor?

Editor of the WESTERN ELECTRICIAN:

In your issue of July 26, 1890, I observe on page 42 a kind of parallel column picture, and an article accompanying the same, entitled "Who is the Inventor?" And on page 46 an editorial article commenting upon the same.

Without any disposition to criticise the views expressed, which certainly display fairness of intention, I may perhaps for the benefit of your readers be permitted to say that I think they do not do justice to the Patent Office.

Referring first to the article on page 42, let me say that with respect to the drawing, there is nothing more common than for inventors who are working in association with each other, or for attorneys drawing specifications for inventors employed by the same interests, to use the same drawing with such trivial modifications as are necessary to bring out the particular thing invented, and described in the particular specification which the picture is intended to illustrate.

It is even a matter of ordinary practice for a drawing to be used by two or more inventors, or two or more attorneys in a number of applications, even when there is no sort of relationship between the parties; provided that the main

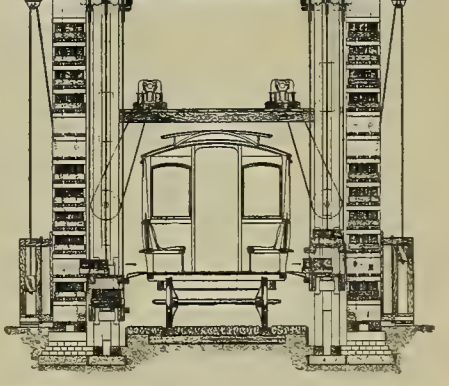


FIG. 3. FOR ELECTRIC STREET RAILWAYS.—STORAGE BATTERY RACK.

features of the drawing are convenient for the engraftation of the particular thing which is newly invented, and which may very likely be quite a minute improvement.

Consider now the two claims which you have printed, the first respectively of patents Nos. 432,131 and 432,279; they have indeed each three elements, but here the specific resemblance ceases; and indeed, the two drawings may easily be differentiated in the light afforded by the two claims. No one will seriously dispute the proposition that the two claims in question might (provided the things invented were both invented by the same person) be incorporated as separate claims of the same patent. And in that case the patentee might be understood as saying, "I have invented such and such a combination, it is my invention and you must not use it without my leave;" further along he inserts the other claim, and he says "This is also my invention and you must not use this either." They are in fact distinct inventions, and one may infringe the first, without

necessarily infringing the second; furthermore, though both form parts of the same patent, each could be separately sued on, and cases are frequent where suits are brought on some of the claims of a patent and not on others.

If then the two claims are so far distinct that they may be incorporated as separate claims of one and the same patent, where can the wrong be of making them the subjects of two patents when they are invented by different persons?

In some respects the first claim cited may be the broader, and in others the second may; for example the first two elements of the first claim of patent 432,131 are broader in their scope than are the first two elements of the same claim of patent 432,279, for it is obviously a phrase of greater scope, to say that "the conductivity decreases from one place to another," than to say that "the conducting surface decreases in breadth from one place to another," because the latter phrase describes only one way of doing the thing.

And it is also an expression of wider scope to say that we "connect a conductor to a portion of a conducting material where it is of greatest conducting power," than to say we do so "at the point of its greatest breadth."

But on the other hand, it is also broader to speak of "a contact face of greater width," than of "one which is formed with a series of flexible fingers."

It thus appears that both claims may be equally valuable, and that the combinations described by each may be and are diverse. What then, must the Patent Office deny one of them on the ground that the same inventor ought to have invented both? I cannot think this argument would hold water; nor can I see how the office could have done differently than to grant each party a patent for the machine he had invented, if it be new and useful.

The Patent Office was not intended to guarantee inventors against infringement; it gives a patent which is prima facie evidence that the patentee was the first inventor of the thing he said he was; but the courts only can settle questions of infringement.

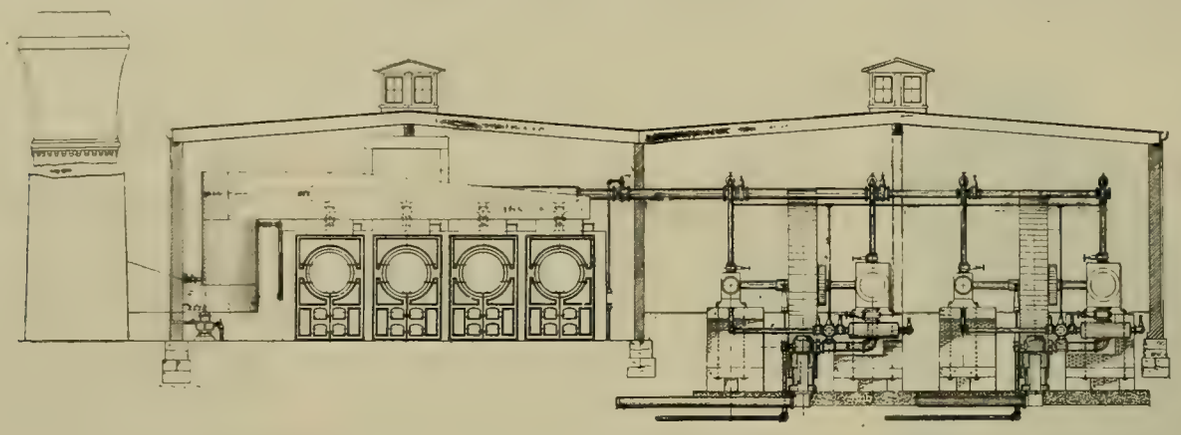
Examination in the present state of all arts is no easy thing. Take for example electricity alone. Why, when patents are being issued in the United States alone at a rate exceeding that of 2,000 per annum, and when we recollect that three or four dozen others also are issuing patents, and that the examiner has not only these, but also all printed publications to look out for, the wonder is not that sometimes a duplicate patent issues (although I do not regard this as one), but that an examination is ever completed, and that a patent is ever sustained.

Then, too, it is to be remembered that every inventor, or at least every new inventor wants broad claims; how can he tell that he had better claim his invention just as broadly as the state of the art will warrant, and no broader? And when his broad claim is denied on some reference, he argues the inapplicability of that reference to his case, and rejoices correspondingly if by hook or crook he can persuade the examiner that the reference does not apply; but if he has to narrow his claim to get it allowed, the examiner is again blamed for allowing such useless claims. Truly he is between the Scylla of allowing claims so broad as to be invalid, and the Charybdis of allowing them so narrow as to be useless

Let us not therefore blame the Patent Office unduly. On the whole it does things fairly and well At least such is my experience.

THOMAS D. LOCKWOOD.

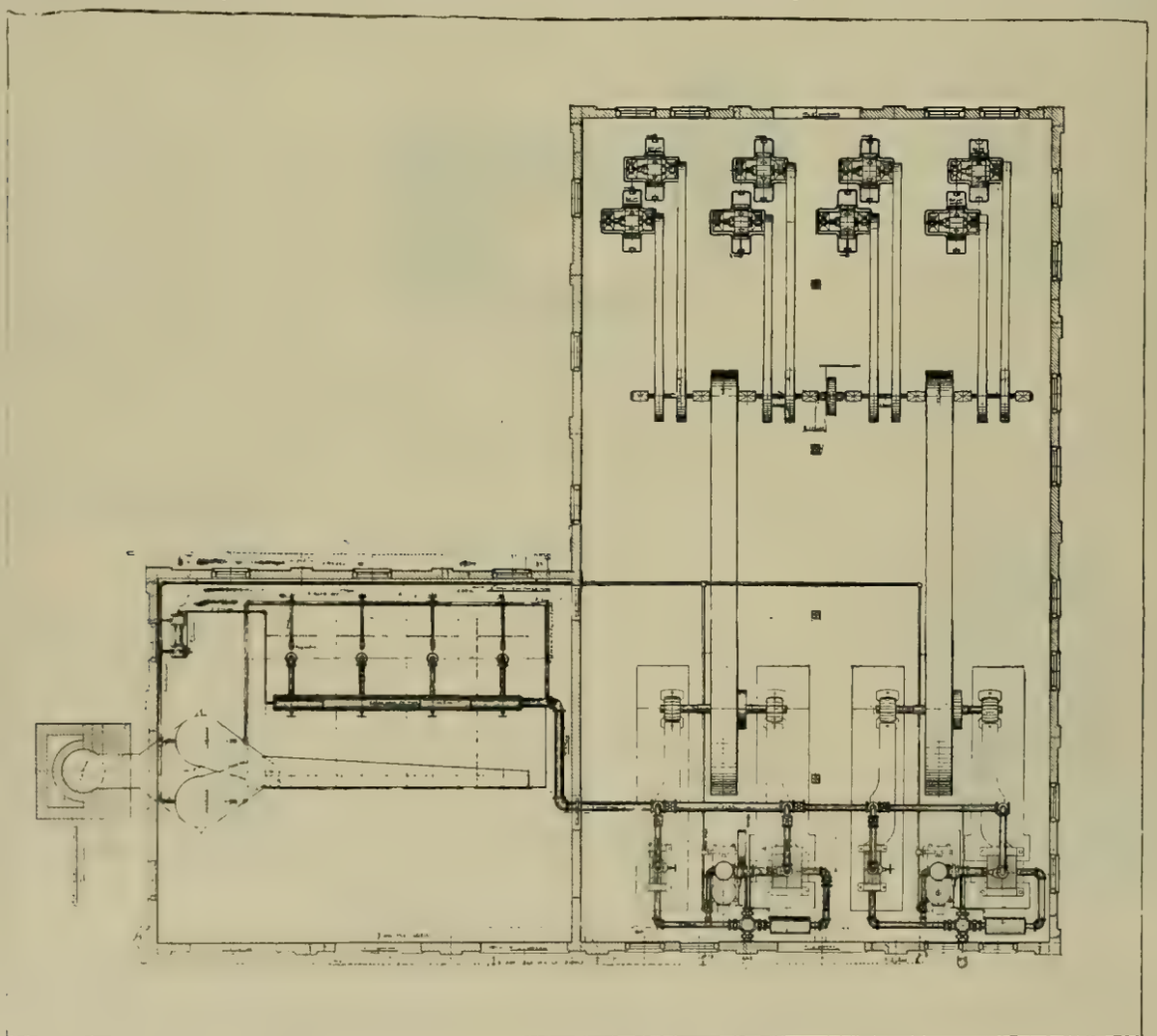
Boston, Mass , August 2, 1890.



POWER STATION OF THE KNOXVILLE STREET RAILROAD COMPANY.

Power Station of the Knoxville Street Railroad Company.

One of the recent installations made by the Thomson-Houston Electric company, is shown in the accompanying illustrations of the power station built for the Knoxville Street Railway company, Knoxville, Tenn. The drawings are the plan and section of the elevation from which the construction of the station and the disposition of the apparatus can be readily seen. The building is one story, brick, and divided into



POWER STATION OF THE KNOXVILLE STREET RAILROAD COMPANY.

boiler and engine and dynamo rooms. The steam plant consists of four steel tubular boilers built for from 115 to 125 lbs. pressure, with furnaces designed for burning a low grade of slack coal. Economizers are also provided for utilizing the waste gases in bringing the feed water up to the boiling point before it is pumped into the boilers. Four ways of feeding the boilers are utilized and so arranged that in case of accident to any one of them, the operation of the steam apparatus would in no way be impaired.

The engines are of the cross-compound condensing Corliss type and so arranged that each pair, which is considered as one engine, can be operated as a twin engine and in case of accident, either side can be run alone. Each side can also be worked at high or low pressure, so that provision is made for operating the plant, even though half of the engine is undergoing repairs. This is claimed to be the first plant of its kind in the world which has been erected for electric railway purposes, and very satisfactory results are anticipated from it. Each engine will carry its full load, under the varying conditions of railway work, on an evaporation of 18 lbs. of water per horse power per hour.

The engines are of extra large proportions throughout so as to withstand the severe service incidental to railway work.

The electric apparatus comprises eight Thomson-Houston railway generators, and the usual appliances for their operation. Each generator, as well as each engine, is so arranged as to be thrown in or out of action without interfering in the least with the operation of the remainder of the plant. The engines, boilers, and piping were furnished by C. & G. Cooper of Mt. Vernon, O., and the counter-shafting by the Holyoke Machine company, of Worcester, Mass. The plant is rapidly nearing completion and will be in operation sometime this month. The installation was designed by L. H. McIntyre of the railway engineering department of the Thomson-Houston Electric company. The electric railway for which this plant is designed is 3.40 miles in length and will operate five motor cars.

Complimentary Dinner to S. Dana Greene.

S. Dana Greene, who has been acting as general manager of the General Edison company at Chicago since last May, was tendered a complimentary dinner by a few of his friends at the Chicago Electric club just before his departure for New York last week. Mr. Greene has been appointed assistant to the general manager of the Edison General company and will have his headquarters at New York. Among those who were present at the dinner were C. A. Benton, A. H. Reece, Lieutenant F. B. Badt, E. H. Harrison, Mr. Elliott, H. H. Harrison, Theodore Bailey, W. A. Kreidler and Alex H. Lewis of Chicago, and Daniel Hemingray of Covington, Ky. John I. Beggs, late manager of the Edison Illuminating company of New York, who will succeed Mr. Greene, was also present. A number of letters of regret were received from friends of Mr. Greene who had hoped to be present but who were out of town. After the dinner a number of the gentlemen expressed their regret at Mr. Greene's withdrawal from Chicago and extended him their best wishes for his future prosperity. Mr. Hemingray entertained the company with a number of his characteristic selections. It was a thoroughly enjoyable evening, and Mr. Benton, who had charge of the arrangements, was voted the thanks of the company.

Oliver Wendell Holmes and the Electric Train.

In the August *Atlantic Monthly* Dr. Oliver Wendell Holmes, in "Over the Teacups," causes one of his characters to speak as follows of the electric train:

"There are crowds of people whirled through our streets on these new-fashioned cars, with their witch broomsticks overhead—if they don't come from Salem, they ought to—and not more than one in a dozen of these fish-eyed bipeds thinks or cares a nickel's worth about the miracle which is wrought for their convenience. They know that without hands or feet, without horses, without steam, so far as they can see, they are transported from place to place, and that there is nothing to account for it except the witch-broomstick and the iron or copper cobweb which they see stretched above them. What do they know or care about this last revelation of the omnipresent spirit of the material universe? We ought to go down on our knees when one of these mighty caravans, car after car, spins by us, under the mystic impulse which seems to know not whether its train is loaded or empty. We are used to force in the muscles of horses, in the expansive potency of steam, but here we have force stripped stark naked—nothing but a filament to cover its nudity—and yet showing its might in efforts that would task the working-beam of a ponderous steam engine. I am thankful that in an age of cynicism I have not lost my reverence. Perhaps you would wonder to see how some very common sights impress me. I always take off my hat if I stop to speak to a stone cutter at his work. 'Why?' do you ask me. Because I know that his is the only labor that is likely to endure. A score of centuries has not effaced the marks of the Greek's or the Roman's chisel on his block of marble. And now, before this new manifestation of that form of cosmic vitality which we call electricity, I feel like taking the posture of the peasants listening to the Angelus. How near the mystic effluence of mechanical energy brings us to the divine source of all power and motion! In the old mythology, the right hand of Jove held and sent forth the lightning. So, in the record of the Hebrew prophets did the right hand of Jehovah cast forth and direct it. Was Nahum thinking of our far-off time when he wrote, 'The chariots shall rage in the streets, they shall jostle one against another in the broad ways: they shall seem like torches, they shall run like the lightnings' "?

The fancy about the "witches broomsticks" suggested to another character in "Over the Teacups" a poem on the electric train It describes how the Salem witches becoming tired of their life after 200 years' stay in the world below, obtained permission from their master to return to earth. They created a disturbance, whereupon the "boss of Bedlam" summons them. Dr. Holmes' rhyme continues:

"They came, of course, at their master's call,
The witches, the broomsticks, the cats, and all;
He led the hags to a railway train
The horses were trying to drag in vain.
'Now, then,' says he, 'you've had your fun,
And here are the cars you've got to run.
The driver may just unhitch his team,
We don't want horses, we don't want steam;
You may keep your old black cats to hug,
But the loaded train you have got to lug.'

"Since then on many a car you'll see
A broomstick plain as plain can be;
On every car there's a witch astride—
The string you see to her leg is tied.
She will do a mischief if she can,
But the string is held by a careful man,
And whenever the evil-minded witch
Would cut some caper he gives a twitch.
As for the hag, you can't see her,
But hark! you can hear her black cat's purr,
And now and then, as a train goes by,
You may catch a gleam from her wicked eye.

"Often you've looked on a rushing train,
But just what moved it was not so plain.
It couldn't be those wires above,
For they could neither pull nor shove;
Where was the motor that made it go
You couldn't guess, *but now you know.*

"Remember my rhymes when you ride again
On the rattling rail by the broomstick train!"

What Constitutes a Dangerous Electrical Current?

BY NELSON W. PERRY, E. M.

PART I.

The question is continually arising as to what is a dangerous current of electricity; and the answers that may be encountered are usually so varied that the inquirer is prone to ask again with the result as unsatisfactory as before and a conclusion that the electric fluid is as mysterious in its effects upon life as it is to most people in its other manifestations.

It would not be far wrong to state that the most general feeling in regard to this question at the present time is that a given current might kill to-day and be harmless to-morrow; that what would be certain destruction of life to one individual could be safely borne by another. In fact such a belief is but a consequence of that very common opinion among the laity that electricity is not amenable to infallible laws like other forces, or that if it is, then such laws are at present but imperfectly understood.

Such, however, is far from being the truth. It is indeed very common to hear the statement that we do not know what electricity is—but how often do we hear the statement that we do not know what gravity is?

How many of us if asked the question would hesitate for a moment in stating that we were in possession of full knowledge in regard to gravity and yet at the same time would delegate electricity to the unknown and perhaps to the unknowable? And yet of the two, much more is actually known to-day about electricity than is known about gravity. In fact, the electro-magnetic theory of light so beautifully formulated by Clerk Maxwell has received at the hands of Prof. Hertz within the past two years, experimental demonstration and we know beyond peradventure that electricity is a phenomenon of the ether in the same sense as light is.

We cannot say that we know all the laws of light—we know a great many of them—in fact nearly all that are necessary to explain the phenomena with which we are confronted, and we find that these laws are all absolute in their workings—they are infallible.

So it is with electricity. If we do not yet know quite what it is, we are certainly much nearer a solution than we are in the case of gravity. It would be folly to say that we know *all* the laws of electrical action, but we probably know even more of its laws than we do those of light and they are in no way less certain. In fact scientists have long since come to the conclusion that the laws of nature are all infallible. It is a fundamental doctrine of science that under like conditions like results must inevitably follow. There are no miracles in science; there may be mysteries but they are mysteries because of our ignorance of the conditions and not because of the abeyance of any of nature's laws. The difference between the scientific mind and the unscientific mind is that if an apparent contradiction of an accepted law is noted, the former assumes some condition not understood and the latter immediately assumes it to be what it appears, viz: A direct contradiction of the law.

To the latter such a thing is not so very remarkable—the world is full of just such contradictions; it is therefore not inconsistent with previous experience and it does not even excite surprise. To the scientific mind however, such a thing as the fracture of a law or its abeyance for one instant is an utter impossibility and unthinkable.

Electrical science to the unscientific mind may logically be a department of contradictions; but to the electrician it is one of fixed and inviolable laws as are all the other sciences; and what is more it has arrived at a position of an exact science in which results can be predicated from given data with mathematical exactitude and precision. In fact astronomy does not rest upon a more sure mathematical basis than does the science of electricity.

Electricians are sometimes asked to explain many things that never occurred; for instance it is universally acknowledged that 110 volts—that usually employed in the incandescent light is perfectly safe as far as life is concerned. Yet not long ago it was announced all over the country that a little colored boy was killed at Chattanooga by coming in contact with an incandescent light wire of 110 volts and electricians were asked to explain how t is could happen. It could not be explained and was not until the coroner's inquiry developed the fact that no electricity had been on the wire for over a half an hour previous to the boy's coming in proximity to it, that the boy did not die from an electric shock and that the burns that were attributed to the electric current were due from an oil lamp which the boy had in his hands and not to the electric current.

And then supposing the statement were true, and it is not questioned anywhere, that a current of 110 volts such as is usually employed in incandescent lighting is perfectly safe, yet it is not true that it is safe to touch every incandescent circuit one meets. Most of our electric street cars are operated by a current of 500 volts' pressure. In all such you will observe five electric lights similar to those you see in the stores. Now while each of these lights is only called upon to stand a pressure of about 100 volts, they are placed in a row or in "series" so that the same current passes through each in succession and meets with the combined resistances of all of them. In such a circuit five lights of 100 ohms each resistance can be opposed to a pressure of 500 volts and yet the effect would be to subject each individual light to a pressure of one-fifth the amount or 100 volts. One can however take his choice of shocks due to 500, 400, 300, 200 and 100 volts according as he short-circuits five, four, three, two lamps or only one.

In case an electric road were operated by a current at 1,000 volts it is evident that 10 one-hundred volt lights could be operated in series in each car, and under these circumstances the seeker after sensations could get anything he wanted in the way of shocks from that due to 100 volts' pressure up to that due to 1,000 volts' pressure. That it is quite evident that while the first statement might be perfectly true if comprehensively understood, yet it would not be advisable to assume that all incandescent light circuits or even all circuits containing 110 volt incandescent lights were safe. And again, as we have seen that in the 1,000 volt circuit all pressures from 100 volts to 1,000 could be obtained according to the point where one touched the wire, so it would not be safe to assume that because I touched the circuit with impunity at one point you or anybody else could do the same at another point. And yet this is just what would be assumed by the majority of people, and if you were killed and I was scarcely shocked, it would be referred to as an illustration of the idiosyncrasies of the electric current.

A couple of summers ago I was present at the starting of a new electric underground railroad in one of the coal mines in Pennsylvania. The trolley wire—to use an Irish bull—was a light T rail supported on timbers overhead out of reach of persons standing on the ground. At one point there was a switch by which the current could be turned on or off, and on this day as it was desirable to have this readily accessible, a large wooden block was placed on the ground underneath it. By standing on this, one could readily reach the trolley rail and switch. Had the block been a perfect insulator, a person standing upon it could have touched the trolley rail without the slightest shock even though there had been 5,000 volts instead of 350 as was the case, but as it was, the conductivity was just sufficient to give one standing upon it and touching the rail a right smart shock, and the whole thing being new to the miners, they were amusing themselves by getting up and touching the rail.

One man thinking to have a little fun at the expense of another, jumped upon the block and while he touched the rail with one hand grasped his intended victim, who was standing on the damp ground with the other.

He thought to surprise his friend with a slight shock, such as he himself had been taking in fun before, but the joke was a huger one than he had anticipated, for by grasping the other man's hand he made a good connection with the ground, through his own as well as his friend's body and the result was that both men were violently thrown to the ground, and so quickly that they scarcely knew what had done it; neither man was hurt, but all had a great respect for that trolley rail thereafter.

Not many days from this time, a mule came in contact with this same trolley rail and was almost instantly killed, and in falling he pulled his mate over in contact with it and he too was killed. Now here were three different effects from the same current, yet the conditions being different, the results varied widely.

Now if we were to try to reason by analogy we should say

—this current was strong enough to kill two mules, therefore these two men ought in all fairness to have been killed. But they weren't.

Again, among the miners it was argued that since one man alone on the block could easily stand the shock, and two men catching hold of hands were both thrown to the ground, if three or more had hold of each other, they certainly would have been killed.

The electrician readily sees the fallacy in the last argument, but he does not see how the mules should have been killed while the men escaped. He merely knows from numerous instances of which this was one of the first recorded that mules and horses are very much more susceptible to electrical influences than is man. Why, he does not pretend to say any more than he does why a pig will fatten on arsenic or antimony which are fatal in small doses to man. The physician can tell, perhaps but not the electrician, and the physician had to learn the fact from experience; there was no *a priori* reason why it should be so.

This calls to mind an amusing story that I once heard as to the origin of the term "Antimony" which is the name of a metal closely resembling arsenic in many of its properties.

Some monks had found a new mineral and had prepared from it a new metal, which so far as they could see proved to be utterly worthless, so they threw it away. It fell within reach of some of the hogs belonging to the monastery and the monks noticed that they devoured it with apparent relish. Curious to know the effect of such a diet upon the swine, they fed them regular with it for some time and found that they not only prospered, but grew enormously fat upon it. Some of the monks reasoned that if it was so good for the hogs it ought to be good for themselves too, so some of them partook of a liberal dose of it, resulting in their speedy horrible death by poisoning. The new metal was therefore called "Anti-Monk," which by slight change has become Anti-mony.

The authenticity of this origin for the term is very seriously doubted, but the story serves to illustrate that the fact that 350 volts is fatal to a mule while it is not to man, rests upon the same experimental data that the other fact does viz, that a hog can eat some things with profit that are not conducive to longevity in man.

Now while I know of no *a priori* reasons why a certain quantity of electricity should be fatal to man, still I believe it to be an established fact that the quantity that will be immediately fatal can be fixed with as much certainty as can the fatal dose of any of our well-known poisons, and I think it is now surely settled that a single ampere of current caused to pass through the vital part of the body is much more certain to be instantly fatal in all cases and in any case than is hanging by the neck; and I think the question "is hanging necessarily fatal?" much more doubtful than is the other one—is one ampere of electricity necessarily a fatal dose?" and the answer to both of them is "Yes if properly applied."

A man may be hung by the neck without breaking it, or he may be hung by the hand or by the waist and if not kept suspended too long, there will be little danger of death. So may a man take one or several amperes of current through the hand or leg or foot or other non-vital portion of the body and be not permanently disabled but I do not believe that it is possible for him to take one ampere in such a way that the brain or the heart are in the direct line of the current without instantaneous and painless dissolution.

It has for a long time been generally admitted that one ampere of current if properly applied was considerably in excess of that required to produce instant death in man—there has practically been no question as to that but the question has been how great a voltage was necessary to insure the passage of an ampere of current through the body. It has been supposed, and there has been much testimony adduced in support of the supposed fact that the resistance of the human body, and therefore the electromotive force necessary to drive a given quantity of electricity through it, was such a varying and variable quantity that measurements made of the resistance of certain individuals at one time were of absolutely no value in the case of other people or even in case of the same people at a different time. In fact there seemed to be some ground for believing that the human body offered very different resistances to currents of different potentials, and if this were so, a determination of the resistance to the milder currents that could be used without disagreeable consequences would be of absolutely no value in arriving at the resistance that would be opposed to currents of higher pressure.

The importance of knowing the resistance of the human body at the time of experiment is essential in arriving at either the number of amperes that a given electromotive force will drive through it, or the number of volts that are necessary to force a given number of amperes through it.

As late as last summer there was nothing but the most contradictory evidence on this all important point, if we are to take the evidence of electrical and medical experts who appeared before Referee Becker in the Kemmler appeal.

One expert found upon testing the resistance of a certain electrician these results:

With a current of 1 volt the resistance was 6300 ohms.
" " " " 10 volts " " " 5140 "
" " " " 50 " " " " 3850 "
" " " " 100 " " " " 3500 "

The current was passed from one hand, through the body to the other hand, perfect electrical connection being provided for by moistening the hands with a solution of sulphate of zinc. These experiments seemed to indicate that as the electromotive force increased the resistance of the body decreased.

Next a newspaper man was tried. Connection was again made by means of a solution of sulphate of zinc, but in this case the current was passed from the head to the feet. As was perhaps to be expected from the subject, the average resistance was much greater.

In the first experiment it proved to be 7097 ohms.
" " second " " " " " 6297 "
" " third " " " " " 6092 "

Newspaper men are proverbially early risers, but the electrician is not to be outdone if he knows himself, so the next witness to testify was an electrician who had tested his own resistance from hand to hand with the following results.

Using the current from 1 cell his resistance was 80,000 ohms.

Using the current from 10 cells his resistance was 37,000 ohms.

Later, using the current from 1 cell his resistance was 31,000 ohms.

Later, using the current from 10 cells his resistance was 24,500.

Two minutes after using the current from 1 cell his resistance was 36,000 ohms. Using the current from 10 cells his resistance was 21,500 ohms and in the final tests with 1 cell he found his resistance to be 21,600 ohms; with 10 cells he found his resistance to be 16,000 ohms.

These figures seemed to show two things—first that as the electromotive force experimented with increased, the resistance of the body decreased, and second, that in a series of experiments following each other in rapid succession, the resistance very rapidly decreased.

The significance of these figures is apparent when we remember that in order that one ampere of current shall be forced through a resistance the electromotive force measured in volts must exactly equal the resistance measured in ohms.

Thus from the preceding testimony we find a variation in resistance from a maximum of 80,000 ohms which would require an electromotive force of 80,000 volts if 1 ampere is the current required, down to a minimum of 3,500 ohms through which it would require a pressure of 3,500 volts to force the same current—a variation between maximum and minimum of nearly 2,300 per cent. and in the case of the same individual at different times and different potentials a variation from 80,000 to 16,000 ohms or 500 per cent.

It is evident if these figures are reliable no value whatever is to be attached to measurements made at one time in determining what the resistance would be at another.

It was known that the skin offered the greatest resistance to the passage of the current, and it was readily surmised that in different individuals greater or less callousness might be responsible for very great variations, and in the case of the same individual it was readily to be conceived that the difference in the condition of the skin as regards moisture might have a controlling effect in the measurement of the resistance of the body, and a moistening of the hands with a solution of sulphate of zinc—a good conductor of electricity, was resorted to in the first two cases cited, to remove this difficulty as far as possible, and to insure better contact. But zinc sulphate is a powerful astringent and has a tendency to harden the epidermis and prevent its absorption of moisture, or its exudation in the form of perspiration and as might have been foreseen, failed to accomplish the object for which it was intended.

Thomas Edison had foreseen the objection to the use of sulphate of zinc, and also another, viz: that it would be totally impotent to remove the insulating effects of the oily exudations of the skin, and in other respects since the resistance would depend very much on the tightness with which the electrodes were grasped by the person it would be very difficult to obtain the same conditions with two different persons or to maintain them the same with the same individual during two successive experiments.

So in his experiments to settle the question in his own mind as to the resistance of the human body he chose a liquid for moistening the skin that was not only not an astringent, but rather the reverse and which at the same time was detersive and would saponify the grease.

In a solution of caustic potash he found just such a fluid and he eliminated the uncertainty due to the variability of pressure upon the electrode by causing his subjects to place themselves within the circuit by immersing each hand in a metal jar of this solution which was connected electrically with his battery.

Following this method by which he sought to maintain his conditions more uniform, he tested the resistance of two hundred and fifty subjects—probably by far the larger number that has ever been tested under even approximately similar conditions, and found *their average resistance* to be 1,000 ohms, and out of all this number the extremes were 1,800 and 600 ohms.

He also found that the resistance of the same people at different times was practically constant—the maximum variation of the same individual at different times was 50 ohms or 5 per cent of the average resistance.

Thus we see order again brought out of chaos.

The experiments have since been repeated though not on the same scale, with results so concordant that it is now considered a pretty well settled fact that the human body does not vary more widely in its behavior toward electricity than it does toward other things—drugs or poisons for instance, and the normal resistance of an adult body is a pretty well-fixed figure and the maximum variation from the figure as determined for the individual does not exceed 5 per cent. under ordinary conditions.

CORRESPONDENCE.

New York Notes.

NEW YORK, Aug. 2.—The year's cruise of Uncle Sam's white squadron ended this week and the three war ships are now anchored in North river, just above Twenty-fifth street, awaiting further orders. Admiral Walker reports a successful cruise and speaks in high terms of the hospitable treatment received at the hands of the English, French and Spanish people. In comparison with the modern ships of other squadrons the Chicago, Atlanta and Boston are lacking in some respects, especially in electrical appliances. Admiral Walker says: "The European navies have a system of electric light squadron signals which makes it possible for a fleet to receive, answer and obey orders with wonderful quickness. All the orders at night are made by three red and white lights set perpendicularly. The lights are flashed by an operator at a keyboard placed out of the reach of danger. Of course three red and three white lights are susceptible of many combinations, and any order may be conveyed by them. We have on our ships an arrangement of three electric lights, which we devised after we got across the ocean, and which we have found very useful."

The introduction of the phonograph, like that of the telephone, is attended with many senseless objections and the latest comes from the Philadelphia Board of Park Commissioners. It conceived the idea that public health was being injured by the introduction of the ear piece into the ears of the visitors to Fairmount Park, and consequently ordered out the phonographs. This position of the commissioners is ridiculed by expert physicians and by typewriters who are accustomed to receive dictation from the phonograph. There is about as much danger from the transmission of disease through the phonograph as there is from handshaking, and no disagreeable effects upon the sense of hearing are discoverable, even from constant use.

The attitude of Commissioner Gilroy toward the Steam Heating company has aroused the ire of President Andrews, who now claims that the Department of Public Works is entirely at fault for the bad condition of underground New York. It is claimed that the leaks in the Croton water mains in front of Trinity church and in other places are the source of all the trouble, and the Steam Heating company proposes to bring suits for damages against the city. The complication grows but the true condition underneath our streets is better appreciated, so that we may look for thorough construction in the future by all concerned.

The applications of all the street car lines in Brooklyn for permission to use electric power are now before the common council, and the consent of property owners along the line is being obtained. The three big companies have decided to adopt the overhead trolley system, of which system President Lewis of the Brooklyn City Railroad, says: "We shall have a trolley wire over each track carrying 500 volts, and there will be an elaborate system of connections with a large underground supply wire, which will be laid underneath the curbstones. Iron posts on each side of the street will support the trolley wire, and parallel with it will run the wire carrying the current and getting its supply at frequent intervals from the underground supply wire. The consents from the property owners are coming in very rapidly, and as yet no opposition is manifested to the change."

The grievances of the residents of West Brooklyn against the Brooklyn, Bath & West End railroad were heard by the State Board of Railroad commissioners. The trouble was due to the discontinuance of railway connections with the Thirty-ninth street ferry running between Bay Ridge and the Battery. In behalf of the West End road President Butler said that a new schedule had been adopted by his company in which the fares were made to conform to the statutory rate per mile, and that arrangements had been made with the Brooklyn City and Atlantic avenue street car lines to extend and make connections with the West End railroad, and thus secure the desired relief to remote districts in west Brooklyn.

General Manager Eckert of the Western Union Telegraph company, has issued a circular to the heads of the departments that were affected by the recent fire, requesting them to express to their different subordinates the thanks of the executive officers for the zeal and industry exhibited in furthering the re-establishment of the telegraph service.

The State Railroad commission has approved the application of the Coney Island & Brooklyn railroad for permission to change from horses to electricity. Whether this approval carries with it the right to construct the line across Ocean Parkway is one which the courts will be called upon to decide. The park commissioners object to this interpretation of the approval of the commission, claiming that the Brooklyn Consolidation Act prohibits the crossing of Ocean Parkway at grade by any railroad operated by other than horse power.

W. H. T.

Pittsburg, Pa.

PITTSBURG, Aug. 2.—A mishap occurred on the Central Traction road in this city a few days ago, which caused an interruption of the operation of the road for two whole days. This road is operated by a cable which snapped in two on the afternoon of July 26th. A new cable has since been put in.

The South Side Traction company was last week absorbed by the Birmingham Traction company for the consideration of $200,000, which the latter paid for the franchises and rights of way owned by the former corporation.

The most important horse car lines of the city of Alle-

gheny have just been consolidated into a new corporation, and they will immediately convert the motive power of all these roads into an electric system. The new corporation is called the Allegheny Traction company, and it comprises the Pittsburg, Allegheny & Manchester, the Union, the Troy Hill and the Transverse lines. The entire system operates over 100 cars.

The Squirrel Hill Electric Railroad, which promised to open up a beautiful portion of Pittsburg, for resident purposes, has for the present at least become a dead factor in the street railways of this city. This has been the result of some bad manipulation on the part of the projectors of the road, who were not able to continue the enterprise. It is now in the hands of a receiver, and it will probably be sold before long. E. H. H.

Hastings, Neb.

HASTINGS, Aug. 2.—The Hastings Electric Light & Power company has recently added a 26-light Ball arc machine of 1,200-candle power, making a total capacity for the plant of 66 2,000-candle power, 25 800-candle power and 26 1,200-candle power arc lights, or 117 in all. The company at present is operating 97 lights, making a gain of 75 lights in one year. It is also operating an incandescent plant of 1,350-lights' capacity. The company started in business nearly three years ago, but the lights did not take well with the people until about a year ago. The management takes considerable pride in the growth of the plant, considering the size of the city, 13,000 inhabitants.

The horse car line of the Hastings Improvement company, comprising about fourteen miles of track, with all equipments, was sold at master's sale last month and purchased by Boston capitalists who have organized with a capital stock of $150,000 and will equip the entire line with electric cars. Power will probably be furnished by the electric light company.

The isolated plant of the Nebraska Insane Asylum at this city is lighted by 200 Thomson-Houston incandescents. The engine which is run for laundry purposes during the day operates a dynamo for charging a set of Pumpelly storage batteries. The latter furnish the light after 9 P. M The system is giving excellent satisfaction and the superintendent will at the next session of the legislature make an effort to secure an appropriation for motors to run the laundry machinery. The power is now conveyed about 300 feet by cables, which give unsatisfactory results.

The Nebraska Telephone company now has nearly 300 instruments in use and is making many improvements in its service. E. H. J.

Louisville, Ky.

LOUISVILLE, Ky., Aug 2, 1890.—A local enterprise of interest to every one in this city and in the little cities of New Albany and Jeffersonville, Ind., just across the river, is that of building a suburban belt line connecting the two latter cities. It was the first design to build a steam line some five miles long, forming a belt connecting both cities with Louisville by the new Louisville and Jeffersonville bridge and the Kentucky and Indiana bridge. That plan was finally abandoned, however, and electricity will be employed. A couple of days ago the first steps were taken, and Hon. John M. Stotsenberg of New Albany, formed a company with fifteen incorporators. The necessary papers will be secured at once from the secretary of state. The title of the corporation will be the Ohio Falls Electric Railway company, and its capital stock is to be fixed at $150,000. The route of the electric line, beginning at Jeffersonville, will be from the junction with the Market street tramway, thence along the Riverside turnpike, past the Ohio Falls, Howard Park and Clarksville, past the New Albany & Charlestown road, at Silver Creek, and thence into New Albany. Negotiations for the right of way are not only pending, but a number of property holders have given their consent.

The poles for the electric line on Fourth street are being placed in position, and the ground wires for the return circuit are being laid along the rails. The merchants of the city and the residents along the line have petitioned for asphalt between the tracks as well as on the sides of the street. Now that electricity has been substituted for mules, and the wear and tear will not be so great as before, the request will, no doubt, be acceded to.

Close upon the announcement that Macauley's theater would have a new electric light plant and an electric motor comes the announcement that Manager Bourlier of the Masonic Temple theater, will also equip his place of amusement with electric lights.

The Brush Electric Light company has notified the city of Madison, Ind., that proceedings will be instituted against the corporation for alleged infringement of the double carbon arc lamp patent. The city is using the Jenney system of electric lighting. A compromise, it is predicted, will probably be effected.

The Capital Railway company of Frankfort, Ky., has been incorporated by Messrs. Fayette Hewitt, P. McDonald, John W. Pruett, John Meagher, W. H. Posey and John F. Buckley. The company has been considering the question of building an electric belt line for the Kentucky state capital for some time. Now the last obstacles have been removed, and the right of way has been obtained. Besides, all the other necessary privileges have been secured looking to a speedy building of an electric street railway, which will not only connect the north and south sides of the city, but run along most of the principal streets of each side, and along two of the country turnpikes for some distance. There was a delay in the Frankfort general council, otherwise the line would have been ready by this time The night of the 22d inst., however, the city council met and gave the right for an overhead system of wires instead of an underground system, which the ordinance at first provided. The Thomson-Houston system will be adopted, but the number of cars required, etc., has not yet been determined. Work will begin within ninety days, and two and a half miles must be completed by March 11 next. The entire line when completed will be five or six miles long, and will cost between $75,000 and $100,000. The cars will eventually run out the Owenton turnpike, and return by the Leestown turnpike, thus bringing into close connection many suburbs now difficult of access, and thus completely encircling Fort Hill, which the hill-confined limits of the capital city demand. J. W. L.

Indianapolis, Ind.

INDIANAPOLIS, July 30.—As a result of the change from animal power to electric motors on the Illinois street line of the Citizens' Street Railway company, travel has increased to such an extent that where the company formerly had one car with animal power, it has now a motor car with a trailer. Even with this addition it has not been able to accommodate travel. Recently a second trailer was put on and each train was crowded during the day. There are ten motor cars in service at present and five additional motors have been ordered. Two additional generators of 80-horse power each have been ordered, one of which is now here and will be placed at once in position.

Owing to the weight of the motor cars and the heavy loads carried, it has been found that considerable time is lost in stopping the trains with the old fashioned hand brake. The company, by way of experiment, will equip one of the motor cars with the Eames vacuum brake. If it proves successful, all the cars on this line will be similarly equipped.

The old rails on a portion of the track are to be replaced by newer and heavier ones. This change will put the track into first-class condition.

The citizens of Irvington, a suburb three miles east of the city, for some years have been trying to arrange with a railroad or a street car company for a suburban service. About a year ago an agreement was entered into between that village and the Citizens' Street Railway company, whereby the latter agreed to put in a first-class track and adopt some means of rapid transit. President Shaffer has finally decided upon and ordered two storage battery motor cars which will be put on August 1. The speed is to be about eight miles an hour.

All the trailers on the Illinois street line are lighted by incandescent lights.

The Brush Electric Lighting and Power company of this city is giving its attention largely to supplying power and has a large number of motors in service in printing offices, barber shops, restaurants and drugstores. One large tea store has a motor, set up in its front window, used for running a coffee mill.

The Perry incandescent company has put a large amount of lead armored cable into its underground conduits, and is now making connections with buildings. This company is also doing considerable in the way of supplying motors for light power.

The Jenney Electric Motor company is crowded with orders and finds it almost impossible to keep up with the demand. M.

THE ELECTRIC LIGHT.

The city plant at Little Rock, Ark., will be enlarged by the addition of a new dynamo.

Washington, Georgia, is to be illuminated by 500 Westinghouse alternate current lights.

An electric light plant will probably be installed in the Hotel Detroit, St. Petersburg, Ark.

An alternating current arc light system has been installed in Moline, Ill., and in the factory of the Jarecki Manufacturing company, Erie, Pa.

The Passaic, N. J., Electric Light company will increase the facilities of its plant and add new machinery. Two engines, 125-horse power and 100-horse power, one 80-horse power generator and 1,300 lights are among the contemplated additions.

The Augusta, Ga., Electric Light, Heat & Motive Power company has been formed with a capital stock of $50,000, and will be incorporated at once.

The Westinghouse Electric & Manufacturing company has just sold a 40-light alternate current arc dynamo to an electric lighting company in Three Rivers, Michigan.

The Hyde Park Electric Light & Power company of Hyde Park, Chicago, is taking down all its old poles, and is replacing them with handsome painted poles.

The plants of the Kensington, Ill., Electric Light company, with 50 Sperry arc lights, and of the Hyde Park Electric works, with 62 Sperry lights, were started last week.

The Monongahela City (Pa.) Electric company, an organization lately established, has just concluded negotiations with the Westinghouse Electric & Manufacturing company for alternating current incandescent apparatus of 750 lights' capacity.

The Pacific Electrical Storage company has sold a lighting plant to the Grant's Pass, Ore., Electric Light company for a central station. It will be a 500 light plant and the first central station storage battery plant on the coast, outside of California.

A dispatch from Waterloo, Ia., July 31st, says: The three-story brick building occupied by the gas and electric light company of this city was entirely gutted by fire, which broke out this afternoon; estimated loss, $8,000. There is some insurance on the machinery, but the building, which belongs to the Union Mills company, is uninsured.

According to a San Francisco, Cal., exchange, the United Edison Manufacturing company has made a proposition to the Mechanics' institute directors to place in the pavilion during the Fair an incandescent column or pillar on the floor opposite the entrance, an incandescent revolving Christmas tree at the opposite end of the building, and to place 2,000 incandescent lights in the building, 950 of which will be on the main floor, the institute to furnish 200 horse power to run the dynamos.

The city of Alameda, Cal., has expended $45,000 in the establishment of an electric light plant, and it is now proposed to invest $10,000 more for an incandescent plant to supply private consumers. City Electrician Goldwaite has been instructed to prepare estimates of the cost of supplying 500 or 1,000 incandescent lights from the present plant, and also the cost of the required improvements. It has also been proposed that the city lease the plant to a private corporation which will undertake the work of lighting the city.

THE ELECTRIC MOTOR.

Elmira, N. Y., is to have a new electric line.

Judge Dillon of St. Louis, last week granted an injunction restraining the Southern Railway company from tearing up the tracks of the Union Depot Railway company at Ninth street and Russell avenue. The former company is now changing its motive power to electricity, and desires to make the change at the point named immediately, claiming that two electric lines cannot be run on the same track and wires. It is using the Union Depot company's tracks at Ninth street and Russell avenue, but the latter company is not just now ready to construct its own line anew, but will be in a few weeks.

A correspondent in Little Rock, Ark., writes: "It may interest you to know that the city council of this city has granted the Capital Street Railway company the right to substitute electricity for mules as its motive power over the 15 miles of track operated here by that company. It is understood that in the near future eight or ten miles of additional track will be constructed. The Press Printing company has closed a contract with the Edison Electric Light company of Little Rock to substitute electricity for steam as its motive power. The following machines are to be operated: 1 Campbell two-revolution press; 1 Cottrell & Babcock drum cylinder and folder; 1 Pony Campbell, two revolutions; 1 Pony Hoe, drum cylinder; 2 Quarto universal presses; ½ Medium press; ½ Nonpareil press; 1 Star Sanborn paper cutter; 1 Book trimmer; 2 Ruling machines; 1 Folding machine; 1 Wire stitcher. This machinery requires 70 feet of shafting. The Press company reduces its motive power expenses $100 per month by making the change."

The contract between the city of Rochester, N. Y., and the company controlling the street railway lines of that city, has been executed. The contract prescribes the location and equipment of the power house and provides for the furnishing at all times of power sufficient to operate the cars run by the company. The dynamos shall have a rated capacity of at least 1,000 electrical horse power. The provisions regarding the wiring are very explicit. The steel and wooden poles shall be set or reset in the manner and at the locations approved by the committee and under the direction of the superintendent of the fire alarm telegraph system of the city. The railway company may use the poles of the Brush, Rochester and Edison Electric Light companies, and of the Bell Telephone company for stringing feed, span and guy wires, in all cases where it shall obtain the right to do so, but the poles so used shall first be inspected by the committee and the superintendent. In case these poles are removed by the companies named, the railway company shall erect its own poles. It was decided that steel poles should be erected on Main street from East avenue to the Erie canal and on State and Exchange streets from Vincent place to the Erie canal. Provisions were made for cutting out the current in case of fire and enabling cars to run on each side of the section cut out.

Miscellaneous Notes.

The Boston Manufacturers' Mutual Fire and Insurance company has issued a set of rules for the installation of electric light and power plants.

The Brown Electric company has been formed at Chicago to deal in patents and operate patented appliances, etc.; capital stock, $1,000,000; incorporators, F. H. Brown, I. L. Moore and others.

The Electric Light company's station and the Western Union Telegraph company's office at Seneca Falls, N. Y., were both destroyed in the fire that destroyed the principal part of that village last week.

Following the example of their sires a number of messengers at the stock yards, Chicago, formed a union and "went on a strike" last week. Their action had no noticeable effect upon the commercial world, however.

In the Plymouth Clothing house, in Minneapolis, three of the Carpenter electric pressing irons are taking the place of three self-heated gas irons. One trouble with the gas irons has been that the bottom of the iron could not be kept heated in doing damp pressing, although the burner is located on the bottom of the iron. The trouble is not experienced, it is stated, with the electrically heated iron.

The announcement is made of the incorporation of two electrical companies at Alexandria, Va. The capital stock of each company is $500,000, and in both cases the officers are the same: J. M Glover of St. Louis, president, and C. W. Field, Jr., of New York city, secretary. The names of these companies are the New York Electrical Device company and the Equitable Electrical company. The object of the corporations is not made known.

Personal Mention.

Walter K. Freeman of New York was in Chicago this week.

Daniel Hemingray of the Hemingray Glass company, Covington, Ky., was in Chicago last week.

George B. Shaw, general manager of the National Electric Manufacturing company, was in Chicago Monday.

J. H. Reed, who has represented the Mather Electric company in the west for several years, has resigned to accept the position of general manager of the Easton Electric Light company. He will take personal charge of the western business and will have the exclusive agency of all territory west of the Ohio river. Mr. Reed has been a successful salesman and his friends hope for his continued success.

Business Mention.

The Detroit Electrical Manufacturing company of Detroit is placing on the market a new arc light switch which has been received with great favor.

The Markle Engineering company of Detroit reports an excellent business on the electric light specialities, especially in the improved Stoddard cut-out for which a remarkable sale is predicted.

The C. & C. Electric Motor company of 402 and 404 Greenwich street, New York, reports that its sales during the last six weeks aggregate a greater number than it has heretofore delivered in any one year.

The Pond Engineering company of St. Louis, in order to accommodate increasing business in Texas and on the Pacific coast, has opened branch offices at Dallas, Texas, and Seattle, Washington, from which points the company will be prepared to answer all inquiries regarding contracts for engineering work.

The Jenney Electric Motor company of Indianapolis has just issued a little pamphlet entitled "Electric Motors and the Transmission of Power by Electricity," in which a considerable amount of interesting matter has been compiled. The subjects of electric motors in general, distribution of power, transmission of water power, etc., are considered, and a full description of the Jenney motor follows.

English, Morse & Co. of Kansas City, Mo., report numerous sales of Atlas & Ide engines, boilers, steam pumps and the various engineering specialties for which they are head quarters. The firm shipped the past week a 60 horse power automatic engine and steel tubular boiler with pump heater and complete outfit, to Denver, Colo. They have also shipped the past week a 60-horse power Atlas engine and steel boiler to Arizona.

The Detroit Dynamo company is a new corporation located in the Stamping Building, Detroit. Messrs. King and Collins, the managers, have been in the electro-plating business in Detroit for a number of years. They have built a number of plating machines and finding this type to be unusually salable have determined to adopt it for light and power purposes. They are now placing on the market a complete line of these goods.

The Interior Conduit & Insulation company has been obliged to enlarge its office facilities at 16 and 18 Broad street, New York, and Edwin T. Greenfield, the electrician of the company, is now to be found there, solving the many architectural problems of interior wiring and distribution in conduits. At the factory of the company ten new machines for the manufacture of the interior tubing are daily expected in order to keep up with the immense orders now on hand.

C. E. Sargent, manager for A. L. Ide & Son, 89 Lake street, secured the following orders for Ideal engines during the month of July: Kenwood Bridge company, 65-horse power; Raymond Lead Works, 35-horse power; Lincoln Park electric fountain, 110-horse power; L. Klein, 55-horse power; Chicago Club, 75-horse power; Mounts Gas & Electric Light company, Carlinville, Ill., 55-horse power; Western Electric company, 60-horse power; Standard Wire & Iron Works, 35-horse power. The works at Springfield have several months' orders ahead and are obliged to work night and day to fill them.

The Tripp Manufacturing company of Boston has recently made a shipment of its celebrated anti-friction journal bearings to the Chicago & Northwestern Railway company for passenger car service. The company has shipped electric car trucks to the Concord Horse Railroad company, Concord, N H.; Wilkes Barre & Suburban Street Railroad company, Wilkes Barre, Pa.; Citizens' Cable Traction Railroad company, Pittsburg, Pa. The company is now manufacturing electric trucks for the following roads: West Side Street Railroad company, Milwaukee, Wis.; Citizens' Street Railroad company, Indianapolis, Ind.; St. Paul City Railway company, St. Paul, Minn.; Tacoma & Stellacoom Railroad company, Tacoma, Wash.; Vancouver Electric Railroad & Lighting company, Vancouver, B. C.

The Great Western Electric Supply company is putting out armature and intermediate pinions, made of a substance not heretofore used. This gives a noiseless pinion, it is stated, and at the same time one that will outwear rawhide several times over The company is anxious to receive trial orders from railway companies, believing that the result of a test will be their constant use. The company has tried them and found them much superior to rawhide. As the price is also lower, they should prove far more economical, it is claimed, than any noiseless gear yet tried. Chas G. Armstrong, manager of the House Goods department of the Great Western Electric Supply company, has just returned from the East, where he made arrangements for the handling of a superior line of goods throughout the Central and Western states Thus his company will have all the choice articles made by the National Electric Manufacturing company, and the fine line of telegraph instruments as used by the Western Union Telegraph company. It will be remembered that the recent patent litigation left the Electric Gas Lighting company of Boston on top, giving legal protection to the gas lighting apparatus now supplied to the West by the Great Western Electric Supply company. The same company is the western agent for Brown's electric protector, which protects telephone circuits from the evil effects of lightning and crosses. The company is now importing Ruhmkorff coils and other scientific apparatus.

Electrical Patents.

Issued July 29, 1890.

432,965. Electric Light Fixture. Fred H. Aldrich, Cadillac, Mich.

432,973 Galvanic Battery. Horatio J. Brewer, New York, N. Y.

The invention has special reference to the structure of the cover, by means of which the elements can be supported in the jar.

432,978. Electric Cut-Out. Henry A. Chase, Boston, Mass.

432,979. Electric Cut-Out. Henry A. Chase, Boston, Mass.

432,980. Fuse Block and Lightning Arrester. Henry A Chase, Boston, Mass.

432,988. Automatic Electric Switch and Cut Off Chas. B. Doyle, Maywood, Ill.

The invention relates to switches for connecting and disconnecting electric motors, and embraces four principal features: First, the switch lever carrying a safety catch in connection with a shield; second, a weight acting to move the contact arm across the contacts of the rheostat to gradually shunt out the resistance of the rheostat; third, the lever is adapted to be brought into engagement with the weight when lifted to open the circuit, so as to be connected with the weight to raise the same when the lever is brought down to close the circuit; and fourth, an escapement controlling the rate of movement of the contact, which is impelled by a weight across the contact of the resistance coils so arranged that the resistance is so gradually removed as to prevent injury to the motor.

433,022. Electro Magnetic Cut Out. Bernice J. Noyes, Boston. Mass.

433,025. Conduit for Telegraph Cables. William R. Patterson, Chicago, Ill.

The invention consists in providing rectangular manholes, which are placed so that diagonally opposite corners will be in line with the conduits. The cable, in following the sides from one corner to the other, is bent only 180 degrees—that is to say, there are three bends necessary: first, 45 degrees, then at the corner 90 degeees, and lastly, as the cable goes out, 45 degrees.

The first claim reads: "The combination, with the angular manhole of an underground electric cable system, of conduits connected with the manhole at opposite angles and cables laid in said conduits and bent to conform to the sides of the manhole, whereby space is afforded for splices on opposite sides, and all unnecessary bending of the cable avoided."

433,041. Electrode for Arc Lamps. Llewellyn Saunderson, Kingstown, County of Dublin, Ireland.

433,045. Safety Cut-Out. Charles E. Scribner, Chicago, Ill.

433,046. Loop-Key. Charles E. Scribner, Chicago, Ill.

The loop key is designed especially for use in connection with the switch-boards of telephone exchanges for making the connections and disconnections between the operator's outfit and the telephone lines.

433,047. Test Circuit for Multiple Switch-Boards. Charles E. Scribner, Chicago, Ill.

The first claim follows: "A testing apparatus consisting of a battery and an electro-magnet provided with two windings, one of a small number of convolutions and the other of a large number of convolutions included in a ground circuit, a shunt around the high-resistance coil, including the armature-lever and the flexible cord and terminal plug of said circuit."

433,051. Dynamo-Electric Machine. Henry W. Spang, New York N. Y.

433,076. Spring-Motor. Robert R. Forbes and Samuel S. Holly, Hale's Ford, Va.

433,082. Dynamo Telegraphy. Francis W. Jones, New York, N. Y.

The invention consists in the combination, with a spring jack of any usual construction, of a supplemental or auxiliary switch actuated by the wedge of the spring jack, and having contacts of different potential adapted, respectively, to the resistance of the normal local circuit and to the added resistance of the branch or loop line to be connected to the local, whereby, on insertion of the wedge, the switch may be automatically changed to connect the circuit to a source of different potential.

433,120. Telephone. Stephen D Field, Yonkers, N. Y.

433,167. Apparatus for Detecting Irregularities in Railroad Tracks. James B. Glover, Marietta, Ga.

433,170. Electric Railway. Rudolph M. Hunter, Philadelphia Pa.

433,174. Separator for Secondary Batteries. William P. Kookogey, Brooklyn, N. Y.

433,180. Electro Motor Traction Wheel. Albert L. Parcelle, Boston, Mass.

433 181. System of Electrical Transportation. Albert L. Parcelle. Boston, Mass.

433,187. Safety Cut-Out. Marshall S. Shapleigh, Philadelphia, Pa.

433 210 Electric Apparatus for Railways John B. ODell, Chicago, Ill.

One object of the invention is to so improve the construction of the motor as to better adapt it for service in transmitting the power to a car axle, or in whatever situation it might be employed, and this object is accomplished in the preferred construction by providing a motor with two armatures, a shaft connecting said armatures, and magnets for the armatures, and a pulley or other gear device located upon the shaft intermediate the armatures

433,216. Automatic Electric Train-Signal. Albert W. Reppy, Oakland. Cal

The invention consists in an apparatus adapted to be called into action in any possible contingency, particularly upon the breaking of any portion of the train, or at the will of any passenger or trainman.

433,229. Thermal Cut-Out. Alexander Bernstein, London, County of Middlesex, England.

433,266 Pole for Supporting Electric Wires. Leonard Atwood, Philadelphia, Pa.

433,269. Regulator for Dynamo Electric Machines. Perley P. Belt, Fredonia, Kan.

433,307. Telephone Call Register. Willis E. Robinson, Faribault, Minn.

433.359. Rheostat Switch. James F. MacLaughlin, Philadelphia, Pa.

433,360. Electric Switch. James F. MacLaughlin, Philadelphia, Pa.

433,371. Holder for Incandescent Electric Lamps. Adolf Schirmer, Berlin, Germany.

433 375. Electric Heat-Regulating System. Frank M. Sparrow, Mattapoisett, Mass.

Of the six claims the fifth is given: "The combination, with an automatic electric heat-regulating system, of a supplemental switch connected to be operated by a steam-pressed diaphragm, of the heater for controlling the circuit in which the motor is situated."

433,381. Electro Magnetic Transmitter. John T. Williams, Mount Vernon, N. Y.

433,384. Electrical Syringe. James H. Woodward, Seward, Neb.

433,390. Brush-Holder for Electrical Machines. Warren S. Belding, Englewood, Ill.

433,391. Armature for Dynamos, Etc. Warren S. Belding, Englewood, Ill.

433,392. Blank for Armature Coil Guards. Warren S. Belding, Englewood, Ill.

433,393. Commutator for Dynamos. Warren S. Belding, Chicago, Ill.

433,400. Magnetic Coupling Device. Theodore M. Foote, Boston, Mass.

433,401. Variable Speed Gearing for Electric Cars. Theodore M. Foote, Boston, Mass.

433,402. Reversing-Gear for Electric Cars. Theodore M. Foote, Boston, Mass.

433,407. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

433,408. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

433,409. Electric Railway. Herbert R. Keithley, Denver, Colo.

The first claim is given: "In an electric railway, the combination of a continuous insulated supply-conductor with copper contact pulleys and spindles, and glass insulating supports, all inclosed in a slotted conduit."

433,421. Telegraphic Circuit. Arthur C. Robbins, Brooklyn, N. Y.

433,424. Combination Telephone Key. Charles E. Scribner, Chicago, Ill.

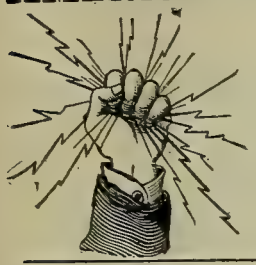
The invention consists in providing a grooved wedge and two studs or separating pieces of insulating material and a knife edge contact point upon one of the springs.

433,425. Contact Device for Electric Railways. Frank J. Sprague, New York, N. Y.

433,430. Lightning Arrester. Alexander Wurts and Oscar H. Baldwin, Pittsburg, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

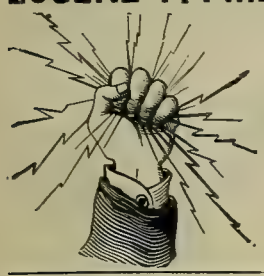
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS
MAKE ANYTHING IN BRASS.
4 LASALLE AVE CHICAGO.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

THE SUNBEAM

MAINTAINS ITS RATED CANDLE POWER.

SEND FOR PRICE LIST.

SUNBEAM INCANDESCENT LAMP CO.,

Corner Randolph and Canal Sts., CHICAGO, ILL.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue 1--66 of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

FIBRONE

Is the recognized **BEST SUBSTITUTE** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES

Also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We claim to manufacture **the very material** wanted by the Electrical Trade. Send for estimates and prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

OKONITE
TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

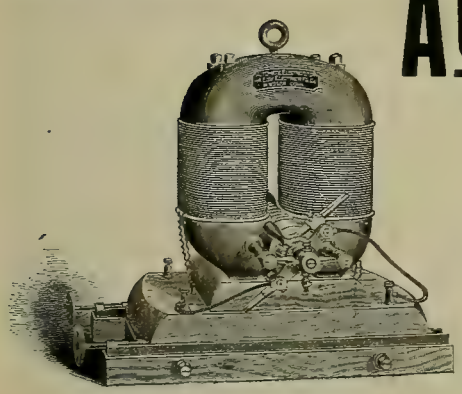
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 508 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

EMPIRE CHINA WORKS,

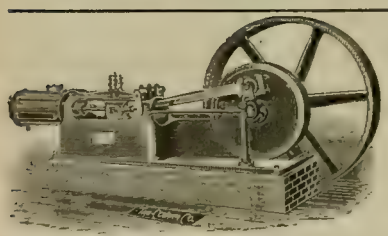
144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.



RICE AUTOMATIC ENGINES.

Simple, Compound, Compound-Condensing.

BOILERS,

HANCOCK INSPIRATORS, FEED WATER HEATERS, Etc.

We make a Specialty of Erecting Complete **Steam Plants.**

SMITH-VAILE STEAM PUMPS for every purpose.

FAIRBANKS, MORSE & CO.,

ST. LOUIS. **CHICAGO.** KANSAS CITY.

DENVER. OMAHA. ST. PAUL.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

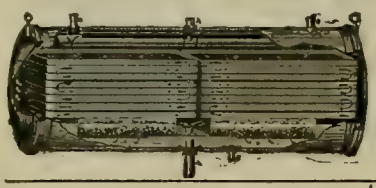
Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. Correspondence Solicited.

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

WANTED.

Man to take charge of Detail Department of Electrical Factory. Must be a good mechanic, and have had experience in managing men.

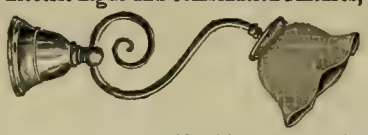
Applications should state experience and salary expected. Address MECHANIC,

Care of WESTERN ELECTRICIAN.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

ELECTRICAL WOOD.

Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

WANTED.

At once, experienced armature winders. Best of reference required.

COLUMBIA ELECTRIC CO.,

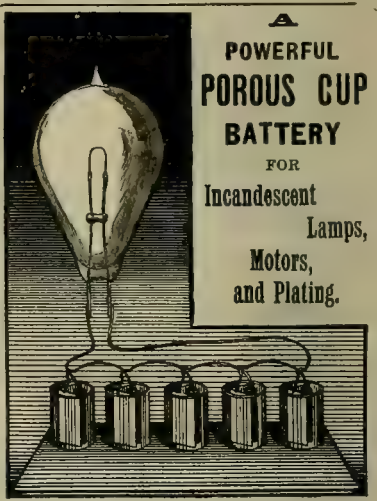
207 E. Fourth St.,

ST PAUL, MINN.

ROSE POLYTECHNIC INSTITUTE,

TERRE HAUTE, IND.—A SCHOOL OF ENGINEERING.

Well endowed, well equipped departments of Mechanical and Civil Engineering, Electricity, Chemistry, Drawing. Extensive Shops & Laboratories. Expenses low. For catalogue address C. A. Waldo, Lib'n.



A POWERFUL **POROUS CUP BATTERY** FOR Incandescent Lamps, Motors, and Plating.

E. M. F. full 2 volts Battery will last from two to four months, according to work required.

Price for Cell	$1 25
Incandescent Lamps, each	1 00
2 Cells and 1 C. P. Lamp	3.50
3 Cells and 3 C. P. Lamp	4.75
4 Cells and 4 C. P. Lamp	6.00
5 Cells and 6 C. P. Lamp	7.00

Battery has been in successful use for ten months, and guaranteed as represented.

E. K. CLASS,

CITY HALL,

RICHMOND, IND.

Electrical Supplies of All Kinds.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

Binders FOR THE Western Electrician **$1.00.**

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

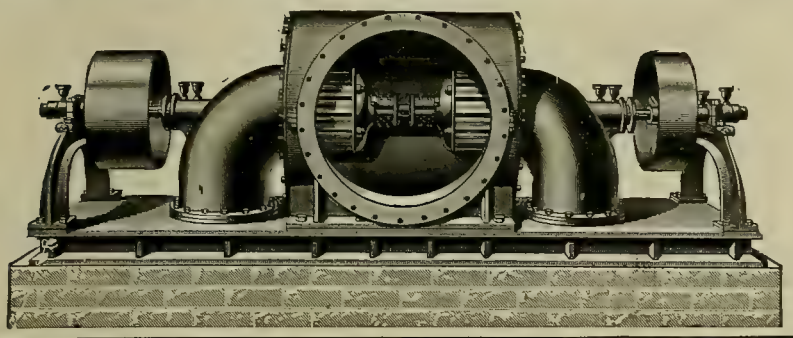
ALFRED F. MOORE

(ESTABLISHED 1870.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO.

1221-1223 Union Ave.

KANSAS CITY, MO.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

WILLIAM S. BATES,

PATENT LAWYER,

204 Dearborn Street, Chicago.

17 YEARS EXPERIENCE IN THE PATENT OFFICE AND THE COURTS.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS

—FOR—

ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,

BOSTON, - MASS.

CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

COLUMBIA Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

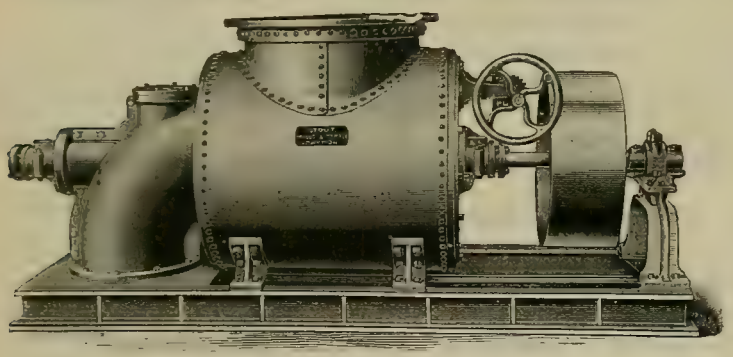
Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

THE SPERRY ELECTRIC CO.,

D. P. PERRY, Vice-President and General Manager,

——MANUFACTURERS OF THE——

SPERRY IMPROVED SYSTEM

——OF——

ARC LIGHTING,

HIGH OR LOW TENSION.

WE GUARANTEE:

1. The new Sperry apparatus free from repairs for twelve months.
2. That the new Sperry improved Dynamos can be coupled in series with perfect safety.
3. That any number of lamps from one to capacity of dynamo can be cut in or out of circuit, singly or in groups, with perfect safety, and without sparking at the brushes.
4. To absorb power in exact proportion to number of lights burning.

WE BELIEVE:

1. The new Automatic Sperry Dynamos and Lamps surpass in efficiency those of any other make.
2. That there is greater economy in operating the new Sperry System than any other.
3. That our automatic regulation has no equal; no rheostat, no wall boxes, no solenoid or dash-pot.
4. That if you will visit our factory we can show you the best arc lighting apparatus in existence.

We invite correspondence with electrical engineers, intending buyers, and interested people everywhere.

THE SPERRY ELECTRIC CO., 195 to 207 South Canal Street, CHICAGO ILL.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

HELMET WATER PROOF WEATHER PROOF BRAND.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

Cleverly 1018 CHESTNUT ST. PHILA.

Electric Specialties.

——WE MAKE——

Electric Supplies Under Contract.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. C. HOBART, Sec'y. J. H. EICKERSHOFF, Sup't.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. **Compound and Valveless.**

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

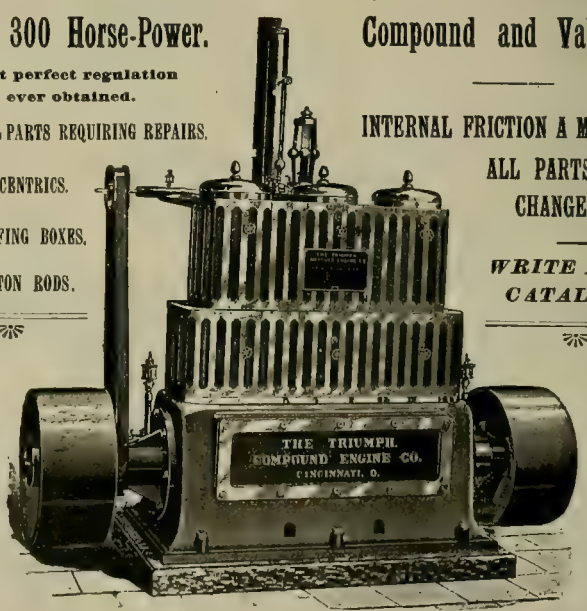
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

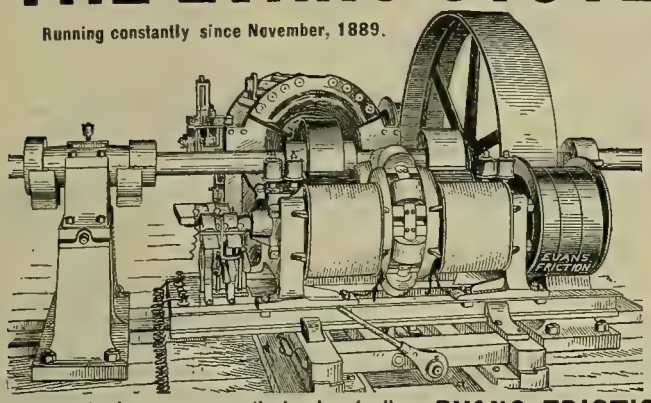
THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

Running constantly since November, 1889.



We guarantee less pressure on the bearings for the same power than with ordinary belting.

JAMESTOWN ELECTRIC LIGHT AND POWER COMPANY,
JAMESTOWN, N. Y., Feb. 1, 1890.

EVANS FRICTION CO., 85 Water St., Boston, Mass.:

GENTLEMEN:—I take pleasure in replying to your request that I should give you my experience relating to the use of the Evans Frictional Pulley for the driving of dynamos. On the 14th day of November last, we commenced the use of your pulley on a Thomson-Houston L. D. Arc Dynamo, and after two and one-half months trial I can assure you the test has been most satisfactory to us. We have recently placed a No. 7 Brush Dynamo on the opposite side of the same fly wheel; both machines are running perfectly. The great advantage derived is in being able to throw any machine in or out of gear without interference with other dynamos running from same shaft. It has many other advantages to recommend it, namely: there is positively no slipping of belts, economy of space, also economy in cost of belts. The bearings have *less pressure* than those operated by the usual method. I consider your system a success, and were we to build another station, we would place an Evans Friction Pulley on each and every dynamo. I have much pleasure in recommending your system to the management of all Electric Light and Power Stations.

CHARLES W. GRANT, President,
Jamestown Electric Light and Power Co.

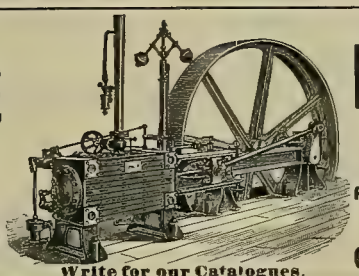
ADDRESS THE
EVANS FRICTION CONE CO., 85 Water St., BOSTON.

Also manufacturers and patentees of Cone Pulleys (as per cut) which have been in successful operation for over three years, transmitting from one to fifty H. P.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,
79 and 81 Washington St., Brooklyn, N. Y.,

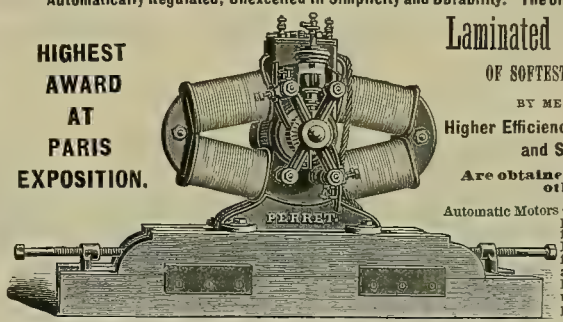
—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

ARMATURES REPAIRED and REWOUND
COMMUTATORS TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS M. WILKINS. E. WARD W LKINS

TRADING AS

PARTRICK & CARTER,

Manufacturers of and Dealers in Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

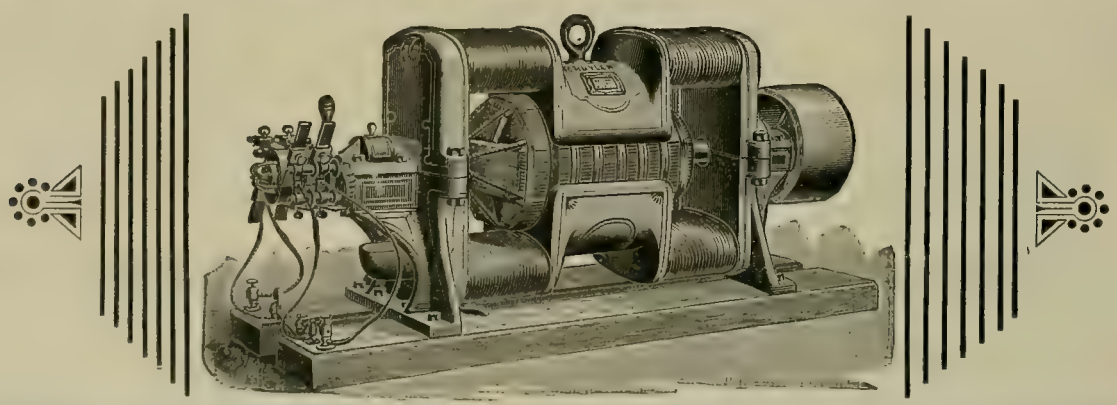
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S
PATENTED
OVAL
Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

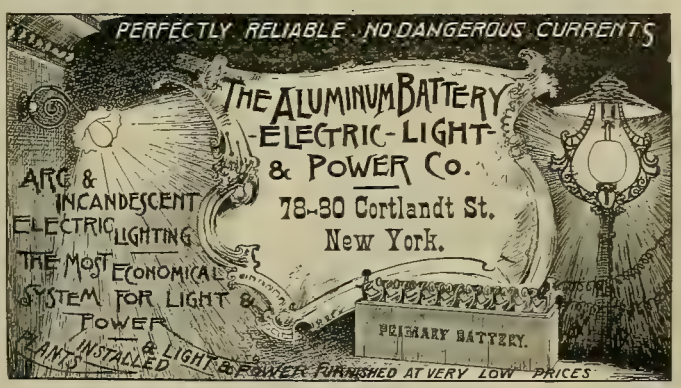
Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

OKONITE
TRADE MARK.
WIRES, CABLES,
TAPE and CORD
FOR
PROMPT SHIPMENT.

HOGGSON'S
IMPROVED
Door Spring.
Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

WHEN YOU BUY A MOTOR

From ANY Manufacturer or Dealer,
State that you WANT IT SUPPLIED WITH the
Whittingham Automatic Switch.
Send for Catalogue.
Automatic Switch Co.,
No. 8 Keyser Building,
BALTIMORE, MD.



TRADE GONDA MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World.

THE LECLANCHE BATTERY CO.,
149 West 18th Street, - - NEW YORK.

POND ENGINEERING CO.,
ST. LOUIS, CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.
ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.
COMPLETE STEAM PLANTS CONTRACTED FOR.
ERECTED READY FOR SERVICE.
SPECIALTIES:—The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, Etc.
SEND FOR LATEST CATALOGUE.

SPEAKING TUBES and WHISTLES,
Oral, Electric, Pneumatic, and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.
W. R. OSTRANDER & CO.,
21, 23 and 25 Ann St. New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE, out August 1st.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.
THE ACME LINK BELT
IS MADE ONLY BY THE
Page Belting Company, Concord, N. H.
BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.
STREET CARS
FOR
ELECTRIC MOTORS
CARS ADAPTED TO ALL SYSTEMS.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

THE CENTRAL THOMSON-HOUSTON CO.,

A. STUART, President.

215 West Fourth Street, CINCINNATI, OHIO.

ELECTRICAL ENGINEERS AND CONTRACTORS,

BUILDERS OF ARC, DIRECT AND ALTERNATING INCANDESCENT LIGHTING, CENTRAL STATIONS AND ELECTRIC POWER PLANTS.

ELECTRICAL SUPPLIES OF ALL KINDS. { SIMPLEX WIRE AND GRIMSHAW RUBBER COVERED WIRE ALWAYS ON HAND. } Bottom Prices. Quick Shipments.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

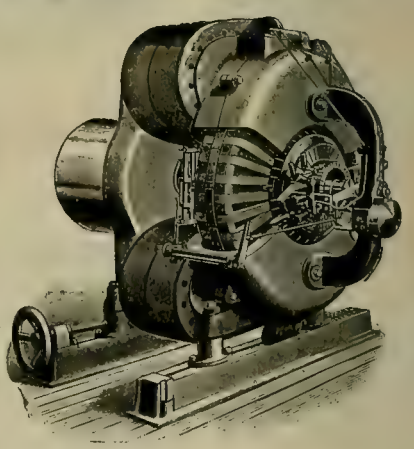
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)

MANUFACTURERS OF

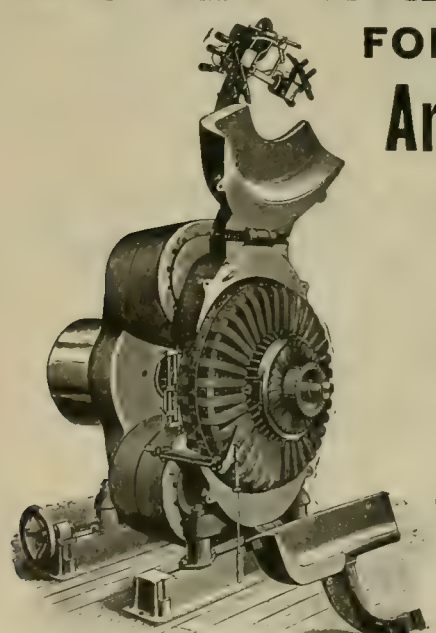
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE: No. 425, THE ROOKERY, CHICAGO, ILL.

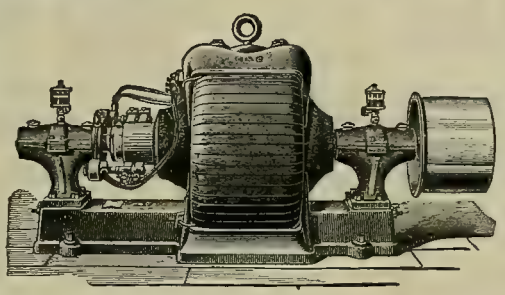
NEW YORK OFFICE: 115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

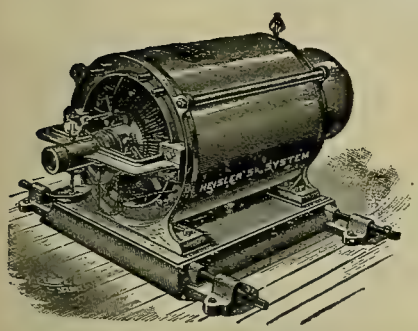
Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st	Edition	2,500 Copies.	Incandescent Wiring Hand-Book,	2d	Edition....(Just ready.)	2,500 Copies.
" " "	2d	"	2000 "	Bell Hangers'	1st	"	2.500 "
" " "	3d	"	(Just ready.) 2,000 "	" "	2d	"	1,000 "
Incandescent Wiring	1st	"	2,500 "	Total within Eighteen months			15.000 "

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

280 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

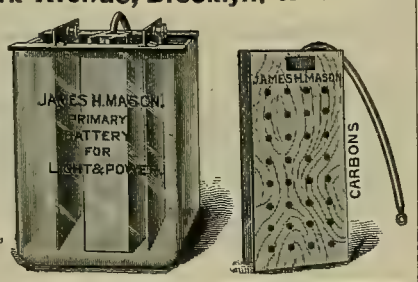
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



THE BARNES WATER EMERY
Tool Grinder.

It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.

Sold subject to approval. Send for full description and price.

W. F. & John Barnes Co., Rockford, Ill.,
Address No. 761 Ruby Street.

Barnes' Patent
UPRIGHT DRILLS.
20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.

Barnes' Patent
ENGINE LATHE,
15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.

They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to W. F. & JOHN BARNES CO., Rockford, Ill., Address No. 761 Ruby st.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

SPRAGUE
ELECTRIC RAILWAY SYSTEM.

More than one hundred different street railways in operation or in course of construction.

MORE THAN 175
SEPARATE ORDERS
From Street Railways for Electrical Equipments.

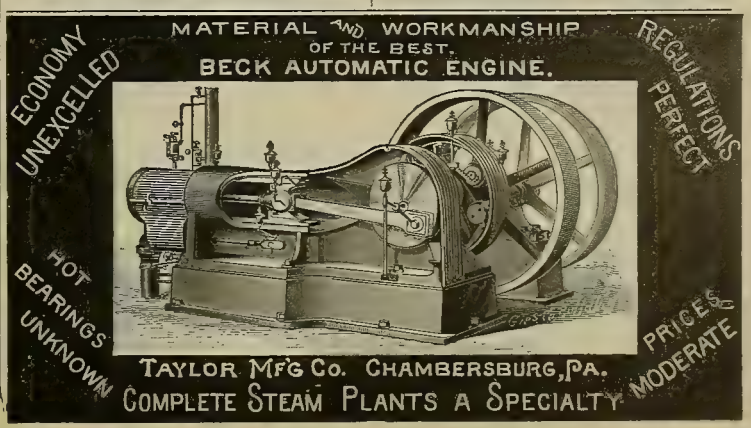
The Sprague Electric Railway System has been proved to be the most

DURABLE, RELIABLE, ECONOMICAL, CONVENIENT.

Sprague
ELECTRIC RAILWAY & MOTOR COMPANY,
16 and 18 Broad St., NEW YORK.

GEORGE P. BARTON,
LAW OFFICE,
225 DEARBORN STREET,
CHICAGO, ILL.
Patent and Trademark Cases.

C., B. & Q. R. R.
—IS THE—
Best Appointed Line
—FOR REACHING THE—
West, Northwest and Southwest.



ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

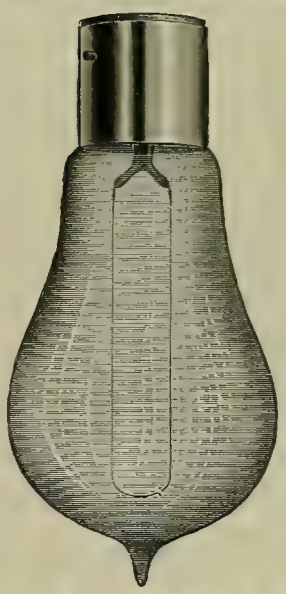
THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,
ALL CANDLE POWERS,
ANY VOLTAGE,
ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT CO., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER CO., Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

GRIMSHAW WHITE CORE
WIRES AND CABLES.

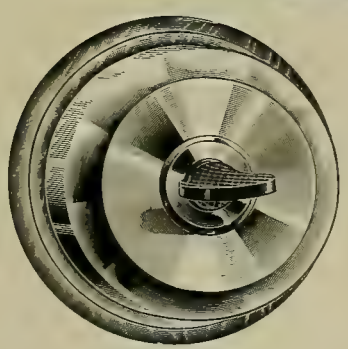
=FOR=

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

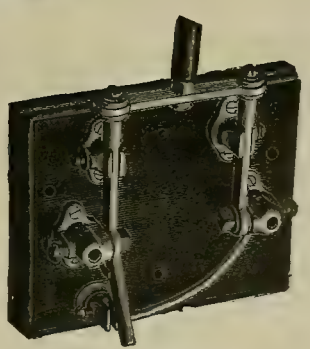
GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

Switch-Board Cables,
Grimshaw White Tape,
Grimshaw Black Tape,
GRIMSHAW SPLICING COMPOUND.

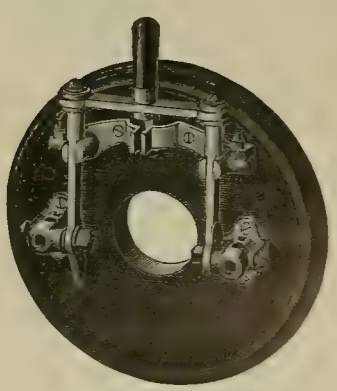
McLennan Switch.



Paiste Switch.



Arc Lamp Wall Switch.



Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.*, CHICAGO, ILL.

SHIELD BRAND LINE WIRE.

MOISTURE-PROOF. **DURABLE.**

Mr. W. A. RICHMOND, Supt. Electric Dept. Concord Gas Light Co., writes as follows:

"We have between twelve and fourteen miles, two and three braid Shield Brand in use here running through trees, and bad ones at that. It has given perfect satisfaction thus far, after being in use two years."

Strongly Recommended for CITY LINES or running through foliage.

P. and B. Weatherproof Line Wire

Far Superior to Insulations Ordinarily Known as "Weatherproof."

Write for Samples and Quotations.

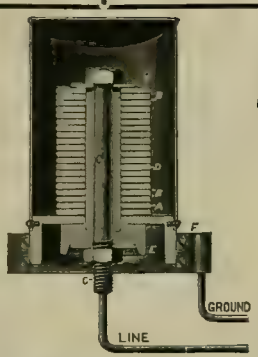
WIRT Lightning Arrester

PATENTED.

For Arc or Incandescent.

HIGH OR LOW TENSION — DIRECT OR ALTERNATING.

On Poles or in Buildings



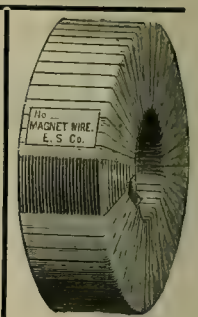
Long Life. High Efficiency.

THE ELECTRICAL SUPPLY CO. SUNBEAM INCANDESCENT LAMP CHICAGO ILLINOIS U.S.A.

To Fit Edison Sawyer-Man, Thomson-Houston, OR U. S. Socket.

MAGNET WIRE.

Prompt Shipment from Chicago Stock or Direct from Factory.



P-O-L-E-S

FOR ELECTRIC ROADS —OR— ELECTRIC LIGHT CIRCUITS.

Cross-arms, Pins, Brackets, Insulators, Lag Screws, Poles, Steps.

SEE OUR CATALOGUE No. 560.
For full information regarding Wires and Supplies for Electric Lighting.

SEE OUR CATALOGUE No. 648.
For full information regarding Electrical House Goods, Also Telegraph, Fire Alarms and District Messenger Systems.

THE ELECTRICAL SUPPLY CO.,

171 Randolph Street.

C=H=I=C=A=G=O.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208, and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

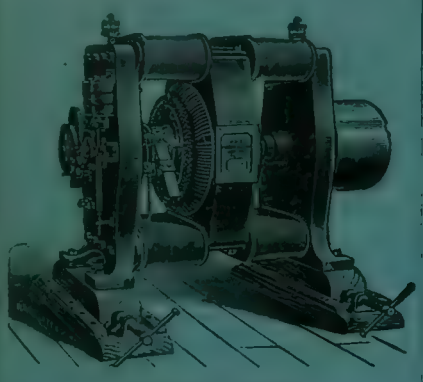
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



WOOD ARC DYNAMO.

MAIN OFFICE:

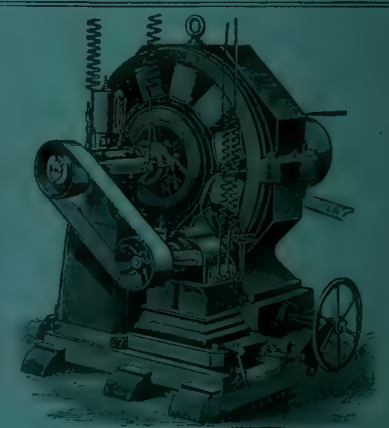
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

Western Electrician.

$8 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, AUGUST 16, 1890. No. 7.

ALUMINUM BRASS AND BRONZE COMPANY,

MANUFACTURERS OF

COWLES' ALUMINUM AND SILICON COPPER ALLOYS,

IN INGOTS, SHEETS, RODS, WIRE AND CASTINGS.

Sheet Copper, Sheet Brass, PURE ALUMINUM.

STEWART BUILDING, 53 Chambers St., New York. ROLLING MILLS, Bridgeport, Conn.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { BAKER, BALCH & CO., Seattle, Wash. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufactures can be found at our Agencies.

AN INVITATION BY CABLE

MANUFACTURERS.

To Visit The Stockton Hotel, CAPE MAY.

We will be there during the National Electric Light Convention, Commencing August 19th, 1890, with samples of Wire and Cables.

GEO. WILEY. FRED. DEGENHARDT.

STANDARD UNDERGROUND CABLE CO., PITTSBURGH, PA.

MAGNOLIA METAL.

—INDORSED BY THE—

United States and German Governments.

BEST ANTI-FRICTION METAL

For Dynamo, High-Speed Engine, Steamship, Car, and all Machinery Bearings.

MAGNOLIA ANTI-FRICTION METAL CO.,

Owners and Sole Manufacturers,

London Office: 75 Queen Victoria St. Chicago Office: 41 Traders' Building.

74 CORTLANDT ST., NEW YORK.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York. 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

—MANUFACTURERS OF—

Weather Proof Wire, Annunciator Wire, Gas Fixture Wire,

Insulated Iron Wire, German Silver Wire, Arc Lamp Cords,

Magnet Wire, Office Wire, Tinsel Cords,

Rubber-Covered House Wire, Flexible Brush Holder Cable, Flexible Cords,

Telephone, Telegraph and Electric Light Cables.

PARAGON TAPE.

Please address all communications to the nearest District Office.

EDISON BUILDING, BROAD ST., NEW YORK.

MAIN DISTRICT OFFICES: EASTERN DISTRICT, EDISON BUILDING, NEW YORK. CENTRAL DISTRICT, "THE RIALTO" BUILDING, CHICAGO. MOUNTAIN DISTRICT, MASONIC BUILDING, DENVER. PACIFIC COAST DISTRICT, CHRONICLE BLDG., SAN FRANCISCO. NORTH WEST DIST., WASHINGTON BLDG., PORTLAND, ORE. SOUTHERN DIST., COTTON EXCHANGE BLDG., NEW ORLEANS. CANADIAN DIST., BANK OF COM. BLDG., TORONTO, CAN.

WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave, CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment.

Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964		3,964
Westinghouse		27,710	27,710
Edison		10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734		734
Ball	613		613
Western Electric	566	250	816
Indianapolis Jenney	794		794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324		324
Van Depoele	285		285
Waterhouse	222		222
Heisler		500	500
Remington		300	459
Sperry	130		130
Excelsior	90		90
Hochhausen	60		60
Weston	30		30
Fuller	10		10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System	Arc	Inc
Thomson-Houston	16,927	[illegible]
Brush	6,090	4,259
Westinghouse	321	49,167
Edison		13,858
American	1,537	[illegible]
United States	632	6,141
Schuyler	1,766	
Ball	962	6
Western Electric	788	
Fort Wayne	1,756	8,005
Van Depoele	450	
Waterhouse	287	
Heisler		3,815
Remington	129	
Sperry	160	
Excelsior	205	30
Hochhausen	70	
Weston	[illegible]	
Fuller	[illegible]	
Reliance	30	
National		1,000
Bernstein		215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Automatic Switch Co..... xxi
Ansonia Brass & Copper Co.... i
Allis, E. P. & Co.....xxiv
American Electrical Works.... xv
Abendroth & Root Mfg. Co....
Aluminum Brass & Bronze Co. i
Aluminum Battery, Electric Light & Power Co.... xxi
Ball Engine Co.....xxiv
Baggot, E..... xvi
Barton, Geo. P.....xxiv
Bernstein Electric Co.....——
Brush Electric Co.....xxix
Butler Hard Rubber Co. xx
Bain Foree..... xvi
Brown, Frank T..... xvi
Bates, W. S xvii
Barnes, W. F. & Jno..... xxv
Baxter Electric Motor Co..... xxx
Bleckert & Nelson..... xvi
C. B. & Q. R. R..... xxv
Cleverly Electrical Works.... xviii
Colburn & Co., I. W.... xvi
C. & C. Electric Motor Co....xxiii
Central Electric Co..... xi
Continental Dynamo Co.....——
Connecticut Motor Co..... xx i
Columbia Incandescent Lamp Co xvii
Crosby Electric Co..... iv
Day's Kerite Insulation C o.... i
Dayton Globe Iron Works Co. xviii
Electrical Supply Co..... xxviii
Empire City Electric Co.....xviii
Eastern Electric Cable Co. xv
Edison General Electric Co.,— Railway Dept xxv
English, Morse & Co..... xvii
Excelsior Electric Co..... ...xxii
Elektron Mfg. Co..... xix
Eddy Electric Mfg. Co..... xv
Electric Construction & Sup. Co vi
Edison Mfg. Co.....xxiii
Evans Friction Cone Co..... xix
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co.....xvii
Eureka Tempered Copper Co..xvii
Easton Electric Co..... iv
Electric Merchandise Co..... xvi
Electrician Publishing Co.....xxiv
Empire China Works xvi
Fibrone Mfg. Co..... xv
Fort Wayne Electric Co.....xxx
Fairbanks, Morse & Co..... xvi
Fletcher & Fletcher Electric Co xvi
Glass, E. K..... xvi
Globe Carbon Co..... xvii
Greeley & Co., E. S..... xiv
Gibson Gas Fixture Co.....xviii
Great Western Electric Sup. Co. v
Heisler Electric Light Co.....xxiii
Holmes, Booth & Haydens..... xvii
Harmount, G. A..... xvi
Hazazer & Stanley..... xiv
Holtzer-Cabot Electric Co..... i
Hawkeye Electric Mfg. Co....——
Hill Clutch Works.....xxiv
Holmes & Co., C. H..... xvii
Ireson, Chas. L.. .....——
Interior Conduit & Insulation Co.xiv
India Rubber & Gutta Percha Co. i
Ide & Son, A. L..... xiv
Illinois Electric Material Co.... xiv
Jewell Belting Co..... xv
Jones Bros. Electric Co..... xix
Knapp Electrical Works xxvii
Law Telephone Co..... xv
Leclanche Battery Co..... xxi
Lewisohn Bros.....xxiv
Laminar Fibre Goods Co..... xix
Mitchell Vance Co... xxx
Monitor Electric Co..... xvi
Munsell & Co., Eug..... xv
Munson Belting Co, Chas..... xiv
Mason, Jas. H..... xxv
Magnolia Anti-Friction Metal Co. i
N. Y. Belting & Packing Co...——
National Carbon Co..... iv
National Electric Mfg. Co..... x
Noye Mfg. Co., Jno. T..... xvi
Northwest Thomson-Houston Co. vii
Ohio State University..... iv
Ostrander & Co., W. R. xxiv
Okonite Co..... xv
Partrick & Carter..... xx
Phoenix Glass Co.....——
Paiste, H. T..... xiv
Pond Engineering Co..... xxi
Pumpelly Storage Battery Co. xxii
Phillips Electrical Works, E. F xv
Page Belting Co.....——
Purdue University..... xiv
Queen & Co..... xv
Roeblings' Sons Co., Jno. A... ix
Shultz Belting Co.... xxi
Stilwell & Bierce Mfg. Co.... xvii
Standard Carbon Co. xx
Stephenson & Co., Jno..... xxi
Schuyler Electric Co..... xx
Southern Electrical Supply Co. xxi
Sperry Electric Co.....xviii
Sawyer-Man Electric Co..... xii
Schoverling, A xxiv
Standard Paint Co..... xiv
Standard Underground Cable Co. i
St. Louis Electrical Exposition ix
St. Louis Electrical Supply Co. xxii
Standard Electrical Works. ... xvi
Sunbeam Incandescent Lamp Co. xv
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department xxvi
Taussig, S..... xvii
Taylor Mfg. Co..... xxv
Triumph Compound Engine Co xviii
Turner Brass Works..... ... xv
Union Hardware Co. xiv
United Electric Traction Co... xxv
United States Electric Lighting Co..... xiii
Woodbridge & Turner..... xvii
Westinghouse Electric Co. ....——
Wollensak, Jno. S..... xxv
Western Electric Co..... iv
Weston Electrical Instrument Co..... xiv
Western Power Construction Co. vi
Wanted.....xvi, xiv, xxv

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co.
Pumpelly Storage Battery & Elec. Motor Co.

Aluminum.
Aluminum Brass & Bronze Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Aluminum Battery Electric Light & Power Co.
Central Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electric Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Lewisohn Bros
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
Aluminum Brass & Bronze Co.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Lewisohn Bros.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Automatic Switch Company.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Mitchel-Vance Co.

Electroliers and Combination Fixtures.—Continued.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
American Electrical Works.
Ansonia Brass & Copper Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Mitchell-Vance Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Aluminum Brass and Bronze Co.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Aluminum Brass & Bronze Co.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.
Bates, Wm. S.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Aluminum Brass & Bronze Co.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Lewisohn Bros.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

J. H. REID, General Manager,
411 & 412 Royal Ins. Bldg. CHICAGO.

WESTERN ELECTRIC CO.,

WE ARE THE EXOLUSIVE WESTERN AGENTS FOR THE SALE OF

A. C. Dav's Kerite Wires for Telegraph, Telephone, and Electric Light Use.

PRICES ON APPLICATION.

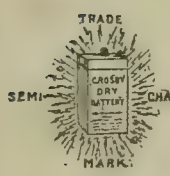
CHICAGO. NEW YORK.

You Will Oblige Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

OHIO STATE UNIVERSITY,
COLUMBUS, OHIO.
Civil, Mechanical, Mining and Electrical Engineering. SEND FOR INFORMATION.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.



ELECTROMOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 10 AMPERES.

ADVANTAGES OF THE CROSBY DRY BATTERY FOR OPEN CIRCUIT WORK.

THE CROSBY DRY BATTERY is the **best Open Circuit Battery in the market.** It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing **more work** than any other. In addition to this, it is the **most reliable, most compact, most durable** and **simplest** cell yet discovered. It is so constructed that **it is not destroyed** or seriously injured by **short circuiting,** and we are prepared to prove at any time that its **power of recuperation** is proportionately greater than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks, and all the uses to which Open Circuit Batteries may be put, **it has no equal,** whether it be compared with **Liquid or other Dry Batteries.** We guarantee **depolarization, absence of offensive crystallization and perfect cleanliness.**

The Crosby Battery is the only Dry Battery sold **semi-charged. (To charge it only a small quantity of pure water is necessary.) It does not work until wanted.**

The preference as **between Liquid and Dry Batteries** should always be given to the **latter,** provided the amount of working power required and a constant current can be obtained. **No form of Dry Battery** has as yet been placed before the public, **except the Crosby Dry Battery,** which will do the work of Wet Batteries and **give a constant supply of Electricity sufficient for reliable Open Circuit work at all times.** The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with which their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance, and easily broken and injured. **The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids,** and, after once being properly connected, **requires no attention whatever,** while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.

The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for **Open Circuit Work.** If, however, through an accident, it becomes **Short Circuited, it recoups itself.** This cannot be said with equal truth of any other Dry Battery known.

The Crosby Dry Batteries are manufactured in **different sizes and forms,** to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistance is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in **the Crosby Dry Batteries Varies from one to ten amperes,** according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

CYLINDRICAL.

SIZE IN INCHES.

	Height.		Diam.
No. 3	7¼	x	2½

RECTANGULAR.

SIZE IN INCHES.

	Height.		Width.		Length.
No. 2	5	x	1½	x	4½
No. 3	9	x	1½	x	8

TELEPHONE.

SIZE IN INCHES.

	Height.		Width.		Length.	Price.
Long Distance	7½	x	2½	x	4¾	$2 00
Telephone	7½	x	2	x	4¾	1.50

N. B.—OTHER SIZES AND SHAPES TO SUIT PURCHASERS.

[COPY.]

CROSBY ELECTRIC COMPANY, New York.

OFFICE OF FLEMMING'S ELECTRO MEDICAL INSTRUMENT MANUFACTORY,
No. 1009 ARCH STREET, PHILADELPHIA, March 8, 1890.

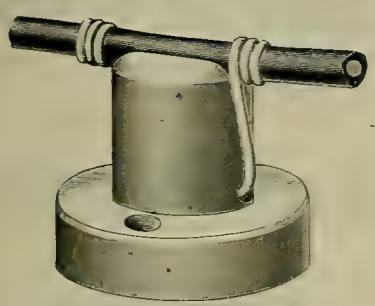
GENTLEMEN:—The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it Jan. 28, 1890, at 4 P. M., kept running all night and following day, Jan. 29 when at 4 P. M. it became accidentally short circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till Jan 30; 7:30 A. M., started again, and left running till Feb. 13, stopping during night time. Thus, in defiance of a two-hour short circuit, this cell functionated 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterward, still retains its working capacity, apparently as good as previous to its testing.

Very respectfully,
(Signed) OTTO FLEMMING.

THE CROSBY ELECTRIC CO., Judge Building, Fifth Ave. & Sixteenth St., NEW YORK.

GREAT WESTERN ELECTRIC SUPPLY COMPANY.

190 & 192 Fifth Avenue, CHICAGO, ILL.



CUTTER'S E. L. PORCELAIN INSULATOR.
(Send for Special Circular)

ELECTRIC HOUSE GOODS

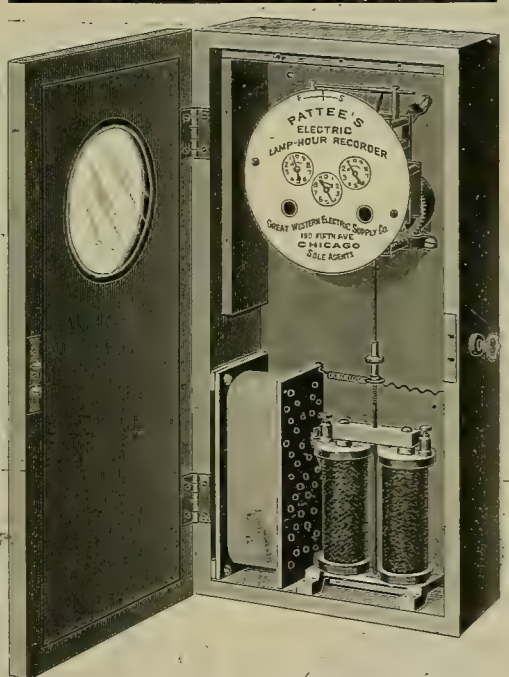
Of the most approved patterns:

BATTERIES,
BELLS,
PUSHES,
ANNUNCIATORS,
BURGLAR ALARMS,
GAS LIGHTERS,
MEDICAL COILS.

Fine Line of Telegraph Instruments.

SIMPLEX WIRES

Gives the most thorough insulation, unequaled for MINING and UNDERGROUND Service.



PATTEE'S LAMP-HOUR RECORDER.
(SPECIAL CIRCULAR OUT NOW.)

ELECTRIC RAILWAY SUPPLIES.

POLES,
FEEDER WIRES,
TROLLEY WHEELS.

Have you tried our noiseless pinions?
Order a trial lot.

CARBON BRUSHES,
MAIN SWITCHES,
TROLLEY INSULATORS.

The most Serviceable Pole Top.

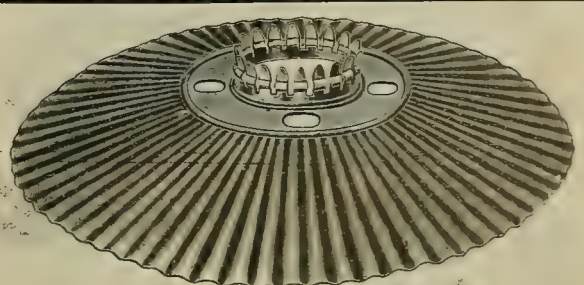
TREE TRIMMERS,
RAIL DRILLS,
POLE HOLE AUGERS.

All Copper Rail Bonds.
(Send for Special Circular.)

Electric
AND COMBINATION
Fixtures.

All the most popular and most artistic styles.
New and original designs in variety.

OPAL SHADES,
OPALESCENT SHADES,
CUT GLASS SHADES.



CUTTER'S COMBINATION TIN SHADE.
Needs no shade holder.

THE

ONLY COMMERCIAL ARC LAMP

FOR

INCANDESCENT CIRCUITS.

Burning two in Series on Circuits of 100 to 120 Volts.

WILL USE EIGHT AMPERES OF CURRENT.

WE ARE PREPARED to furnish SERIES LAMPS for any PRESSURE, CONSTANT POTENTIAL.

These Lamps, when burning TEN IN SERIES, on 500-VOLT CIRCUITS, use 8½ amperes, and give a CLEAR, STEADY LIGHT.

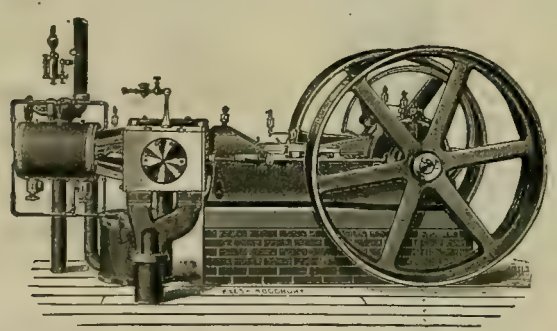
We guarantee our Lamps, Electrically and Mechanically.

PLEASE STATE SYSTEM AND VOLTAGE USED. ADDRESS

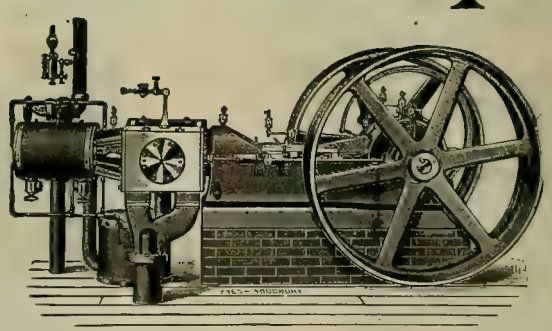
ELECTRIC CONSTRUCTION & SUPPLY CO.,

18 Cortlandt Street, NEW YORK.

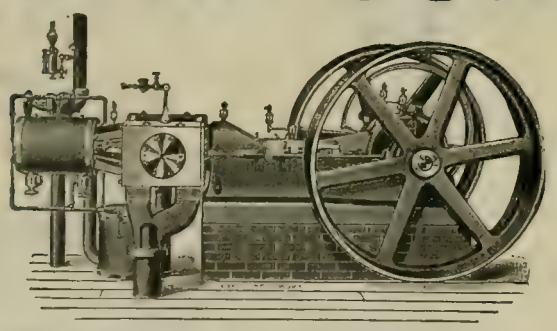
None so Good, None to Equal.



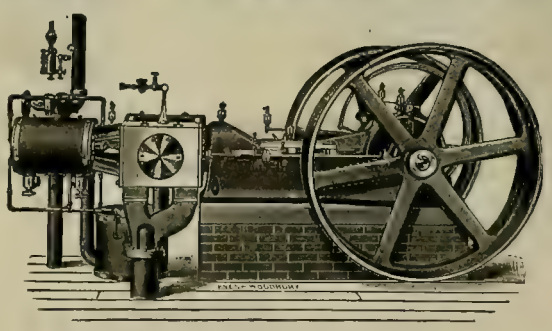
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

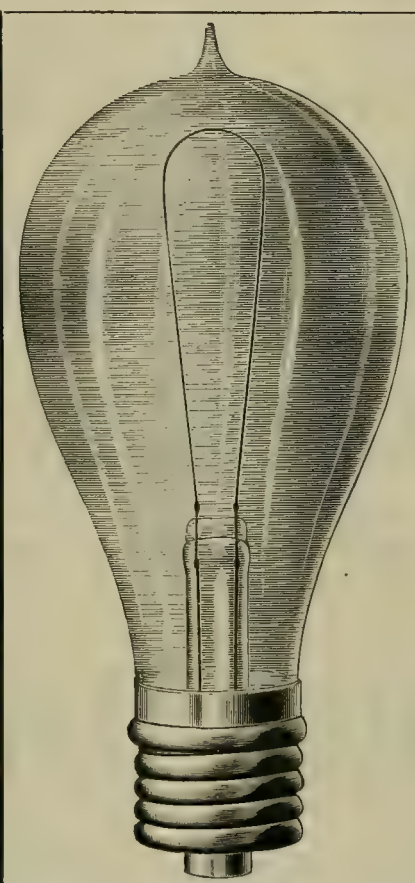
We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

EDISON GENERAL ELECTRIC COMPANY.

EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.

No. 2.
No. 2 is the Thomson-Houston.



The Edison Incandescent Lamp.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No. 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

EDISON BUILDING, - - BROAD ST., NEW YORK.

Please address all communication for circulars and prices to nearest District Office.

Main District Offices:

Eastern District, 16 & 18 Broad St., New York City.
Central District, Rialto Building, Chicago, Ill.
Northwestern Dist., Washington Bldg., Portland, Ore.
Mountain District, 730 17th St., Denver, Colo.
Pacific District, Chronicle Bldg., S. Francisco, Cal.
Canadian District, Toronto, Canada.
Southern District, Cotton Exchange Building, New Orleans, La.

ST. LOUIS ELECTRICAL EXHIBITION,

Sept. 3,--Oct. 18, 1890.

Parties desiring space at the coming exhibition should apply **AT ONCE**, as the number of applications already received occupies nearly all the available space.

FREE SPACE, FREE POWER AND FREE FREIGHTS

Are offered to all, and an attendance of over one million people is assured.

GOLD MEDALS Will be awarded by a competent committee, and everything done to advance the interests of Electricity. All the leading manufacturers have secured space, and the exhibit will surpass anything of the kind ever seen in America.

WRITE FOR PARTICULARS TO

FRED. H. WHIPPLE,

GENERAL MANAGER, DETROIT, MICH.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

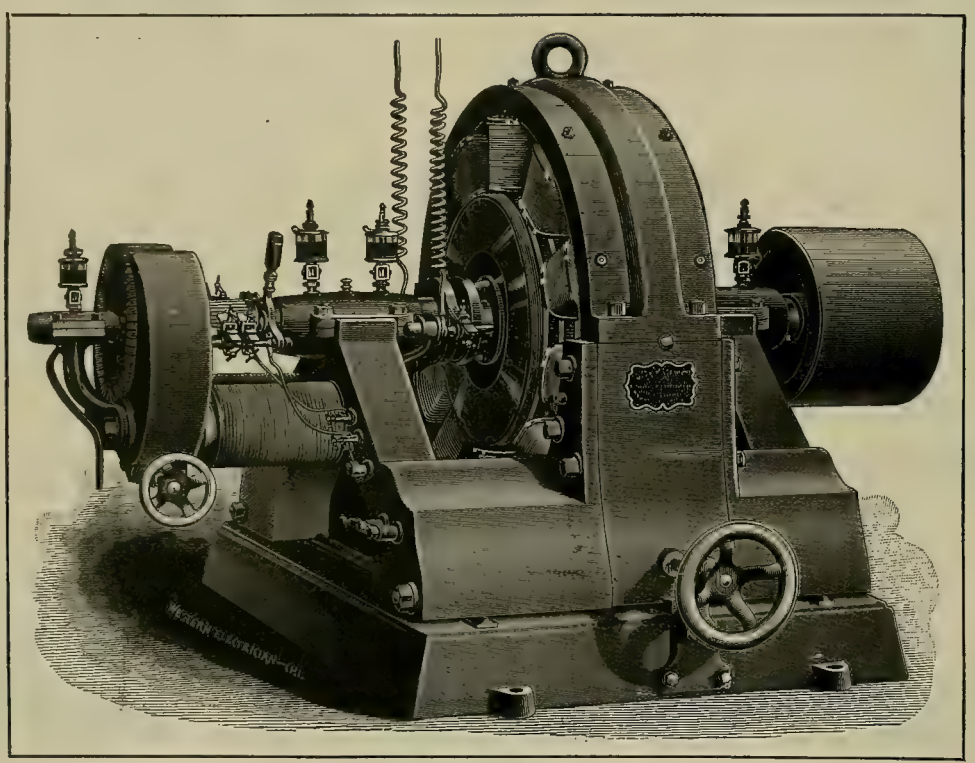
We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BEST OF ALL

THE NATIONAL
TRANSFORMER SYSTEM
OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., Seattle, Washington.
THOMAS WOLFE, Southwestern Agent, Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts., 141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts., 1517 Larimer St., Denver, Colo.
CHAS. M. BLANCHARD, Agent, Girard Building, Philadelphia, Pa.
L. N. COX, Agent, 16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent, Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts., 531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

AUTHORITIES TALK.

Sir Wm. Thomson, F. R. S., and Dr. John Hopkinson, F. R. S.

— VERSUS —

Mr. Bottomley and Mr. Harber.

Sir WILLIAM THOMSON, F. R. S.

THE UNIVERSITY, GLASGOW,
June 19th, 1890.

I have tested the insulation of two specimens of Okonite Wire sent to me recently, and have found thoroughly satisfactory results for all ordinary temperatures and potentials.

The thickness of the Okonite in these specimens was 1.8 millimetres (.072 of an inch), and its insulation resistance held good up to **7,500** volts. After the passing of current through it at this very high potential for some time, I found the insulation resistance for ordinary potentials only reduced from 6,700 (its original value) to 4,500 megohms per statute mile at 16° Cent.

I am well acquainted with Dr. Hopkinson's tests of December, 1886, which were submitted to me early in 1887, and I know the results of his recent tests of the same specimens, showing no deteriorations, but actually an improvement, in the insulating quality after three-and-a-half years' keeping.

I have also seen the published certificates of many practical men of different dates from March, 1886, to December, 1888, which give trustworthy evidence of the practical success of Okonite Wire for telegraphs, telephones, and electric light and power.

With this evidence before me, in addition to my own electric tests and examination of the insulating material in respect to toughness and other mechanical qualities, I believe Okonite to be a very valuable material for the insulation of electric conductors in a large variety of practical uses.

(Signed.) WILLIAM THOMSON.

Dr. JOHN HOPKINSON, F. R. S.

WESTMINSTER CHAMBERS,
5 VICTORIA STREET, S. W., June 19th, 1890.

In December, 1886, I made a series of careful and somewhat elaborate experiments upon Okonite Wire, and fully reported upon the same. My report, of which I append a copy, was as complete as it could be at the time. One point it was then impossible to determine, and that, practically, the most important point of all, namely, the question of the durability of the insulation.

It is almost impossible, in most instances, to judge of the suitability of any particular insulating compound for wires **until it has stood the test of time for some years.** It so happened that samples of Okonite Wire that I tested in 1886 had been left with me, and have remained in my possession ever since, parts of the same having been used in my laboratory and for various other purposes.

I have now again tested these samples, and append the tests, together with the results obtained in 1886. In the case of A and C, the test is after one minute's electrification; in the case of B_1 and B_2 the test is a mean during an interval from one-half minute to five and one-half minutes from first electrification; the temperatures are practically the same, viz.: 15°5C. in 1886, 15°C. now. Samples A and C have been immersed in water for five days, B_1 and B_2 for a shorter time. B_1 is a sample which had been twisted in 1886 for the purpose of ascertaining whether the material would stand mechanical disturbance. B_2 had six kinks made in it for a similar purpose.

A, in 1886	6,180	A, now	7,000	...	Megohms per statute mile.		
C, in 1886	7,590	C, now	11,680	...	do.	do.	do.
B_1 in 1886	5,435	B_1 now	11,740	...	do.	do.	do.
B_2 in 1886	4,750	B_2 now	13,700	...	do.	do.	do.

In my last report I stated that I was most favorably impressed with the qualities of the wire, both on account of its high insulation and mechanical reliability. Tests on the samples proved that the **insulation was practically perfect,** both for high and low potentials, and that the insulation would stand very rough handling and a considerable temperature, without injury, and indeed with but slight reduction of its insulation resistance. I can now add that the **result of time has shown** that not only is the insulation excellent when made, and that it will stand mechanical disturbance, **but that for a term of three-and-a-half years it is perfectly durable, and remains as good as at the first.**

(Signed.) J. HOPKINSON.

Buy the wire that stands the test of the highest authorities in the world and is ordered in 1,000,000 feet lots by the largest buyers.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable System.

LOOK OUT!!

FOR

NOVELTIES

IN

ELECTRICAL SUPPLIES

DISPLAYED BY THE

SAWYER-MAN ELECTRIC CO.

AT THE

CAPE MAY CONVENTION.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

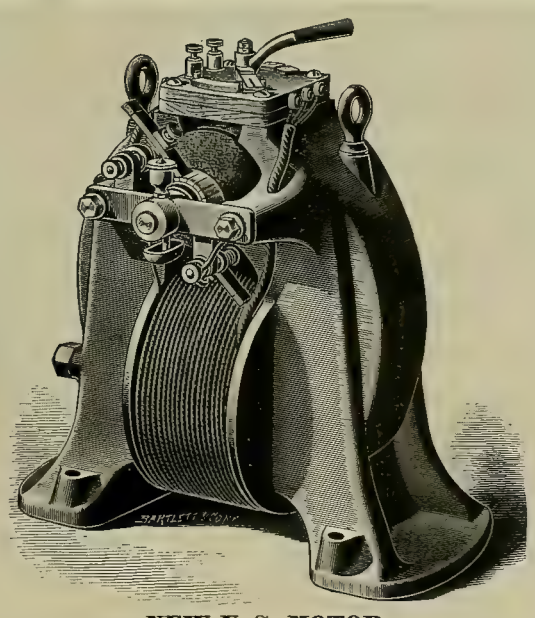
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power required,
and at any required E. M. F.



NEW U. S. MOTOR.

Superior in Design and Workmanship and unequaled in efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

PURDUE SCHOOL OF ELECTRICITY.

New laboratory, fitted with best appliances, dynamos, storage batteries, and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue.

PURDUE UNIVERSITY, La Fayette, Ind.

THE E. S. GREELEY & CO.,

GENERAL ELECTRICAL SUPPLIES,

5 and 7 DEY ST., NEW YORK.

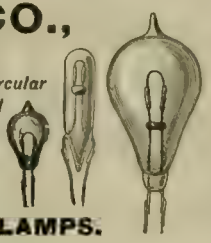
ELECTRICAL MEASUREMENT

Instruments and Batteries of the Very Highest Grade,

Precision and Constancy, Quality and Finish, the Best in the World.

Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.



MINIATURE INCANDESCENT LAMPS.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,

32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

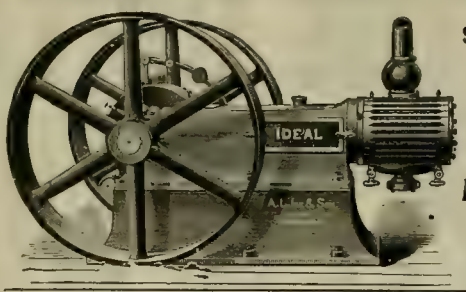
Messrs. Hazazer & Stanley.

GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

Yours truly, *CHAS. E. GOODRICH, Electrician, 503 Eighth Avenue.*

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers

SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street

THE WESTON STANDARD

Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

Office and Factory, 114 William Street, **Newark, N. J.**

WHAT IS CANVAS JACKET?

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. **16 & 18 BROAD STREET, NEW YORK.**

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G MOSS, SECY & TREAS.

Charles Munson Belting Co.

MANUFACTURERS OF

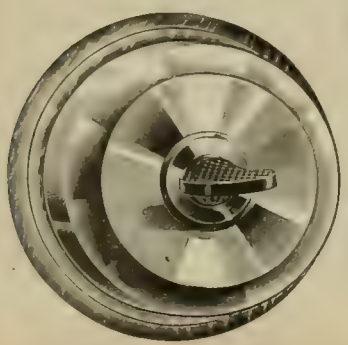
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH



FOR INCANDESCENT WORK

Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,

12th and Market Sts.,

Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL

—THE—

Celebrated P. AND B.

ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

59 Maiden Lane, - NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, AUGUST 16, 1890. No. 7

Electric Mining Locomotives.

It is pretty generally conceded that the application of electricity to mining work will constitute one of the most important fields of the electrical engineer. An enormous amount of work has already been done and mining operators throughout the country are becoming thoroughly interested in the employment of electrical apparatus. The use of electricity in mines is extending rapidly, for the very excellent reasons that its utilization as an agent for transmitting power has been demonstrated to be both more economical and more convenient than steam.

In the accompanying cuts are shown two views of electrical tramways at the Lykens Valley Coal company's mine at Lykens, Pa. For the photographs, of which the cuts are reproductions, the WESTERN ELECTRICIAN is indebted to W. M. Schlesinger of the Schlesinger Electric Mining company of Columbus, O. Mr. Schlesinger writes that the locomotive shown in Fig. 1 was the first electric mining locomotive ever successfully operated in America.

The weight of the locomotive was 5½ tons, its length 11 feet and its height 5 feet. It was operated by a series motor with three brushes, and a German silver rheostat was used for regulation. For a conductor an iron rail was used, which is shown in the cut.

The locomotive was first operated in July, 1887, in drift No. 1 of the Lykens mine. The road was at first 5,300 feet long, but its length was soon extended to 6,300 feet. There was a grade of 2 per cent. against the load and one of 3 per cent. in its favor, the average grade being 3 inches in 100 feet in favor of the load. After leaving the mine the road passes through a cross cut 180 feet long into the Little Lykens vein; two of the curves have radii of 20 and 30 feet.

The loads hauled by the locomotive were on the average 100 tons. On one occasion, however, a train composed of 31 trams, each with a load of 5 tons, was hauled out of the mine. The length of the train was 380 feet, and as the cross cut is only 180 feet the locomotive had to contend at one time against these S-shaped curves. After two years' service the locomotive was rebuilt in the form shown in Fig. 2, (see next page.) The series motor was the same as that employed on the old frame, but the transmission was changed. Instead of chains beveled gears were used from the motors to the front axle, power being communicated to the rear axle by connecting rods.

The German silver resistance was discarded and in its place a water rheostat was used which Mr. Schlesinger considers far preferable.

At the same time a second locomotive of the same construction as that shown in Fig. 2 was put in operation in the mine to replace an 8-ton steam locomotive. The level on which it is used is 800 feet below the first road. The distance from the power house measured along the wires is 2,000 feet. The road is 7,000 feet long and the average loads carried are 100 tons.

The wires for the line, which pass down a steam way, are covered with underwriters' insulation. The asbestos in the covering was found to serve admirably, it is stated, in resisting the action of the mine water. The wires are attached to glass insulators and great care has been taken to prevent their touching either the walls or the timbers.

In both gangways, as can be seen in the illustration, a 25 pound rail is used for a conductor. It is fastened to posts erected for that purpose. The track is used for the return.

FIG. 1. ELECTRIC MINING LOCOMOTIVES.

Farewell Banquet.

One of the pleasant events of the last week in electrical circles, was the little informal farewell banquet tendered S. Dana Greene and C. A. Benton by the WESTERN ELECTRICIAN at the Union League Club, Chicago, on the evening of the 7th. The invitations were confined to a few of the intimate friends of Messrs. Greene and Benton, the following gentlemen being present: S. D. Greene, C. A. Benton, Jno. I. Beggs, F. B. Badt, A. H. Lewis, F. E. Degenhardt, Wm. Hood, F. S. Terry, Alex. Kempt, Dan'l Hemingray, and W. A. Kreidler. After dinner brief speeches were in order. Messrs. Greene and Benton expressed their appreciation of the numerous courtesies that had been extended to them during their short stay in Chicago. Both of the gentlemen spoke very highly of the Chicago Electric Club and the good work it is doing in bringing electrical people nearer together and advancing the general good of the electrical fraternity. Great regret was expressed on the part of all that Chicago was to lose two such congenial and capable gentlemen as Messrs. Benton and Greene had shown themselves to be. One of the best speeches of the evening was made by John I. Beggs, who succeeds Mr. Greene at Chicago as manager of the Central States district for the Edison company.

Minneapolis Exposition.

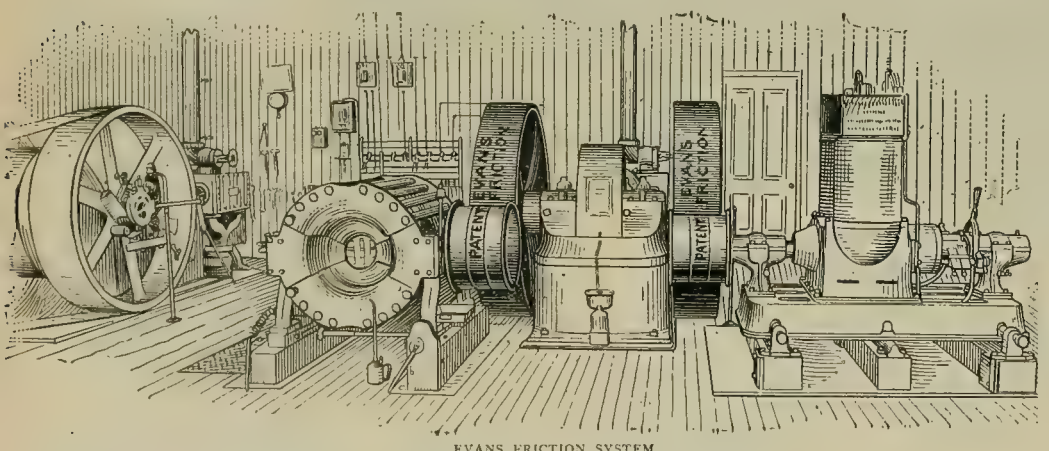
William M. Regan, general manager of the Minneapolis Exposition, which opens August 27th and closes October 4th, states that the electrical exhibit will be the most extensive and complete ever made in the country. The Edison exhibit as made at the Paris Exposition in 1889, will be a feature, but it will be more complete in every way. An exhibit of more than ordinary interest will be made by the Thomson Electric Welding company, of Lynn, Mass. The Edison exhibit is already on the ground, and is being arranged under the direction of Luther Stieringer, of New York. Nearly three car loads of electrical material to be used in the exhibit have arrived. The principal feature is a tower of light, the plans for which were drawn by Mr. Stieringer. The tower has been built in the center of the building, and is about 70 feet high, and eight feet in central diameter. It is of Egyptian design and is to be covered with 7,500 incandescent lamps. From the top of the tower festoons of lamps will hang in various designs, making it a most brilliant lighting spectacle. The Edison exhibit includes talking dolls, electric railroads, dynamos, telephone and telegraph instruments, and phonographs, as seen in Paris and at the Lenox Lyceum. The working of the apparatus is to be illustrated by experts from the Edison laboratory. The Thomson electric welding apparatus will also be in actual operation. Much interest is being manifested in the exhibit. There will also be a very extensive exhibit by the Carpenter-Nevens Electro Heating company of Minneapolis, which will have in practical operation a number of very recently patented electrical apparatus, illustrating the various applications of electricity to heating. There will also be a very extensive exhibit by the power department of the Edison general company, and a very extensive line of exhibits and electrical merchandise and apparatus. The convention of the Edison illuminating companies will be held in Minneapolis, September 16th. The large number of delegates who are expected to be present will find the exhibits of great interest.

Milwaukee's Electric Roads.

The formal transfer to the Villard syndicate of the Milwaukee City railway property and all its new franchises and good wishes took place in New York Saturday, Aug. 2d, where the new directory was elected. The transforming of the line into a complete electric road will begin at once, Julius Meyer, of the Edison Electric company's engineering corps, having arrived in Milwaukee from New York to superintend the work. The formal transfer of the Cream City road to the same syndicate followed on Tuesday. The proposed important extensions of both lines will be pushed with energy, and by Jan. 1, 1891, the roads will be complete electric lines, with extensions finished.

Evans Friction System.

In the accompanying cut is presented a view of the station of the Electric Light company at Hutchinson, Kan. It will be noticed that the machines are operated by the Evans friction system. The use of the frictional gearing system it is claimed, has proved entirely successful in the station. The Thomson-Houston dynamo at the left is of a 50 lights capacity. The Edison machine is a number 16 of 720 incandescent lamps capacity. Both generators are driven from the fly-wheel of an Armington & Sims engine. This plant has been running constantly since January, 1890. The friction system is that of the Evans Friction Cone company of Boston.



EVANS FRICTION SYSTEM.

Residents of Helena, Mont., have established an electric light company, and are now erecting a plant both for arc and incandescent lighting with a capacity of 1,500 incandescent and 40 arc lights. The plant will be furnished with the alternating current system of the Westinghouse Electric & Manufacturing company.

Street Railway War at Springfield, Ill.

Advices from Springfield, Ill., indicate a sharp controversy between the street car companies of that city. The "mule line" it appears, has been trying to hold valuable franchises without giving the people any service, and there has been a strong opposition to this policy which culminated in the present struggle. A correspondent writes: The Citizens' company, known as "The Mule Line," had a franchise to extend its track south of Allen street on Spring street, but did not take advantage of it, and its operations generally have been unpopular and unsatisfactory. The new electric line represents the more progressive element, anxious to improve the city. The Citizens' line has an unused track, just laid, on Allen street, ending at Spring. At 1 o'clock Sunday morning the electric company put a big force of men to laying a track on Spring street, past the end of the Citizens' track, so as to get ahead of them, and capture the Spring street line. They had only three rails laid when they were stopped by Mayor Hellweg and the police force. They claimed the privilege under a state charter of laying tracks anywhere in the city. The mayor was obdurate, and refused to let them proceed until the council gave them permission. The electric company kept its men on the ground all night. At 1 o'clock to-day President Schuck, of the mule line, headed a force of men who attempted to lay a track parallel to that of the electric company. They came to blows, but the row was stopped by the police. Then citizens took a hand, and, throwing off their coats, laid about a block and a half of the electric company's track and the police did not interfere. While all the police force was busy on Spring street preserving order, President Van Ginkle, of the Electric Street Railway company, took a large force of men and laid about 2,000 feet of track on South Grand avenue, two miles away where the mule line had another charter track it would not use. The police did not find them until about 7 o'clock this morning. The whole police force has been watching the 300 men the car companies have employed all day long.

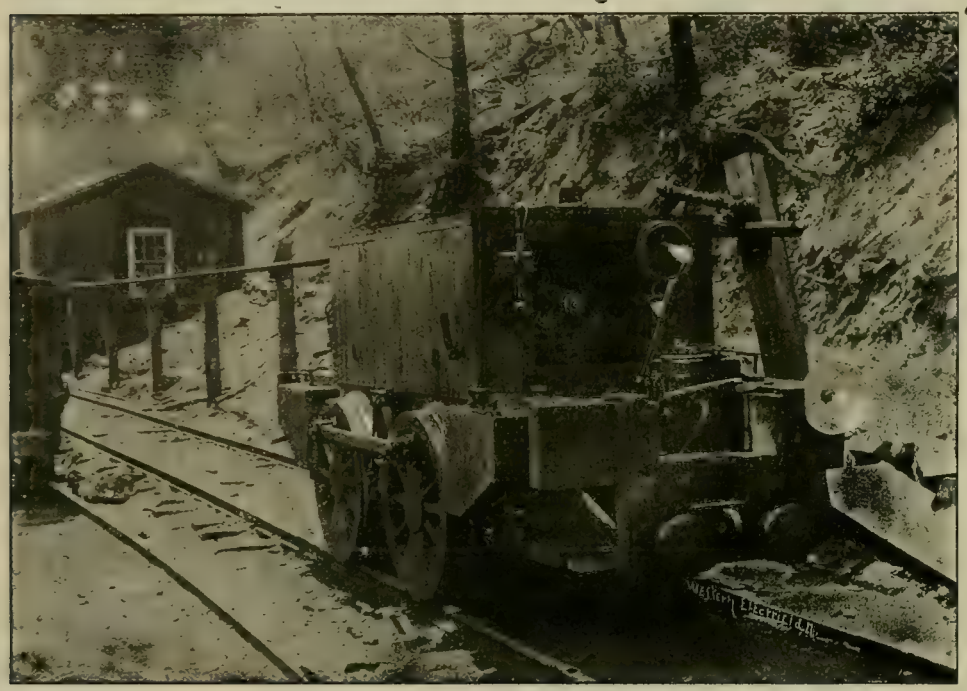
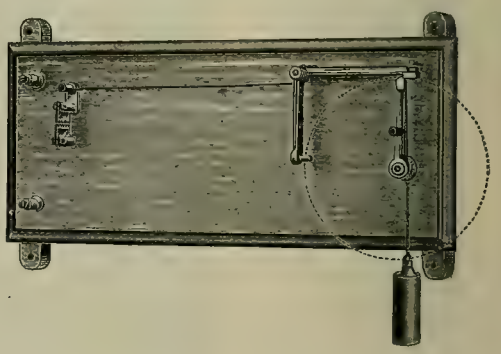


FIG. 2. ELECTRIC MINING LOCOMOTIVES.

Hot Wire Lightning Arrester.

A lightning arrester should protect circuits when they are idle with as great fidelity as when the dynamos are in operation. It should be so constructed as to have no self-induction; therefore, it is asserted, it should have no magnetic coils or condenser plates, of greater or less thickness in the circuits. An absolute break of sufficient distance to interpose enough resistance to open the arc should be made at every flash of lightning that comes in on the lines. These breaks should be made automatically, so as to take care of a number of flashes in rapid succession without any manual attention. An arrester has an especial advantage, if it is adapted to protect circuits used for alternating currents with an equal degree of promptness and certainty as circuits used for continuous currents.

In the illustration is represented a lightning arrester, invented by Foree Bain, Chicago. The cut shows how the circuit to ground is opened by the expansion of a small iron wire resulting from the passage of the flash or the dynamo current. The iron wire forms a part of the circuit to ground. The lightning leaves the line at the comb, passes over this wire which, in consequence, expands. A spring acting against the wire causes the trigger to unlatch the metallic winch, which forms part of the circuit. To the winch is attached a string, wound around a drum. To the string is hung a small weight which causes the winch to revolve when released. When the wire has been expanded by the passage of current, the winch makes three-quarters of a revolution and stops against an insulated stud on the arm, part of which forms the trigger. It rests against this insulated stud, leaving the circuit to ground open until the wire contracts sufficiently to release it from this stud. It then completes the revolution, and once more rests against the trigger, and is ready for another flash to repeat the operation. This arrester is said to be thoroughly reliable, and may be placed on either side of converters of alternating circuits or in dynamo rooms on either alternating or continuous circuits. In actual operation the wire does not get warm enough for the heat to be detected by touch. The instruments are introduced by the Central Electric company, Chicago.



HOT WIRE LIGHTNING ARRESTER.

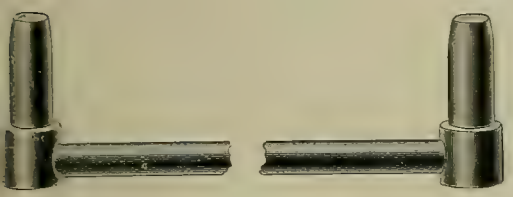
Dubuque Storage Battery Road.

A trial of the first storage battery car on the Rhomberg street railway system in Dubuque, was made last Saturday. The car was tested on the several parts of the line, and according to the local papers, "worked like a charm." At first six storage battery cars are to be operated on the system, and the number will eventually be increased to fifteen. The storage batteries are of the New York Accumulator company's make, and the motors are of the Edico type.

The Canadian press is not familiar with electrical apparatus, as is shown by the fact that a St. John paper recently published an article in which it presented a cut of an Edison dynamo of the ordinary type, which is called a "stationary Sprague motor for driving machinery."

A Copper Rail Bond.

In electric railways with overhead wires, the resistance of the ground return and the consequent loss of energy will depend largely on the connection between adjoining rails. Many forms of rail-bonds now in use, which are made wholly or in part of iron, still leave better conductivity to be desired. The Great Western Electric Supply company of Chicago, is making a rail-bond entirely of copper. The cut shows the two end pieces and part of the connecting wire, full size. The taper pieces fit into holes drilled in the rails, and when upset in place, they form a good metallic connection. The connecting piece can be made of any desired diameter and length to suit different circumstances, and can be bent to meet any unusual change.



COPPER RAIL BOND.

This rail-bond does away with brass and iron pieces.

The Patent Department.

The case presented in the WESTERN ELECTRICIAN recently showing that the methods of conducting the business of the patent office might be improved calls to mind the experience of a prominent patent lawyer who occupied a position in the patent department for many years. This gentleman is now the attorney for one of the leading electrical companies of the country and is a recognized authority on patent law. He began life as a telegraph operator, ticket agent and agent for an express company at a small town in northern New York. The excitement attending a life of this kind did not agree with him, so he secured a position in the office of the census enumerator at Washington. This engagement did not last long, however, but when the work in the census department was finished he was assured by a political friend of a position in the patent department. He had no idea of what he would be required to do, and it may be readily seen that his experience had not been of such a character as to qualify him for a responsible position in this department. Yet this was the result of his conference with the head of the office.

"What do you know?" was the first interrogation that was propounded the youthful applicant.

He admitted that his knowledge of the ways of the world was far more extensive than his scientific and classical education had been.

This proved no drawback and he was questioned as to his knowledge of special branches —chemistry, agricultural implements, machinery, electrical apparatus, etc. In all of these important branches he was sadly deficient. The result was that this young man, with no special qualifications, was assigned to the electrical department, probably, as he himself explained later, because he knew as much on this particular branch as any body else in the office. There was not at that time, it should be remarked, the same activity in this department that there now is, yet many of the patents granted in those days proved valuable property to the holders, and made colossal fortunes for their owners in some instances.

"I was soon installed as a full-fledged examiner," said the attorney, when referring to his experience, during a recent visit to Chicago, "and I plodded along through the claims many of which were 'Greek' to me and to many of my superiors. I worked hard though and I soon saw that there would be a good opportunity for me if I mastered the subject and became familiar with patent law. In those days the patent lawyers knew absolutely nothing of electrical science and I fear the same may be said of some of those making a specialty of electrical patents to-day. It was the same way in the patent office. The examiners were like myself, without any special training for the work, and if we succeeded in keeping out of trouble it was due to good luck rather than any merit of our own."

Many of the patents issued to-day appear to have gone through the same process as that described by the patent attorney just quoted. He says one of the great troubles the commissioner of patents has to contend with is lack of funds. He is not permitted to pay enough for help and consequently he cannot command the services of men of experience. He is constantly making appointments, drilling recruits only to have them desert him in a few years or just as soon as they gain sufficient experience to engage in practice for themselves. This is the story of many other reliable attorneys who have passed through the patent department as they would a training school for any other profession.

Operating Window Cleaners by Electricity.

Another interesting application of the storage battery and electric motor is reported by William Hood, the Chicago representive of the Accumulator company of New York city. Mr. Hood closed a contract with Abram Bachrach last week for 12 23 M cells to operate a one-half horse power C. & C. motor. This motor is used for driving a portable window and sign cleaner. The inventor of the device contemplates taking contracts for cleaning the windows and brass signs on buildings throughout the business district. The storage batteries and motor will be arranged in an attractive cart, specially constructed for the purpose. The motor will operate a buffer attached to a long flexible shaft, which will enable the workman to clean a window or polish a sign in a very few minutes, whereas, the same work if performed by hand, would require considerable time. The inventor of this ingenious device is highly pleased with its operation, and will soon publicly exhibit his outfit. The cart is now being constructed by Studebaker.

The Detroit Dynamo.

The cuts presented herewith illustrate new types of dynamos manufactured and recently

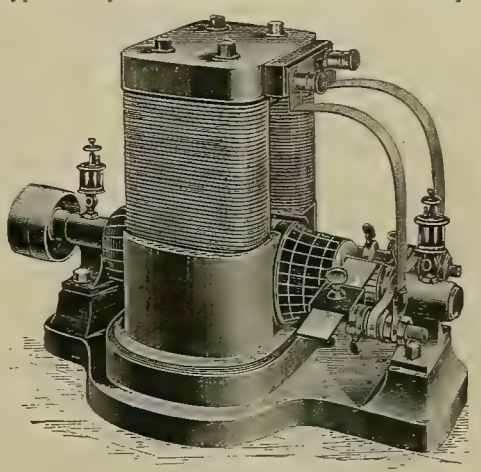


FIG. 3. DETROIT MOTOR.

placed on the market by the Detroit Dynamo company of Detroit, Mich. Messrs. King & Collins, the managers of this company, have for a number of years been doing business in Detroit as the Detroit Electro-Plating company. Fig. 1 shows the type of electro-plating dynamo constructed by the company.

The success attending the introduction of this machine for plating purposes led the company to adopt a similar type for use in lighting, Fig. 2, and it is also making motors of the same general form, Fig. 3. The machines are small and very compact. The armature is of the Siemens' drum type. The field cores are of wrought iron.

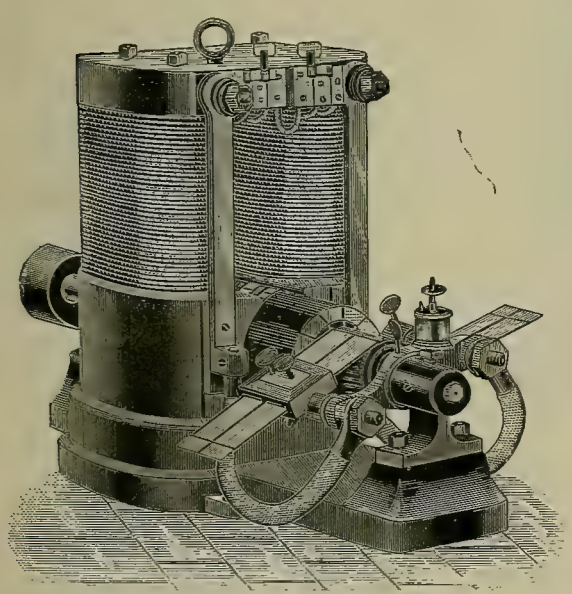


FIG. 1. DETROIT ELECTRO-PLATING DYNAMO.

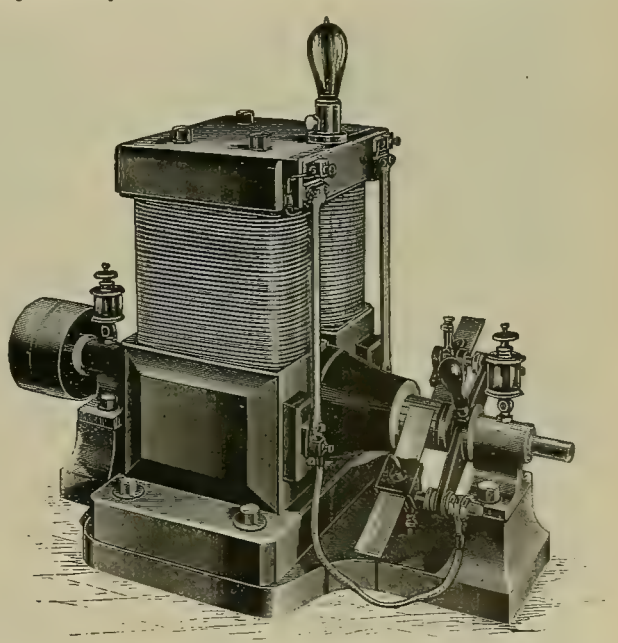


FIG. 2. DETROIT INCANDESCENT DYNAMO.

The company is building lighting dynamos in sizes from 10 to 100 16-candle power lights; the motors range from ¼ to 5-horse power. The lighting machines are wound for 110 volts. The motors are wound for either 110, 220 or 500 volts, and the plating machines run at a constant pressure of 5 volts. The manufacturers claim for the plating machines that they do not reverse, and that they are high-class generators.

An Electrical Riding School.

One of the attractions at Nice, Italy, last winter, was an electrical riding school. The cuts tell the story. Wooden horses are urged around a ring by the propelling power of electric motors. In the Nice riding school six of these flying horses are in operation. The power plant consists of a Rechniewsky dynamo, which is driven by a 12-horse power gas engine. The

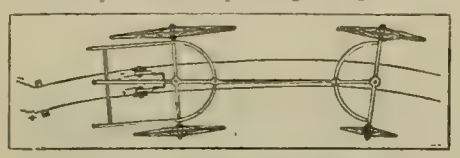


FIG. 3. ELECTRICAL RIDING SCHOOL.

motors take 1,000 watts each. When the dynamo circuit is closed, all the horses start together, their relative speed being proportional to the radii of the rings on which they are whirling. Those on the outside are designed for persons who enjoy rapid transit, while those on the inner circles are intended for older individuals, who object to too speedy locomotion. Each

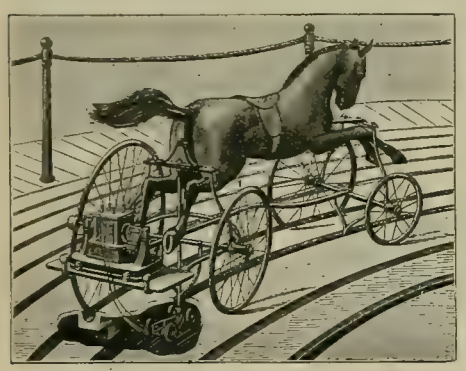


FIG. 2. ELECTRICAL RIDING SCHOOL.

horse, however, is independently controlled, and its speed can be regulated at will by the rider. The general operation of the horses is controlled by the electrician in charge of the switch-board on the side of the room. Any animal can be stopped instantly. Fig. 1 gives a general view of the riding school. The flying vehicles are operated by the motor by friction. One of the

FIG. 1. ELECTRICAL RIDING SCHOOL.

four wheels on which the horse is mounted, Fig. 2, has a rubber tire in contact with the motor pulley. The friction is sufficient in the case of the horses on the outside ring to bring up the speed to 18 feet per second. Higher speed it is stated, would be dangerous. In the construction of the vehicles, on which the horses are mounted, the greatest care was taken, so that there would be no danger of upsetting. A plan of the vehicle is given in Fig. 3. The current is conducted to the motors by wires from two rolling contacts, which slide over two copper strips forming the dynamo circuit. The riding school has been so successful in Nice that a similar institution is to be equipped in Paris, and before long electrical horses will doubtless take the place of some of the flying horses in America. The cuts are reproduced from *La Nature*.

What Constitutes a Dangerous Electrical Current?

By Nelson W. Perry, E. M.

PART II.—CONCLUDED.

The average normal resistance of an adult body from hand to hand may be accepted as 1,000 ohms. As the highest estimates have usually placed the quantity necessary to kill at not more than one ampere if passed from hand to hand or head to foot, the electromotive force that must be associated with the same idea will be 1,000 volts, because the pressure is capable of forcing just one ampere of current through a resistance of 1,000 ohms. We must not, however, assume from this that all currents of 1,000 volts that pass thus through the body are necessarily fatal because currents may exist of vastly greater electromotive force, but lacking in quantity —such, for instance, the spark from a Leyden jar which may be many thousand volts and yet be so insignificant in quantity as to permit of its being taken without unpleasant effects. Then again, if we should assume a case in which, say a single ampere of current would only just be sufficient to cause death, it is not to be taken for granted that death could not be caused in any way by *less* than one ampere.

Prof. Tait and Balfour Stewart in their joint work "The Unseen Universe," call attention to the different effects that may be produced by the same amount of energy when applied in different ways and cite as an illustration, that a pillow weighing 30 pounds moving at a rate of 10 feet per second that is a velocity it would attain if it had fallen a little less than 2 feet, has nearly the same energy as a pellet of No. 1 shot as it leaves the muzzle of a fowling piece. "How different the quality of these equal quantities of energy of the same kind," say they.

Then again it is observed that a force suddenly applied will often produce very different results from an equal one that has been gradually applied, and an interrupted or alternating current of electricity is found to produce more violent physiological effects than a continuous or steady current of the same electromotive force.

In the present state of our knowledge it is not possible to arrive at the increased effect quantitatively, but that there is increased effect is a matter of very common experience. Mr. Edison is quoted as having stated that three volts of the alternating current would be fully equivalent in physiological effects to 8 volts of the direct current. Mr. Westinghouse would probably not admit that there was anywhere nearly so much difference between the two.

It is desirable that we do not here confuse the effects due to the breaking of a circuit.

Every one is familiar with the thumping that occurs when the water is suddenly turned off in a long pipe. There is no jar when the water is turned on at the faucet, but if the pipe is very long and the water is under considerable "head," a sudden turning off of the flow may result in such a thump as to burst a pipe capable of withstanding a very much greater pressure than that due to the head of water. In fact, this extra pressure due to the sudden stoppage of a flow of water, is utilized in the hydraulic ram to force water higher than its source.

Now in the flow of electricity we have an exactly similar phenomenon. While the sudden closing or starting of an electric current will produce momentary physiological or magnetic effects in excess of the same current more gradually applied, its electromotive force is not increased by its sudden starting, but if a circuit be suddenly broken, we have effects exactly analogous to those observed in the case of water in a pipe. If the wire be very long, these increased effects become more apparent, and if the long wire constituting the circuit is coiled many times around a soft iron core as in the case of an electro-magnet, the voltage may be enormously increased by the breaking of the circuit. This effect, which is said to be due to momentum in the case of water, is called the "extra current," and is ascribed to "self-induction" in the case of the electric current.

In some cases this extra current may be several times as strong as the normal current, and it thus becomes apparent how an otherwise harmless current may become an agent of death.

For instance, where a man might catch hold of a broken trolley wire carrying a current of 500 volts with safety if it were merely hanging down and not touching the ground, he would in all probability be instantly killed if he found such a trolley wire lying on the ground and he should pick it up, because in the first case he would be merely completing the circuit through his body to the ground of a current that is usually considered safe, and in the other by breaking such a circuit already completed he would get the benefit of the "extra current" which might be several thousand volts.

It may be laid down as a very safe rule to follow, therefore, to be always suspicious of every wire one meets with in these days, but be especially suspicious of every wire one finds lying on the ground. It is harmless there, but it may be exceedingly dangerous to lift it up. If it is a charged wire, and one can never be sure that it is not, it is sure to be more dangerous to handle than its normal current would imply.

While a dose of electricity not sufficient to kill is exceedingly painful, as the writer and almost every other electrician knows by experience, it is perfectly certain that a sufficient dose is perfectly painless.

Jules Verne in his story, "A Journey to the Moon," places his heroes in an immense projectile which is fired at the moon from a cannon of suitable proportions. After the projectile has started on its journey the hero is at first mystified by the fact that he has heard no report of the explosion. He refers to his figures and finds that according to his calculations the projectile should have an initial velocity greater than that of sound. He concludes, therefore, that he could not have heard the explosion because he has kept ahead of the sound.

A little over a year ago the writer by invitation formed one of a select audience of gentlemen before whom Prof. Maybridge showed with the lantern a series of instantaneous photographs. In order to make the intervals between the exposures as well as the times of exposures exceedingly short, the plates had been exposed and stopped by means of an electric current.

One very interesting series of pictures that he showed was intended to illustrate the slowness of the brain in receiving impressions. To illustrate this he had employed two women—one stood in a bath-tub and the other stood upon a chair and poured a bucket of water over the former's head and shoulders. In order to make the shock more intense, Prof. Maybridge had had the bucket filled with icewater, unknown to the victim who would scarcely have consented to the ducking had she known the temperature of the water. One view represented the water tipped over and the water falling but not yet quite touching the girl's head. The next view showed the water already splashing from her head and shoulders, but although the water had already touched her and some of it had splashed off from her shoulders, still she had not yet received the sensation.

The third picture showed her just beginning to respond to the shock, and the subsequent ones illustrated the various phases of this response; but what interests us here in this connection is the second view. The electric current had in that case first exposed the plate, and then after a very short interval had shut it off again; that is to say, had acted twice with an interval of time between the two sufficiently long for the sensitive plate to take an impression of the view and this after the icewater had touched the woman's shoulders and *before* she was conscious of it.

This is the reason that death by electricity if applied in sufficient doses must be absolutely painless, that with the velocity of light, or at about 186,000 miles per second, the impulse has gone on its way and completed its work. In fact, there are reasons for believing that death by this means is so swift that the dose could be repeated a number of times within the interval that is known to elapse between the receipt of an injury and the cognizance of it by the brain.

In receiving an electric shock it makes a very great difference how we have come in contact with the current, and in accidental cases it is almost impossible to tell just what the conditions were, and consequently how much current passed through the body. For instance let us take an ordinary arc light circuit such as are common in all of our cities. Such a circuit carries a current usually of 9.6 amperes at a pressure of 45 volts. I speak of this kind of circuit because in the popular mind it is considered particularly deadly. One may catch hold of the bare conductor with both hands without feeling the slightest shock, because then the body forms what is called a "derived circuit" of high resistance while the wire between the hands is of very low resistance. The law of flow in such cases is that the current will divide itself among all paths to which it has access in proportion to the conductivity of those paths. In the case just cited the conductivity of the wire between the hands may be 5,000 times as great as that of the body, and in that case 5,000 times as much current would take that path as the other, leaving $\frac{8}{8000}$ ampere the quantity that would pass through the body—a quantity so small as not to be perceptible.

If one placed his hands on the wire so that a lamp came in between them, the resistance of the lamp would be added to that of the metallic path, and its conductivity would no longer be 5,000 times as great as that of the body—it would be less and therefore a greater proportion of the current would pass through the body than in the first case.

The greater the number of lamps "short-circuited," as the technical phrase is, the smaller the proportion of the current that will follow the wire, until if so many lamps and other resistances are included between the two hands that the resistance of that part of the current is as great as that of the body, then half the current will pass through the body, and half will follow the wire.

It might be perfectly safe, therefore, to catch hold of both of the wires of the so-called deadly arc light circuit if one were sufficiently far from the dynamo so that there were but two or three lights beyond him, whereas it would be surely fatal to do the same thing near the dynamo, where by so doing one would short-circuit many or all of the lamps on the circuit as well as the resistance of the circuit itself.

In practice, however, it is never safe to touch even one of the bare wires of such a circuit unless perfectly insulated from the ground, for the reason that there are liable to be leaks or ground connections somewhere along the line, and by touching one wire while standing upon the ground, a path would be opened for the current from the point touched through the body and the earth to the leak, thus short-circuiting all of the resistances between the two points.

It is therefore another safe rule to follow—never connect two points of an electric circuit between which there exists a high resistance of any kind, by means of the body, as the high resistance forms an obstacle to the passage of the current through that conductor, and forces it to take any other paths open to it.

In the case of a shock by coming into contact with an arc light wire while in more or less perfect electrical connection with the earth, it is always due to an earth connection somewhere else on the line. It is not infrequently claimed in such cases that the shock received is due to the full force of the current, which in many arc light circuits runs up to 3,000 volts or over. This, of course, is seldom true. In fact, in such cases it is usually utterly impossible to tell just what current was received, first because the exact location of the leak or leaks on the line is usually never known at the time of the accident, and therefore it is impossible to tell just how many lamps or other resistances have been short-circuited, and then in the second place the normal resistance of the body is usually not the only one concerned in the short circuit—there is the undetermined resistance of the boots and also of the ladder, or whatever else one is standing on, and also the resistance due to imperfect contact with the wire as well as that of the leak itself. Since the quantity of current that will pass through the body is dependent upon all of these factors which are usually undeterminate, any statement as to what current a man received under such circumstances, is at best the merest guess and usually the poorest kind of a guess at that. We now see, however, how one man may be killed and another be only slightly injured from contact with the same circuit.

The case would be somewhat different, however, if having hold of the conductor with two hands it should become broken between the points at which it was grasped. The body would then be virtually short-circuiting an infinite resistance and would receive the full current of the machine up to the capacity of the machine to force it through his resistance. That portion of the circuit nearest the dynamo would be more dangerous to try the experiment on than that portion furthest removed—in fact there would be no difference where it was tried; it could have but one result in the case of machines of large capacity, viz: death. The various high resistances which different investigators have attributed to the human body, aside from the other modifying causes that I have shown, make it apparent how possible it is under circumstances otherwise apparently favorable, for a person to receive a very slight shock comparatively from a very strong current.

On the other hand several electricians have testified that they have taken currents of very high electromotive force—one in particular testifies to having taken 10,000 volts, and the fact that he lived to tell it is evidence enough that it was not fatal. I have no reason whatever to doubt that it was so; and if there were any object in doing it, or rather if there were sufficient object, I would not hesitate to take myself an alternating current of the same or even greater voltage. I should want to take it in my own way, however, and I could do it without fear of fatal effects, whereas I should feel sure of being instantly killed if I took one ampere of current at 1,000 volts from hand to hand, or from head to foot in the most approved way.

Another feature that has undoubtedly been a very potent factor in the discussion of this question of the uncertainty of the physiological results from the electric current should be referred to. In 1888 the State of New York enacted a statute substituting death by electricity for death by hanging. Any change so radical as this would naturally have attracted wide attention and given rise to considerable discussion, and indeed, with the information then at hand as to the behavior of the human body toward electricity, there seemed ample grounds for a difference of opinion not only as to the advisability of the change, but also as to the practicability and certainty of the new method. Of course none of the manufacturers was willing to have his machine used for this purpose. The electrical journals of the day teemed with contributed and editorial comments favoring the views of the manufacturers, and the validity of the law authorizing the execution of criminals by electricity was severely attacked and not allowed to rest until affirmed by the highest court. The electrician through whose instrumentality the machines were procured and other arrangements for the carrying out of the law were made, was professionally ostracized and branded with the most opprobrious epithets, and every endeavor made to manufacture a public opinion against which it would be impossible for such a law to stand.

The company whose machines were procured is the one that has been most active in the introduction of what are known as high potential alternating currents. Their business rivals who confine themselves to the use of the direct current usually at lower potentials were not slow to take advantage of what appeared to them a business opportunity, and we therefore have seen arrayed against each other the representatives of the two systems—the high potential and especially the alternating current representatives—trying to defeat the execution of the law, and using every argument that presented itself to prove the extreme variability of the resistance of the human body, and therefore the uncertainty in any given case as to the probable action of a given electromotive force, and the low potential men endeavoring to prove the necessarily dangerous character of all high potential currents in general, and of alternating currents in particular.

Thus we have had the leading representatives of the two systems appearing in print in one of our leading periodicals each showing the harmlessness of his own system and the dangers of the other, and each suggesting a series of precautions, which if observed, would reduce the danger from electrical currents to a minimum in a way perfectly satisfactory, doubtless, to himself, but not to the other, because in each case the following of the suggestions of each necessarily involved the abandonment of his opponent's system.

Since perhaps the majority of electricians actively engaged in this country are identified with either one or the other of these two great interests, we find them too taking sides—usually with the interest with which they are connected. The old saying that "the wish is often father to the thought" is not merely a pleasant jingle of words, but a psychological fact and we thus have had most sincere arguments on both sides of the question by men who intended to be and were thoroughly honest.

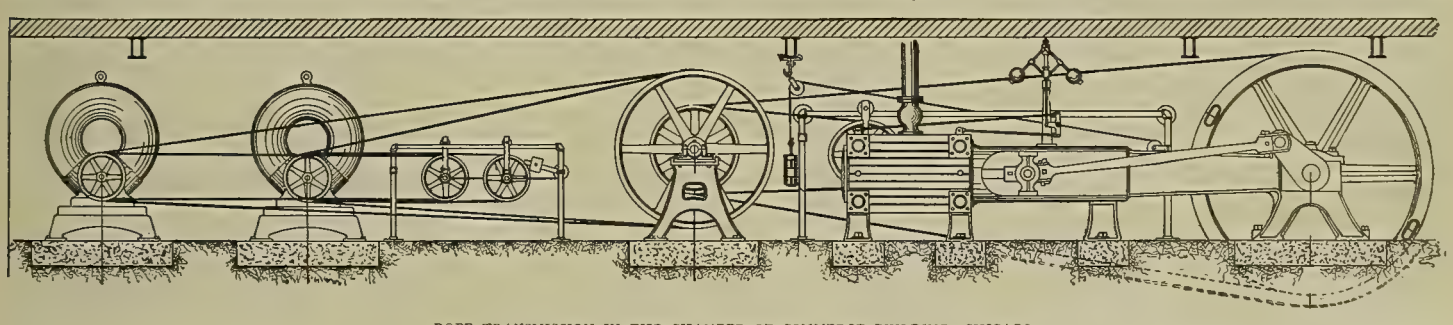
As a person who is identified with neither party, and yet who has business affiliations with both, I have thought that I could discuss the question free from the bias that has naturally existed in many other instances, and my conclusions from the facts and evidence at hand are, that a large majority of those who are free to weigh the evidence dispassionately are in no uncertain mind that a single ampere of current passing through the body from hand to hand or from head to foot is as surely fatal as anything we know.

I also believe with a great many who have given this subject much thought that a very much less quantity than one ampere would be sufficient to insure immediate death. I have little sympathy, however, with the attempt that has been made to distort the facts in the case to the injury of the business of one of our largest electrical interests, or with that other attempt to create a false sentiment against the so-called "debasement of science," which it is claimed is involved in the substitution of the electric current for the guillotine or the halter.

Rope Transmission.

The electric light plant in the Chamber of Commerce building, Chicago, will eventually be one of the largest in the city. For driving the Mather dynamos the Link-Belt Machinery Co. of Chicago designed a rope transmission plant. The power plant has two 150-horse power Corliss engines, each driving independent jack shafts. From each of these jack shafts are driven two 800 light dynamos.

The accompanying engraving is an elevation of one of these drives, and shows the engine connection to the jack shaft and the suspended single track tension carriage. The sheaves that drive the dynamos are each provided with disk friction clutches, so that either one or two generators can be run at will.



ROPE TRANSMISSION IN THE CHAMBER OF COMMERCE BUILDING, CHICAGO.

An electric light plant will soon be installed at Dawson, Ga., by the city and local capitalists together.

Improvement in Trolley Devices.

Foree Bain of Chicago, has invented an improved trolley device for electric motor cars, by which it is claimed contact with overhead circuits is secured, notwithstanding irregularities in the overhead wire due to sagging or other causes. It is also claimed for the device that it does not require different adjustment for forward and backward movements of the car. In the accompanying cuts, Fig. 1 shows the rear elevation of a mining machine operated by an electric motor, and provided with this appliance. Fig. 2 is a view in side elevation of the trolley device. Fig. 3 shows the trolley device in a modified construction. The cut represents a mining machine having an electric motor *B*, supported on that part of its frame which carries the cutters. To one side of the motor *B* is secured an upright bar *C*, which should extend to or beyond the upper of the wires, supported along the side near the top of the mine to form the circuit. The bar *C* is bifurcated, as shown, to constitute a guide, preferably from near a point on the plane of the lower of the circuit wires to its upper end. The rollers *D D* of the trolley device may be connected, one to follow the other, as shown in Figs. 1 and 2, by a connecting bar *E*, secured near its opposite ends to the journal ends of the rollers, which through *E* are connected with the machine by a jointed arm or lever *F*. The upright arm *I* of the jointed connecting medium *F* is pivoted at its lower end to the machine, and the arm *H* is pivoted to the upper end of the arm *I*, extending thence at an angle through the guide afforded by the bifurcated bar *C*, and secured at its farther extremity to the bar *E*. The jointed lever *F* affords a convenient guide-support for the wires, connecting the trolley-rollers with the motor.

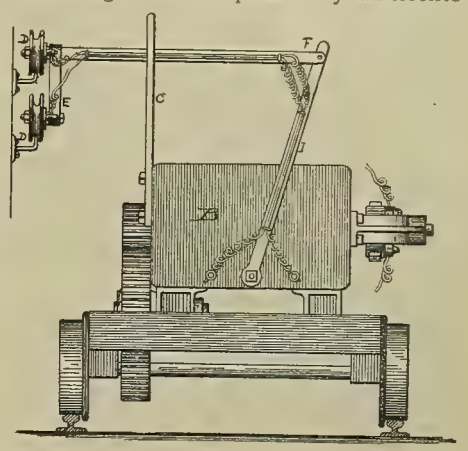
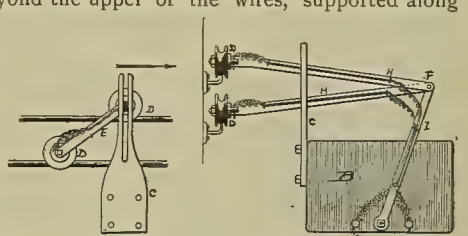


FIG 1. IMPROVEMENT IN TROLLEY DEVICES



FIGS. 2 & 3. IMPROVEMENT IN TROLLEY DEVICES.

Instead of connecting the rollers *D D* by the bar *E*, and thence connecting them through a single arm *H* with the pivotal arm *I*, they may, as shown in Fig. 3, be each separately connected pivotally by an arm *H*, passed through the guide-bar *C*, with the upper end of the arm *I*, affording the same advantages as in Figs. 1 and 2.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building. - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Electric Mining Locomotives. Illustrated	77, 78
Farewell Banquet	77
Minneapolis Exposition	77
Milwaukee Electric Road	78
Evans' Friction System. Illustrated	77
Street Railway War at Springfield, Ill.	78
Hot Wire Lightning Arrester. Illustrated	78
Dubuque Storage Battery Road	78
A Copper Rail Bond Illustrated	79
The Patent Department	79
Operating Window Cleaners by Electricity	79
Detroit Dynamos. Illustrated	79
Electrical Riding School. Illustrated	80
What Constitutes a Dangerous Electrical Current? By Nelson W. Perry, E. M. Part II.	80, 1
Rope Transmission. Illustrated	81
Improvement in Trolley Devices. Illustrated	81
Editorial	82
Combination Cone Shade. Illustrated	83
The Preece Dynamo. Illustrated	83
Death of Jeptha H. Wade, with Portrait	83
Patent Litigation	83
Kemmler's Terrible Death	83, 84
Safety of Passengers on Electric Cars	84, 85
Electrical Exhibitors at the St. Louis Exposition	85
DEPARTMENTS.	
Correspondence	85, 86, 87
The Electric Light	87
The Electric Motor	87
The Telegraph	88
Electrical Patents	88

BEGINNING with this number the advertisements in the WESTERN ELECTRICIAN will be indexed and classified. To maintain and correct weekly an alphabetical and classified list of advertisers in a paper as large as the WESTERN ELECTRICIAN is a matter of no small labor and expense. We undertake the work for the convenience of the thousands of readers who each week peruse the paper and consult its advertising columns. The index in the comprehensive form in which it is presented forms a veritable buyers' guide, and as such will be of benefit to readers and advertisers alike. It will be found on advertising page III.

THE people of Minneapolis are nothing if not enthusiastic. They assert that the electrical exhibit to be made at the exposition in their city, in the fall, will be the most noteworthy display of the kind ever made in the world. Some of the arrangements perfected at the present time are noted in another column.

IN the present issue is presented the conclusion of Nelson W. Perry's interesting article on "What Constitutes a Dangerous Electrical Current?" Mr. Perry's advice in regard to wires, addressed to those who are unfamiliar with electrical work will meet, we think, with the hearty indorsement of the readers of the WESTERN ELECTRICIAN.

ACCORDING to all reports the attendance a the summer meeting of the National Electric Light association at Cape May, April 19th, 20th and 21st, will be unusually large. The list of topics to be discussed was presented in the last issue of the WESTERN ELECTRICIAN. The programme should prove unusually interesting, and those who attend the Cape May convention will doubtless experience an exceedingly enjoyable visit.

SINCE the directors of the World's Columbian Exposition have obtained the necessary legislation from the state legislature and the Chicago city council there has been an increased interest in electrical circles in the appointment of the electrician to have charge of the electrical section of the World's Fair. The friends of the several candidates continue to present the latters' claims with commendable persistence. As far as systematic work is concerned, Prof. Barrett, city electrician of Chicago, is decidedly in the lead.

THE pioneers of the telegraph are passing away. In the present issue is chronicled the death of Jeptha H. Wade, whose name will always be identified with the early days of the telegraph. Within a period of about two years the WESTERN ELECTRICIAN has been called upon to chronicle the demise of George M. Phelps, Sr., and Hiram Sibley, and now comes the news of Mr. Wade's death. James D. Reid, who had an intimate knowledge of both the characters of Mr. Wade and Hiram Sibley speaks of the former telegraph pioneer when he was elected to the presidency of the Western Union Telegraph company in the critical period of 1866 in these terms: "Mr. Wade knew how to appreciate and how to estimate the value and force of obstacles, how to carry out by careful and prudent steps and in well arranged detail a fine conception and organize it into a vital, permanent force. * * * Wade carried no horn. He was a sapper and a miner. He did his work by quiet, effective, well-planned, thoroughly thought-out methods. The walls might fall at the blast of Sibley's horn, but the city was made opulent by Wade's executive and administrative skill." In another column are presented a portrait and biographical sketch of Mr. Wade.

IN a recent issue of the WESTERN ELECTRICIAN appeared an article devoted to the comparison of two patents just issued. The two alleged inventions seemed so nearly identical that we thought it would be difficult to determine to whom the patent really belonged. The Patent Office, we thought, erred in issuing two patents for what was practically one invention. The article in question has roused considerable interest and the comments which we made at the time have in some quarters been criticized, but it may not be out of place to repeat that we have not modified the views which we expressed at that time. We realized then that the two patents did not cover inventions absolutely identical, but they seemed to be so nearly alike that they related practically to the same thing. We have noticed that when one begins to state the differences between the two inventions his distinctions are of the hair-splitting variety. We do not think the Patent Office was justified in issuing two patents. We contend that the patent law is becoming too attenuated when one who invents a coating of conducting substance, "in which the conductivity decreases from one place upon the surface to another," may be prevented from using an exactly analagous "conducting substance which gradually decreases in breadth from one point to another." We submit that it is not invention, but a mere change of form or modification which any mechanic could make without the exercise of inventive faculty. In short, we contend that patents should be issued for inventions and not for mere forms of expression—slight, meaningless verbal changes. This matter has been considerably discussed since the publication of the article in the WESTERN ELECTRICIAN, and we trust the discussion may have its effect on the Patent Office. If patents so nearly alike are to be issued infringement will be rendered easy and patent property will not appreciate in value.

THE first electrocution which took place at Auburn prison, August 6, was characterized by incidents of the most horrible description. The rope was discarded in New York state because of the horrors which its employment had caused; but the wired chair which was substituted has proved to be a far more horrifying means of effecting a criminal's death. The experiment—for it was nothing more—is now generally conceded to have been a miserable failure; all the predictions uttered by the opponents of electrocution have been verified, and a second trial would be a disgrace to enlightened humanity. That these views are generally entertained by the press is indicated by the editorial opinions quoted elsewhere in this issue. It is not our purpose here to speak at length of the ghastly circumstances which attended the execution. The daily press accounts have told in great detail the sickening story. Death was not caused instantly. Two applications of the current extending over a period of four minutes at least, were necessary before death came to the relief of the writhing victim. At the end of the first application the physicians supposed that life was extinct but on the cessation of the current evidences of returning animation horrified the spectators; the gruesome apparatus was put in operation again and several minutes elapsed before the doctors were prepared to affirm that they were in the presence of death. The poor wretch was burned about the head and back where the electrodes were in contact with his body. The doctors state unanimously that Kemmler experienced no pain; but in reading the accounts of the execution one feels something like a suspicion growing upon him that perhaps the medical gentlemen did not wish to reveal the whole truth. It is not hard to believe that they decided to suppress the facts out of consideration for the feelings of the public. Whether they told what was conceived to be the truth or not is immaterial; they were mistaken on so many points about the execution that it is by no means impossible that they are in error in regard to the unconsciousness of the condemned murderer. All the arguments which were used in support of electrocution were disproved by the half dozen minutes of experimenting in the death chamber. The current did not cause death suddenly, as the physicians had confidently prophesied, but on the contrary it was effected slowly and barbarously. But we are told by the advocates of this new manner of causing death that the entire affair was bungled; that it is not fair to condemn electrocution unqualifiedly when a second experiment may prove successful. The answer to this appeal for suspension of judgment is patent. It has been demonstrated at least that the new method is uncertain, and there is no reason to believe that a second trial would not be attended by equally horrible results. A second electrocution would probably be bungled in fully as outrageous a fashion. Electrical engineers of experience, who alone are competent to superintend an electrical execution, will never consent to pose as successors of Jack Ketch. If electrocution is to remain the legal mode of inflicting the death penalty in New York state we may expect to see repetitions of the horrors of the first experiment. Ignorant workmen, with a prison warden as chief electrician, do not constitute a staff competent to handle skilfully electrical apparatus. We trust the first electrocution will be the last. The repeal of the electrical execution act is demanded by public opinion, and the New York legislature will, we think, eventually wipe out the obnoxious law. The matter of electrocution will unquestionably be brought once more before the attention of the National Electric Light association at Cape May next week. The organization will doubtless feel called upon to express its opinions in no uncertain terms. With public sentiment so strongly against the new death penalty the association should find no difficulty in making itself an effective instrument in securing the repeal of the barbarous electrical execution act.

Combination Cone Shade.

Tin shades being cheap and unbreakable there has always been a call for them from factories, mills, stores and other places where porcelain shades would prove too costly. An additional reason is found in the fact that bright tin reflects the light better than porcelain or glass shades. A year ago George Cutter, now manager of the Great Western Electric Supply company, Chicago, designed a tin shade which required no holder. The popularity of this combination tin shade has now led the company

COMBINATION CONE SHADE.

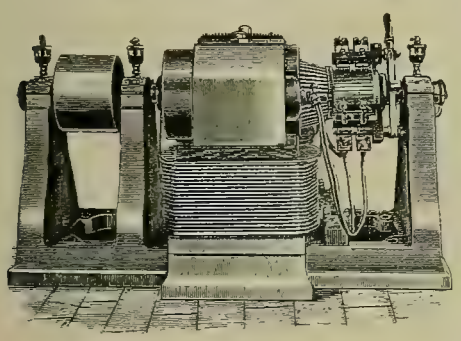
to bring out a new pattern called a combination cone shade. As the cut shows, it is of a deep cone shape, well fitted for the use of book-keepers, draftsmen, engravers and others who want the light concentrated on their work. As it fits the Thomson-Houston, Westinghouse and Sawyer-Man sockets directly, it will hang squarely at all times.

The Preece Dynamo.

The Preece dynamo is shown in the accompanying illustration. The bed-plate and brackets are made in one complete casting. The plummer blocks are filled with adjustable phosphor bronze bearings, and each bearing is filled with a sight feed lubricator.

The magnet yoke, which is cast in one pieee, is let into a recess in the bed-plate, and the pole pieces are separate castings bolted to the magnet yoke. The field coils are wound upon separate shells with zinc flanges, and are interchangeable for all machines of the same output. The armature is built up with charcoal iron discs insulated from each other with a specially prepared varnished paper, and are held in position on the shaft by two insulated bolts passing through the driving end plates which are firmly keyed to the shaft. The armature core is ventilated internally by suitable divisions which are left at every 2 inches between the plates. The armature is wound one layer deep, with 19-17 strand braided cable, and connected up to a 60-part commutator, there being one complete turn per commutator bar.

The armature on the pulley side is provided with a blower to send a current of air through the pole pieces and prevent an accumulation of



PREECE DYNAMO.

dust; both ends of the armature are protected with brass shields fitted to the pole heads. The brushes are made of soft brass wire and their pressure upon the commutator is regulated by thumb screws.

At a speed of 800 revolutions per minute the e. m. f. is 110 volts, and the current at full load, 250 amperes. The rise of temperature after 10 hours continuous run is said to be 40 degrees on the armature conductors, and the field coils 30 degrees Fah. above the temperature of the air. The cut is reproduced from the London *Electrical Review*.

Death of Jeptha H. Wade.

Jeptha H. Wade, whose name is identified with the early days of the telegraph, died at his home in Cleveland on Saturday last. He was one of the wealthiest and most highly esteemed residents of the city. Mr. Wade was born in Seneca county, N. Y., in 1811. He became interested in telegraphy as soon as the first message had been sent from Baltimore to Washington. He began at once the study of the new science at Detroit. He then placed himself at the head of a corps of laborers and pushed into the woods of Michigan, constructing along the line of the Michigan Central, the first telegraph line west of Buffalo. He opened, equipped, and self-taught, conducted both as manager and operator, the office at Jackson. He soon entered the field as proprietor, and began building lines on his own account. He covered Ohio and Illinois, and "Wade's lines" were known as far west as St. Louis. At this time the manager of a telegraph line was expected to make insulators, wires, and all other appliances required for the equipment of the line. The greatest obstacle was imperfect insulation, and here Mr. Wade stepped in and invented the famous "Wade insulator." It was imperfect insulation that made

JEPTHA H. WADE.

the first telegraph line between Cleveland and Cincinnati a failure, and Mr. Wade purchased the stock, and set the business on an efficient and paying basis. In extending his lines to St. Louis, he was first to demonstrate the practicability of inclosing a submarine cable in an iron armor. In 1852 no one was making any money in telegraphy, and telegraph stock was so low that whole blocks were given Mr. Wade on the guarantee that the stockholders would not be called upon for any further assessments. Much more was bought at 5 and 10 cents on a dollar. In 1854 Mr. Wade united his lines with those controlled by the House Telegraph Printing company of Rochester, and then Mr. Wade as general manager controlled all the lines from Buffalo, St. Louis, Chicago, Detroit, Cincinnati, Cleveland, Milwaukee, and intermediate points. The later outcome of this combination was the Western Union Telegraph company. Mr. Wade next turned his face toward the "Great American Desert," which was then said to lie between the Mississippi and the Pacific states. He became the originator and first president of the Pacific Telegraph company. The construction with all its difficulties was effected under his direction. He blazed out the way which his telegraph line afterward assisted the Union Pacific Railway to follow. When the Pacific company was combined with the Western Union he became the first president of the combination and served there until 1867. After his retirement Mr. Wade began his career as banker, capitalist and philanthropist, which made him one of the best known of Cleveland's citizens. He left a fortune of about $5,000,000.

Patent Litigation.

Judge Blodgett granted a preliminary injunction to the Western Electric company at Chicago, August 11th, restraining the Ellithorpe Air-brake company from infringing letters patent 148,447 granted Augustus Hahl, March 10, 1874, and 172,993 granted Elisha Gray, February 1, 1876, for electric annunciators for elevators. Suit was begun by George P. Barton, attorney for plaintiff, August 8th. There has been considerable litigation over these patents, though this is the first time a preliminary injunction has been applied for. The first suit was against the Chicago Electric company nine years ago, and at that time Judge Blodgett sustained the patents. Many suits have been commenced since that time, but have all been settled without protracted litigation.

Kemmler's Terrible Death.

William Kemmler, who was convicted of murder at Buffalo, N. Y., May 10, 1889, was executed at Auburn prison August 6. This was the first execution under the new law of the state providing for the substitution of electricity for the rope in capital punishment, and it was likewise the first time the new method was ever tried in any country. Elaborate preparations had been made for the event, numerous experiments had been made on animals and the advocates of the new method announced that it could not fail as they were fully satisfied that death would be both instantaneous and painless. The result proved otherwise, and the experience was a miserable failure according to the statements of eye witnesses It had been the intention of the warden of the prison to comply with the law and an effort was made to keep the whole affair shrouded in mystery, but in spite of all his efforts every detail of the preparation was made public and complete accounts of what transpired in the execution room were secured. The witnesses of the tragedy, for thus it can be appropriately termed, were mostly medical experts who favored the new method, yet these men agree that the execution was both sickening and revolting in the extreme. District Attorney Quimby of Erie county, who secured Kemmler's conviction and who defended the new law when the case was appealed on the ground that the punishment was "cruel and unusual," was obliged to leave the room before the close of the tragedy so revolting was the proceeding. And yet Quimby is not possessed of a remarkably sensitive nature, and Kemmler is not the first murderer brought to justice through Quimby's efforts. Another proof is the fact that one of the remaining witnesses fainted and others were made sick by the sight.

The apparatus prepared for the execution has been described so often that it is needless to refer to these arrangements here. It was supposed the warden and his assistants were familiar with their operation, and that the proceedings would be conducted expeditiously, yet there was considerable delay and when, finally, the victim was seated in the death chair, bound and fastened with heavy straps, the officials' lack of familiarity with the apparatus was shown. The lower electrode was pressed against the prisoner's spine and when the head-piece had been adjusted, Kemmler moved his head about freely and called the warden's attention to the fact that the cap was not sufficiently secured. When this had been changed and it was supposed everything was ready the word was given and at 6:40 the current was turned on. After seventeen seconds the current was switched off and the dynamo was stopped. The physicians proceeded to make an examination. When the head piece was removed they were horrified to find the prisoner was still living. He gave unmistakable signs of life. The chest began to move up and down in deep, strained breathing. A gurgle came from Kemmler's throat. The sound of the breathing grew into an awful succession of wheezes. It was a half breathing, half groaning sound that grew more and more intense each minute. Finally foam began to spout from between Kemmler's clenched teeth, and the foam sputtered all over his clothes. At the same time Dr. Balch, who was very near Kemmler, noticed the blood dropping from Kemmler's hand where his thumb nail had cut it. "The man is not dead," said Dr. Balch. With trembling hands the attendants readjusted the cap. Then the order was given to turn on the current but there was considerable delay as the dynamo had been stopped when it was thought the man had been killed. The second trial was made, and for four minutes the current was left on. Then another cry of horror escaped the witnesses. The condemned man's body was burning and the sickening odor of burning flesh filled the room. The order was again given to turn off the current. This time there was no mistake. The man had not only been killed but he had been burned as an examination of the body showed. He had succeeded in separating his body from the lower electrode in his struggles after the first shock, and when the current was turned on the second time there was imperfect contact at this point. This is the explanation of eye witnesses. A theory was broached, believed by many and widely discussed, that it was not electricity at all which eventually killed Kemmler, but this fierce arc of fire which burned into the base of his spinal column. The physicians who made the autopsy, notwithstanding that they all believe that Kemmler still lived after the first shock was administered, expressed the belief that it was eventually electricity unaided by the burning that killed him. When the autopsy was made it was found that there was a deep circular imprint on the top of his head made

by the sharp pressure of the electrode's rim. The spot where a tuft of Kemmler's hair had been cut off just before death was found to constitute not more than one-third of the area of contact with the electrode, and close examination disclosed that the edge of the copper within the electrode had slightly burned the scalp just where the hair had been cut. Examination of the electrodes on the fatal chair disclosed that the sponge in the base of the spine was dried and scorched by heat generated, owing to imperfect contact, or to insufficient wetting of the sponge during contact. The result was a terrible burning of the back, clear through to the spine. This, coming in contact, had been burned to a black cinder and the flesh above had been cooked until yellow, while the inner tissues had been baked. The sponge in the upper electrode had been singed, though not so much as the other, and the scalp only singed instead of incinerated. The fact that he was not instantly killed is attributed to improper contact or to insufficient voltage or pressure. Contact certainly was not perfect at the head, for two-thirds of the contact was upon the man's thick, smoothly brushed hair, the clipped spot being one-third the size of the electrode's diameter. As the warden had the voltmeter placed in another room, none of the witnesses had any knowledge of the voltage of the current when turned on. The replies of the warden to questions on this subject were evasive and no one knew what the pressure was.

COMMENTS OF THE PRESS.

The new method of executing murderers in New York as exemplified in the case of Kemmler at Auburn, is generally condemned by the press of the country. A few extracts from editorials of the leading newspapers of the country on this subject are herewith presented. Probably the most important is that telegraphed to the *Medic l Record* of New York by Dr. George F. Shrady, its editor, who witnessed the execution. Dr. Shrady, immediately after the execution made the following statement to a reporter: "In my long professional experience I have waded through blood, figuratively and practically, but this morning's scene is the worst I have ever witnessed, and I do not want to see its like again." The following is an extract from Dr. Shrady's editorial: "While we allow that electricity has been a success as far as the killing is concerned we must also admit that we have gained little if any over the ordinary method of execution by hanging. The preliminaries of electrothanasia are far from pleasant to contemplate Alongside of those for hanging they are terrible. There is something more than weird in the preparation of the machine, the deliberate fixation of the victim, the adjustment of the electrode, and the thousand deaths in contemplating one, 'which more than equals the quick though damnable taking off.' The horrors, though hidden, are nevertheless felt. There is something else to be thought of than the mere quickness of death. While the latter might have been triumphantly done, the agony of the criminal during the preparations must be terrible as compared with that of hanging. It becomes a serious question if humanity is not paying too dear a price for instantaneous demolition. The awe and mystery of death are intensified a thousand fold in anticipation of what this instrument of subtle power may do as compared with either the noose of the rope. the grip of the garroter, the smart of the knout, the bore of the bullet' or the chop of the ax. And yet to harness the lightning and bore it through a human body is thought to be one of the advances of the nineteenth century."

The New York *Sun*: "The first duty of the next Legislature will be to repeal the Electrical Execution law and to restore the old method of administering the death sentence by hanging.

"Scientific curiosity has been gratified sufficiently by this one awful experiment. The present generation is not likely to hear of another such scene of horrible uncertainty, unknown torture, and heart sickening circumstances as was witnessed yesterday morning by the assistants at the judicial experiment upon the body of William Kemmler Civilization will find other lines on which to manifest its progress. It may be taken for granted that public sentiment in New York will tolerate no further essays in this new experimental science of man-killing by electricity, pending the time when the law can be repealed in the name of the State's dignity and of the enlightened humanity of the nineteenth century."

The New York *Press:* "It will not mend matters at all to say that there was ignorant bungling on the part of the executioners; that the first current was not kept on long enough, and the last current too long. It was argued in behalf of this mode of execution that death was to be instantaneous, lightning-like, painless and that the maudlin hero worship attending the dramatic march of the nervy murderer to the scaffold was to be done away with, and a secret and mysterious taking off, devoid of sensational features, to be substituted. The act went so foolishly far as to prohibit the newspapers from publishing the details of such an execution—a prohibition which, by the way, they most properly and completely ignored yesterday. The age of burning at the stake is past; the age of burning at the wire will pass also."

The New York *World:* "The first experiment in electric execution should be the last. Its result strongly condemns this method of putting criminals to death as very cruel and very shocking. The theory of unconsciousness from the first moment of shock is at best a mere assumption. It was not sustained in Kemmler's case by outward indications. Apparently the man died in agony, by slow torture. The effect upon the witnesses was sickening. The effect upon the public is still more shocking, chiefly because of the attempt to do this judicial killing by torture in secret, and to conceal the facts, whatever they might be, from the public in whose name and by whose authority the killing was done. The folly and wickedness of that attempt are sufficiently emphasized by the result. The electric execution law ought now to be repealed on all accounts. So long as it stands, convictions for capital offenses will be difficult to the point of impossibility. Juries will not willingly condemn men to death by torture. So long as capital punishment is maintained old-fashioned hanging is good enough, provided it is administered by trained and skillful hangmen."

The Rochester, N. Y., *Post-Express:* "The miserable, contemptible, cranky law for the execution of murderers by electricity was tested at Auburn yesterday, and, so far as can be judged, it failed utterly to attain its professed objects. It is more than doubtful if the execution of Kemmler was either sudden, painless, or certain; and assuredly it was the most sensational execution that had taken place in this state for years. The people must face the consequences of their own acts; and if the law dooms a man to death the public responsible for the law must know that he has died and should know how he has died. The idea that we can quiet our conscience by putting the victim away out of sight and killing him secretly is below contempt. That style of thing might do for mediæval Venice; it will not do for America of to-day. If we cannot endure to hear about sensational executions then we should adopt unsensational punishments."

The Rochester, N. Y., *Morning Herald:* If the reports current respecting what took place in Auburn prison yesterday are true, a human being was there deliberately and horribly tortured to death under the authority and by the officials of the great state of New York. If the reports from Auborn are true there can be no longer any doubt—the opinions of all the courts in the state to the contrary notwithstanding—that electrocution is a cruel and unusual form of punishment and therefore contrary to the constitution of the state and of the United States We hope in the name of humanity and for the sake of the morals as well as the sensibilities of the people of this state that Kemmler's death will be the last, as it was the first, on record by what is known as official electrocution."

The Chicago *Herald:* "The people of the state of New York may be properly arraigned before the bar of mankind for atrocious barbarism. Before the civilized world they will be held to a moral accountability, first, for the sickish sentimentalism that thought the rope too ignominious for murderers; second for the refinement of cruelty that suggested the use of electricity, and, third, for the blunders which these "doctors," these "professors," these "electricians" and these scientific quacks, when permitted to work their diabolism in their own way, committed in the death chamber. A queer combination of mushy tenderness and fiendish inquisitiveness brought about the change in the method of inflicting the death penalty in New York. There was no health and there was no humanity in it. It came as a new thing to an age on which old horrors had palled and to which sensation was a necessity. It was rotten and crumbling Rome over again, throwing captives to the lions. New York has now feasted full upon its prey. The denouement has been reached. Kemmler is dead, after two attempts with flesh burned to a crisp and with the odor still upon the raiment of his executioners. Is New York pleased with the job? It will hear presently how the world regards it."

The Chicago *Evening Post:* "In spite of the doctors' assertion that the death of Kemmler was instantaneous and painless, the mass of people, with whom the technical phrases of the doctors and alleged experts carry little weight, will always believe that the labored respiration that followed the first application of the electrical current denoted the presence of life and sensibility in the subject and that the wretch was actually tortured to death with a refinement of cruelty that was unequaled in the dark ages."

The Chicago *Times:* There seems to be no doubt whatever that it was horrible to the spectators and that it was necessary to apply the current a second time in order to make certain that the wretch, strapped head and legs and arms to a chair, was actually disposed of. The last fact tells its own story. Columns of explanation will not serve to dissipate the unfavorable impression which it creates in the mind of the reader."

The Chicago *Tribune:* "The most favorable criticism that can be passed now is that in Kemmler's case the method of death was not the success which was promised, and that as an agency for killing a man by due process of law electrocution has not yet demonstrated its superiority to hanging Indeed, the evidence, so far as developed, is all the other way, and the burden of proof rests more heavily than ever upon the advocates of the new system. The general expression of opinion now favors the allegation made by counsel that execution by electricity is both unusual and cruel."

The Boston *Herald:* "There has been, perhaps, no person under capital sentence in modern times who has passed through such an ordeal of mental suffering as has Kemmler. He has had to pass through repeated periods of elation and depression; has had to prepare to meet death and then to find the work of preparation unnecessary; so that in his case the terrors incident to capital punishment have been doubly intensified."

The Boston *Post:* "As to the comparative merit of electricity and the gallows, the experiment at Auburn has shown that the former is effective, but has by no means proved that it is more decent than the latter and has left an impression that it is far more liable to accident and far less certain than the method which it supplants. The test which New York has made should deter others from adopting the system, at least until further demonstration is made."

The Boston *Globe:* "The killing of criminals by electricity appears to be a ghastly failure. If investigations shall fully establish the truth of the sickening story that comes from the prison, there will never be another legal killing by electricity in this or any other country."

The Boston *Journal:* The relative humanity of the new method as compared with the old must turn upon the question whether the prisoner was conscious during the delay. The physicians present are agreed that there was no suffering after the first shock, and if they are correct in that opinion the experiment may perhaps be regarded as measurably successful, though the results are hardly such as to warrant a general adoption of the new method."

The Buffalo, N. Y., *Express:* "A man had to die in order that a barbarous, inhuman law might be repealed. William Kemmler deserved to die. Perhaps he even deserved the cruel and unusual death which was given him. The manner of his taking-off renders it certain that no other poor wretches will be made the sport of sciolists and mock-humanitarians under the shadow of the electric execution act. The failure of the experiment on the first human victim of electrocution will convince the legislature as the unaided voice of the people could not convince."

The Buffalo, N. Y., *Courier:* "If this story does not horrify the civilized world, then men and women are more callous than we believe them to be." It favors a repeal of the law.

Elmira, N. Y., *Telegram:* "And let us sincerely and earnestly hope that the ignorant, sodden wretch will also be the last man to be legally executed by electricity, for the accounts of those who witnessed it all agree that the scene enacted in Auburn prison in the early gray of Wednesday morning was in the extreme cruel, barbarous and inhumanly revolting. And still those who favor the new mode of killing blandly remark that from a scientific point of view the experiment was a success, though they add as to the question of whether it was humane or not the public must decide. And the public will decide, and that right quickly. The hair-brained fanatics have had their say, and the result has been a spectacle of horror and damnable cruelty. Now it is the turn of the people of common sense and humane ideas. There must be no more executions by electricity in the Empire state."

Rochester, N. Y., *Democrat and Chronicle:* "That it will be the last as well as the first execution by electricity, at least for a long time, it is safe to conclude. To-day Mr. Cochran's argument would be most persuasive with any judge in Christendom and the state legislature will hardly need an additional incentive to repeal a law, which has worked so disastrously. It may be that the time has not yet come for the abolition of capital punishment, but certainly the events of yesterday will strengthen in a marked degree the position of opponents of the death penalty and give renewed vigor to the discussion of this important question. So far as electricity is concerned it has been tried and found lamentably wanting."

The execution attracted almost as much interest in London as in America. When the reports were received in the English metropolis W. H. Preece in an interview recalled his denouncing electricity as a means of execution before the British Association in 1889, his experience proving the difficulty and uncertainty of killing even a rabbit with the most powerful induction coil ever made. Asked whether the most powerful Leyden battery would be effective to kill, he said he did not think it would. The American plan was as good as any that could be devised. The great difficulty lay in the absence of accurate knowledge as to what amount of electricity would be certain to produce death without torture. From a scientific point of view the Kemmler execution was a failure. Beyond doubt he suffered intense torture. The *Chronicle* says the scene was worthy of the darkest chambers of the inquisition in the sixteenth century. The *Times* says it would be impossible to imagine a more revolting exhibition. It advocates a lethal chamber in preference to the use of electricity. The *Standard* says: "The scene can be described as a disgrace to humanity. It will send a thrill of indignation throughout the civilized world. We cannot believe that Americans will allow the electrical execution act to stand."

FAVORS THE REPEAL OF THE LAW.

Senator Donald McNaughton of Rochester, N. Y., a lawyer of ability and experience who is esteemed throughout the state, has announced publicly his opposition to the electrical execution law, and advocates its immediate repeal by the legislature. He declared the scene at Auburn prison ghastly and barbarous, and asserted that if capital punishment were to be continued the people must return to hanging. Referring to the constitutionality of the law, Senator McNaughton said: "I think that the argument of W. Bourke Cochran against electricity as a method of punishment was masterly and convincing. The terrible event of yesterday bears out everything he said months ago. It is interesting to read in Mr. Cochran's brief the statement that even if electrocution be proven a failure, the courts will still sentence persons to this form of death." He said:

"If the actual infliction of this penalty upon the relator should prove, beyond all doubt, that it was a torture so frightful that it combined in itself all the worst elements of these tortures which we have hitherto believed to be prohibited by the constitutional provision, the courts, if this application be denied, will still be bound to pronounce the sentence on persons convicted in the future. Because if the law be unconstitutional, it must be unconstitutional *ab initio*. If it be constitutional now, it must always be constitutional. No subsequent developments can change its nature in that respect."

Safety of Passengers on Electric Cars.

To the Editor of the WESTERN ELECTRICIAN:

In your editorial comment on my article entitled "What Constitutes a Dangerous Current?" you emphasize the statement that the shocks due to the various voltages that I referred to as possible in the electric car could not be received by passengers. I am very glad you did so, for it was not my intention at all to imply that there was any such danger. Since you have called attention to it, however, I see that my words might be so construed by those not versed in electricity.

While your statement that it is only the uninitiated who through curiosity meddle with electrical apparatus that are liable to get hurt, I think you must make an exception where street cars are concerned, for nobody but an electrician starting out with the full intention of taking it, could possibly receive a shock.

To get the shocks that I referred to it would be necessary to chop down or unscrew the moulding that covers the

wires in the top of the car, remove the cleats and other fastenings of the wires, strip off the insulation, then *get out of the car* onto the ground while in contact with the bare wire. It would be impossible either by design or through carelessness for any one to get an electric shock of any kind while inside the car.

NELSON W. PERRY, E. M.

Electrical Exhibitors at the St. Louis Exposition.

Fred H. Whipple, superintendent of the electrical display at the St. Louis exposition, announces the following list of exhibitors who have already secured floor space:

Stanley Electric company, Philadelphia, apparatus for electrically filtering water; Jenney Electric Motor company, Indianapolis, motors and dynamos; Fidelity Carbon Manufacturing company, St. Louis, carbons and battery material; C. H. Talmage, Kansas City, electric house heaters; Joseph Irwin, Topeka electric railroad signals; G P. Hackenberg, Austin, Tex., electrical musical telegraphy; John S. Melton, St. Louis, electric foot specialties; Royal Silk Manufacturing company, New York, dynamo towels; W. H. Jenkins, Denver, Colo., electric mining apparatus; Hoover, Owen & Reutchler company, Hamilton, O., engines; N. H. Edgerton, Philadelphia, motors and instruments; Schultz Belting company, St. Louis, belts; Armington & Sims Engine company, Providence, R. I., engine for marine lighting; Thomson-Houston Electric company, Boston, marine dynamos, electric hoists and mining machines; F. M. Sparrow, Boston, electric specialties; Parker-Russell Mining company, St. Louis, carbons; Sperry Electric company, Chicago, motors and dynamos; Chicago Belting company, Chicago, belts; Phœnix Engine company, Meadville, Pa., engines; Sioux City Engine company, Sioux City, Ia., engines; St. Louis Electrical Supply company, St. Louis, general electric supplies; Walter E. Crane, Minneapolis, electric oil filters; Fisher Electric company, Detroit, Mich., dynamos; Foree Bain Chicago, dynamos; Carpenter-Nevens Electro Heating company, Minneapolis, domestic heating appliances; Rose Electric Light Supply company, St. Louis, dynamos, motors and lamps; Buckeye Engine company, Salem, O., engines; Edison General Electric company, New York, dynamos; John T Noye Manufacturing company, Buffalo, N.Y., engines; Western Electric company, Chicago, dynamos; Knapp Electrical Works, Chicago, motors and domestic electrical supplies; Southern Electrical Supply company, St. Louis, motors and supplies; Electric Exercising Machine company, Boston, electric exercising machines; Franklin Electric company, Chicago, electric cigar lighters; Union Electrical Construction company, St. Louis; general electrical apparatus; Pennock Battery company, Chicago; electric battery railroad; A. L. Ide & Son, Springfield, Ill.; engines, dynamos and motors; Kester Electric company, Terre Haute, Ind.; Johnston Electric Train Signal company, Boston, model train of cars with electric signals; Blattner & Adam, St. Louis, household supplies; Connecticut Motor company, Plantsville, Conn., dynamos and motors; Westinghouse interests combined; electrical and mechanical apparatus; Sperry Electric Mining Machine company, Chicago, electric mining machines; Shay, Stevens & Co., Chicago; insulators and battery jars; John Moran, Adair, Mo., electric burglar alarms; Simplex Electrical company, Boston, wires and cables; Washburn & Moen, Worcester, Mass., wires and cables; Automatic Clock company, Syracuse, N. Y., clock cut-outs, etc.; Belding Motor & Manufacturing company, Chicago, motors; Page Belting company, Concord, N. H., belts; A. C. Wolfram, St. Louis, domestic electric goods; Great Western Electric Supply company, Chicago, supplies; Jewell Belting company, Hartford, Conn., belts; Washington Electric Conduit company, Washington. D. C., underground conduits; Russell Electric Lamp company, Boston, arc lamps; Buckeye Electric company, Cleveland, O., lamps; Swan Lamp company, Cleveland, O., lamps; Lockwood Instrument company, Detroit, electrical instruments; Novelty and Electric company, Memphis, Tenn., electric specialties; Pond Engineering company, St. Louis, engine and dynamo; Samuel T. Williams, Baltimore, Md , engines; E. M. Turner, St. Louis, elevated electric railway; Jackson Electric Engine and Telephone company, Boston, electric engine and storage battery; Gibson Electric Fixture company, Philadelphia, electroliers; Zeigler Bros., Boston, electrical apparatus; Electrical Safety company, Boston, electric protectors; Fibrous Manufacturing company, New York, insulating and ornamental materials; De Kosenko & Hetherington, Philadelphia, electrolier, C. & C. Motor company, New York, motors; the Okonite company, New York, wires and cables; Central Electric company, Chicago, general supplies; English, Morse & Co., Kansas City, engineers' specialties; Unicycle Electric Elevated Railway company, St. Louis, electric bicycle; Western Electrical Supply company, St. Louis; general supplies; New York Insulated Wire company, wires.

Regulation of Electric Wires in Boston.

The recent investigation by the mayor and city council of Boston into the methods adopted in other large cities for the regulation of electric wires, has resulted in the presentation of an ordinance to the council on the subject. It is proposed to establish a department of electric wires under the charge of the superintendent of electric wires, who shall be appointed by the mayor and whose term of office shall be three years at $4,000 per year. This official is to have supervision over all electric wires, appliances and machinery in the city and he is empowered in the proposed ordinance to make requisitions for the installations, maintenance and operation of all electrical apparatus He shall be required to keep a record of all electrical apparatus in use in the city, and in a word, shall have complete control of all matters of this kind.

CORRESPONDENCE.

New York Notes.

NEW YORK, Aug. 9, 1890.—The people of New York have never had an opportunity to learn much about electric traction, and it seems to be the object of those who control the great daily papers to keep them in ignorance of the blessings to be derived from the introduction of this improved method of street car propulsion. In order to effect this purpose they studiously avoid saying anything favorable to the new system, and persist in their senseless statements that it is dangerous and a public nuisance; moreover, that it is an experiment. All of this is very foolish and absurd, yet one of the leading metropolitan papers the other day contained an editorial denouncing the overhead system on this line. The best evidence of the superiority of the electric system is the development and extension of the routes on which it has been given a practical test, no matter where they may be or what they have had to contend with. It has outstripped all other systems, and the sooner the people of New York recognize its superiority and adopt it, the better it will be for their own interests and their reputation as wide-awake, live men.

The wires of the fire department are still an eyesore to the mayor, and in response to the claim of the fire department that the streets in which the overhead wires are maintained are not provided with subways, his honor asks that the suggestion of S. S. Wheeler for a re-arrangement so as to carry the wires through other streets where subways are provided, be followed. The mayor adds: "You will see by this letter that there appears to be little cause for further delay in the matter, and I sincerely hope that the wires will be removed very soon."

The people of the village of Jamaica, L. I., who got temporary injunctions restraining the Brooklyn & Jamaica Road company from running electric cars along the main street of their town, lost their suit against the company last week. Justice Cullen dissolved the injunction against the further use of electricity, and also against a double track The use of electricity, he held, was technically in violation of the corporate rights of the company, but it had been employed as a motive power for two years without any objection from the villagers.

The *Evening Post* calls for the enforcement of the provision of the electrical execution law which prohibited the publication of the details of the execution of Kemmler. This provision was generally ignored, and the *Post* suggests that not only the editors of the newspapers are liable if the law is constitutional, but that the telegraph companies which transmitted the messages are likewise implicated. Then, too, the warden of the prison by admitting two press association correspondents violated the statute in the same manner as the telegraph companies. The *World* challenges the authorities to take up the cause and prosecute that journal, expressing confidence that the law will be overturned if ever an attempt to enforce it is made. It is hardly necessary to consider these questions at present, however, as there is little probability that anything will be done. It would not be surprising if District Attorney Fellows would take up the *World's* challenge providing, of course, he could hope for conviction.

The steam heating nuisance will surely involve the city in litigation unless it assumes a determined stand and calls a halt on the operations of the company. The city, by tolerating this nuisance, becomes liable for damages to electric companies whose underground cables are destroyed or damaged by the heat. Then, too, citizens have good cause for action, as the water service is impaired and the air polluted by the same agency.

Subway matters received attention at the hands of the courts again this week in the suit between rival companies, the North American Underground Telegraph & Electric company, which controls the Johnstone system and the Consolidated Telegraph & Electrical Subway company, which is building the city subways. In a contract between the two companies that the Johnstone system shall be used, the clause "so far as desirable" appears.

Kemmler's horrible death shocked this community when the details of the execution were received, and the cry of indignation which followed the publication of the facts, should warn legislators that the sensation-loving people of New York do not care to shoulder the responsibility of such barbarous punishments as inflicted upon Kemmler and that a repetition of the outrage will not be tolerated.

W. H. T.

Indianapolis, Ind.

INDIANAPOLIS, Aug. 7.—The two storage battery cars lately purchased by the Citizens' Street Railway company have arrived, and were tested last week. The cars are for the Irvington line. The distance from the power house to Irvington is about five miles. The trip out was made in 45 minutes, and the return trip in 33 minutes.

The company's electrician says the cars can be run from Irvington to the power house in the city, and the storage batteries changed, inside of 40 minutes. On the strength of this statement, the company intends to run cars every 40 minutes for the present. Eight miles an hour is about the speed of the cars. The two cars cost $10,800. The Julien storage battery is used and Thomson-Houston motors.

Electrician Hinckly of the Street Railway company, is suffering considerably from the effects of a shock received while making some changes recently.

President Caven of the Brush Electric Light company, has filed a petition in the Federal court charging the Union Railway company with failing to observe the injunction prohibiting it from using the double carbon lamp. The writ is returnable August 12th. M.

Milwaukee, Wis.

MILWAUKEE, Aug. 9.—The fight over the city electric lighting contract has finally taken place. Bids were opened on Saturday afternoon. The Badger Illuminating company, which has the contract now, and is controlled by Henry Villard, asked $112.50 per lamp per year, and the Milwaukee Light & Power company, a new corporation which made a contract recently with the United Edison company for a plant of machinery, asked $113 per lamp. Just as the commissioner of public works was opening the bids, Under Sheriff Van Vechten put in an appearance and served the Milwaukee Light & Power company and "all whom it concerned" with notice that S. D. Greene, the district manager of the United Edison company, repudiated the contract made with A. H. Pierce, as agent for his company and the Milwaukee Light & Power company. Pierce, according to the notice, had no power to make any such contract. This unexpected development surprised the commissioners, and their astonishment increased when they opened the envelopes and discovered that the two bids were only 50 cents apart, the Badger company being the lower. Attorney Killilea of the Milwaukee Light & Power company, who was on hand, soon gave the matter another phase. He stated his belief that Pierce was working in the interest of the Badger company. President Wall of the Badger company, indignantly denies the story. In making his bid, he states, he figured that by reducing the present contract price, $150 per lamp, to the extent of 25 per cent., the contract would pay expenses and, in addition, interest at the rate of 7 per cent. on the invested capital. His bid of $112.50 is a reduction of exactly 25 per cent. He said that the members of the Milwaukee Light & Power company tried to make him believe that they would put in a bid of $120, but he told his informants that his bid did not depend on any other, and the other fellows jumped to the conclusion that he would ask more than $120 per lamp instead of less. Mr. Wall is confident that the common council will award the contract to his company.

The common council having adopted a resolution calling for proof as to whether the lights furnished by the Badger Illuminating company are of full 2,000 candle power as demanded by the contract. President Wall has made the statement that the nominal candle power of an arc light is simply a trademark. "Any arc light," he writes to the Board of Public Works, "that has a 10-ampere current and 45 volts—450 watts—is a nominal 2,000 candle power light." Mr. Wall submitted to the board, in support of his position, letters from Alexander Kempt of Chicago, special agent of the Brush Electric company; B. E. Sunny of Chicago, president of the Chicago Arc Light & Power company; H. Wadsworth of Chicago, western manager of the Excelsior Electric company, and W. J. Buckley, manager of the Fort Wayne, Electric company's Chicago office.

Daniel Wells, Jr., the principal member of the company which has been incorporated to build an electric railway from the West Side to Wauwatosa, along the Watertown plank road, now realizes that there is no prospect of the common council granting him a franchise to build into the city, along Cedar street, and has commenced negotiations with the Milwaukee City Railroad company for the use of that corporation's tracks on Chestnut and Third streets to the business center. The line on Cedar street would parallel two other lines.

Although the other companies seeking a franchise to build along the National Avenue road have withdrawn from the field, the Milwaukee City Railway company is experiencing some trouble in securing the franchise to lay tracks to the Soldiers' Home. The Wauwatosa supervisors are willing to give the company the franchise, but they are trying to impose the condition that the company shall grade the road. The distance is a mile and a quarter, and the road has several large hills. The supervisors are now having made a survey, which will be completed in a week

or ten days, in order to determine the expense of grading the road. It is not certain that the company will agree to the condition. President Payne says the company will be reasonable, and expects to put the street in good condition, but will not expend $15,000 in grading the highway. The delay in granting the franchise will likely prevent the running of the road by fall.

Mr. Payne says that while he knows of no definite plans for consolidating the Cream City and Milwaukee City systems, now that both are controlled by Villard, yet he has no doubt that such a consolidation will take place. Mr. Payne, if he wishes it, may have the presidency of the Consolidated company, it is asserted. If it is not Mr. Payne, O. E. Pritt, who has been president of the Cream City Railroad from the date of the sale to the Pittsburg people up to the present time, may be asked to take general charge of the consolidated system, which includes two-thirds of Milwaukee's street railway mileage. There is some talk of two other men, one of them a resident of Chicago, in connection with the presidency.

Mr. Payne of the Milwaukee City Railroad, has unearthed an old ordinance giving his company the right to build on Center street, Teutonia street and the Hopkins road, and he has promptly commenced the work of laying tracks on those thoroughfares, his object being to head off the Hinsey people, who have been preparing to extend their line along the same streets. P.

Nashville, Tenn.

NASHVILLE, Aug. 9 —The success and popularity of the electric street car system appears destined soon to lead to still further large development in this city. It is stated on good authority that the two remaining steam dummy lines are to be operated by electricity. One of these lines runs from the public square to Waverly and Glendale Park, a distance of seven miles, and the other from the public square to West Nashville and Cherokee Park, a distance of about five miles. Both lines have been doing a good business since first started, but the citizens object to the noise and dust inseparable from steam propulsion.

West Nashville is a manufacturing suburb, and already has a regular railroad train for freight and passengers four times a day both ways, and a dummy train each way every 50 minutes. The Citizens' Rapid Transit company will also run its electric cars to the town and park. As several leading capitalists are stockholders in both dummy lines, and also largely interested in the electric lines, it is highly probable the change to electricity will be made.

A buggy backed by a restive horse in front of a Woodland street car was smashed into fragments and two prominent citizens were rolled in the dust one day this week. No serious injury was done the occupants of the vehicle or horse, and the motor man was held blameless. An electric light plant is to be completed and put in operation by Sept. 1st in Winchester, Franklin county, Tenn. This town is famous for its schools and as a summer resort. Wiley S. Embry can give particulars.

An electric light plant and a telephone exchange are to be introduced at Humboldt, Gibson county, this state.

B.

Louisville, Ky.

LOUISVILLE, Aug. 9.—The correspondent of the WESTERN ELECTRICIAN had a long talk last week with Col. M. E. Thornton, the coal king and mine owner of Kensee, who is president also of the Consolidated Coal companies of Eastern Kentucky and Tennessee. Col. Thornton is an advocate of the latest appliances for mining work and is preparing to light up his own mines at Kensee, Ky , with electricity instead of using the old-fashioned miner's lamps. The incandescent lights will be much safer and will give a better light to work by than the old fashioned lamps, he says, and besides will be more economical for the miners, who now have to furnish their own lamps. They will be allowed the advantage of the difference in the cost, which is ten cents a day per miner. In addition Sprague motors will probably be used instead of mules to transport the coal from the mines, a change which will result in a material saving, he states. After the plant is put in, early in the fall, the cost of operating will be much less, except in the single item of interest on the investment, as the cost of the motors will be several times the value of the present motive power. Col. Thornton also stated that as soon as the other plant was well in operation he proposed to put in about five electrical coal-cutting machines. He said that, aside from the first cost of the machines, this method was infinitely more economical, as the coal was cut into blocks with but little, if any waste, which is a considerable amount under the present system. He expects to reduce the cost of mining in his mines, from calculations already made, from 80 cents to 30 cents a ton. The contracts will probably be secured by the branch office of the Sprague company in this city. J. W. L.

Kansas City, Mo.

KANSAS CITY, Aug. 9.—There will soon be incorporated a company to be known as the Kansas City Power, Heat, Light & Building company. It has purchased the half block of ground bounded by Third, Fourth and Wyandotte streets for $115,000, and will soon begin the erection of a seven-story brick and stone building to cost $145,000. The object is to furnish small manufacturers with heat, light, power and floor space, and heat, light and power to manufacturers outside the building. The capital of the company is $150,000. The company includes E. L. Martin, W. B. Grimes J. H. Chamberlain, George R. Nelson, C. E. Force and L. A. Schoen. Machinery will be put in to the amount of $40,000. The original power will be supplied by two 500-horse power engines. The Edison Electric Light & Power company, which is the promoter of the enterprise, will operate the steam heating and power station in connection with its electric station for a time, or build a new station at the start. The original plan was to operate the two stations together. The economy of this is apparent but the objection is that the district it would serve is not as large as the promoters of the plan desire to serve.

A large force of surveyors and engineers from New York City is at work at the proposed site of the huge dam across the Kansas river, near this city, to be constructed by the Interstate Water & Electric Power company of Kansas City, Kan. Should the report of these men be favorable to the project eastern capitalists will supply the money for putting the scheme on its feet. Among the many huge undertakings contemplated by the company is that of furnishing the cities and towns within a radius of 25 miles with electric light and power. In order to get at once established in this line it is proposed to buy out the franchises and plants of the Kansas City Electric Light company of this city and the Consolidated Electric Light & Power company of Kansas City, Kan. To purchase this city's plants at least $500,000 will be required, and from $250,000 to $350,000 to secure the Kansas City, Kan., plant. This purchase would give the company the lighting of both cities for a number of years and the cheapness of the power which it will secure by means of the dam would give it full sway in the way of furnishing private lighting. The company is authorized to have a capital of $1,000,000, but the real capital will be double that amount. The estimated cost of the dam in the Kansas river is $80,000, and the power, buildings, apparatus and plant generally will cost not less than $250,000.

The Southwestern Electrical Supply company will hold a stockholders' meeting on Sept. 30 for the purpose of increasing the capital stock from $6,000 to $50.000. Edward Lasell is president of the company and James Lasell is secretary.

The board of public works has not yet taken action upon the street lighting question, which was referred to the board by the council a month ago. However, certain overtures have been made by electric light companies, and it is probable that the result of the investigation and renewal of contracts will result favorably to the city.

Ex-Congressman William C. Maybury, of Detroit, was in the city recently on his way from Carterville, where he went to examine the contract made with the Jasper County Electric Light & Power company by the Detroit Motor company from a legal standpoint. He was accompanied by G. E. Fisher, electrical expert, also of Detroit. The contract was pronounced entirely satisfactory. The gentlemen were accompanied to this city by W. P. Munroe, representing the Jasper County Electric Light & Power company. Mr. Munroe says that the company he represents will furnish light and power for the mines within a radius of four miles from Carterville and also furnish light for that city. The plant, which is nearly completed, will have a capacity of 700-horse power, which will be augmented as desired until the 2,000-horse power limit is reached. The company will probably establish other stations than that at Carterville when that one is in successful operation.

The Kansas City board of public works has purchased 2,370 pounds of insulated copper wire at 20 cents a pound, with the money recently appropriated for that purpose by the council. The wire cost $616.20, a trifle more than the sum appropriated. The telephone company has agreed to extend its free service to the fire department by putting in any additional telephones that may be needed besides the 21 already in operation. This new wire will be used in establishing a circuit from the central telephone office to the intersection of Independence and Park, Twelfth and Indiana, Eighteenth and Olive, Sixteenth and Locust, Fifteenth and Main, and Southwest boulevard and Twenty-fourth.

The contract for the dynamos of the electric light plant of the new Bullene, Moore, Emery & Co. building has been let to the Westinghouse company through its agent, W. T. Osborne, in this city. There were five bids put in, including those from the Edison, Sprague and Thomson-Houston company. The contract calls for two 500-light dynamos and two 150-light dynamos. There will be 1,100 incandescent lights in the building altogether, about equally distributed among the six floors and basement. Each floor will have half a dozen immense chandeliers. The building has already been wired.

Two rather important changes in street railway management have been made in the recently which will, no doubt, result in materially improving the street railway service. The Ivanhoe Park electric railway has been transferred from the original owners to the Thomson-Houston Electric company. It was formerly a dummy line and was equipped as an electric road by the Thomson-Houston company. It extends from Eighteenth and Vine streets to the southern city limits. The capital stock is $25,000. A. J. King, president of the old company, said that the object of the transfer was that the electric company might place the bonds on the road, the facilities of the Thomson-Houston company for doing this being greater than that of the old company. Whether the transfer is a permanent one or not is not announced. It is the intention of the Thomson-Houston company to improve and fully equip the road. The new company will be organized in a short time, the Thomson-Houston people of course controlling it. D. J. Hoff, who has for some time been the attorney of the Thomson-Houston company, will probably be named as president of the new organization.

The other road in which a change in management has been made is the proposed Suburban electric railway. The franchise for this road was secured from the county court almost a year ago by the the Suburban Railway company, H. M. Meriwether being chiefly instrumental in securing it. The road is to run from Grand and Springfield avenues east to Troost, and thence south to Waldo park. The property holders along the line are to be the stockholders in the company and a good part of the necessary stock has been subscribed. The sole management of the road has been turned over to E. J. Lawless, a practical street railway man, and for years general manager of the Metropolitan Street Railway system. While with the Metropolitan company he made a thorough investigation of the use of electricity as a street railway motive power, and in accordance with his recommendation the Metropolitan company has added an extensive electric line to his system. Under Mr. Lawless it is expected that the Suburban line will be pushed ahead and completed by next spring. P.

Pittsburg, Pa.

PITTSBURG, Aug. 9.—The war among the five electric street railway corporations of Braddock for the right of way to lay tracks and build an electric road through the city has been decided in favor of the Braddock & Turtle Creek Electric Railway company. That organization intends to go ahead with the work immediately, and the road is expected to be ready within six months.

The Mansfield Valley & Pittsburg Electric company has purchased forty acres of land at Mansfield Valley, Pa., for $2,000 per acre. As far as can be learned this appears to be the company which contemplates the establishment of a light and power plant in the Mansfield valley.

The Braddock & McKeesport Electric Railway company has been chartered at Harrisburg and the network of electric railways in Western Pennsylvania is going to have another extensive addition. The route proposed to be covered by this line will run over a distance of seven miles through a very thickly populated district of small manufacturing towns and boroughs. James H. Canfield of McKeesport is president of the company.

In view of the fact that Bernard Donehco, the foreman of the Pittsburg Traction company, is going for a vacation to his old home in Ireland, the employes of the company presented him the other day a handsome gold watch as a testimonial of the good wishes of his fellow-workers.

E. H. H.

Cleveland, O.

CLEVELAND, O., Aug. 3.—The Cincinnati *Times-Star* in a recent issue, printed the following: "There is or was a big company in Cleveland that started out on a large scale to reduce aluminum, the Cowles Bros. They had made probably the largest dynamo ever constructed in this country. But the process was rather disappointing; it was too slow and too expensive. The men dropped an enormous amount of money, and I understand that they have given it up. There was a brilliant chemist up here at Findlay a few years ago, who worked a great deal with aluminum. He died in the midst of his labors, and was supposed to have carried some valuable secrets with him. But I don't think he did."

The Cleveland company referrred to is the Cowles Electric Smelting & Aluminum company, which is very much alive and doing business on a large scale. Its office is in

Cleveland, while the works are located in Lockport, N. Y. As to the Findlay (Seymour) process, there was a good deal of idle talk at the time of the alleged discovery. Whether or not Seymour worked out a successful aluminum process, it is not known.

The employes of the Brush Electric company gave their annual picnic Saturday.

P. Yensen, manager of the Cleveland Telephone company, is back from the Pacific coast. Subscribers are coming in fast. There are now 500 miles of underground conduit in Cleveland.

Sandusky has a new carbon works.

The Bodifield Belting company is making a specialty of equipping electrical plants on land and water. R.

THE ELECTRIC LIGHT.

An electric light plant will be erected at Chester, S. C., soon.

An electric light plant for Cleveland, Tenn., is contemplated by local capitalists.

The Gainesville, Ga., electric plant, recently purchased by the city, will be enlarged.

Dawson, Ga., is negotiating for the establishment of an electric light plant for the city.

An electric light plant will be established at Alexandria, La, by a stock company now organizing.

The Belmont Land company has signified its intention to establish an electric light plant at Charlottesville, Va.

The Mt. Sterling, Ky., Electric Light company has made the city a proposition to install an electric light plant.

An electric light plant will be installed in the Arkadelphia, Ark, Methodist College, now in course of construction.

E. C. Wiley, of Bristol, Tenn, is forming a stock company to manufacture an electric railway signal which he has patented.

The Dallas, Tex., Electric company has filed a charter with J. P. Smith, J. B. Kirby and E. L McDonald of Indiana, as incorporators; capital stock $300,000.

The Augusta, Ga., Electric Light & Motor company has been incorporated by D. B. Dyer, R. M. Spivey, R. M. Conklin and others for the purpose of furnishing lights and motive power throughout Augusta and its suburbs.

The Westinghouse Electric & Manufacturing company has obtained the contract for furnishing its alternating current apparatus to a company recently organized in Bryan, Texas. The plant will have a capacity of 500 lights.

It is reported that the Thomson-Houston Electric company of Boston, Mass., has purchased the electric light plant of the Middlesborough, Ky, Gas and Electric company for $30,000, and will organize a stock company to operate it.

The Goldsboro, N. C., Electric Light & Power company has been formed by I. F. Dortsch, D. M. Rivett and J. C. Easen, with a capital stock of $25,000 It has purchased the plant of the Goldsboro Electric Light company, and will make extensive improvements.

The Sioux City Electrical Supply company installed the plant at the Corn Palace. It comprises 3,000 incandescent lamps and several arc lights. This company volunteers to care for all exhibits of electrical apparatus sent to the Corn Palace. Exhibitors of electrical apparatus can secure space free of charge by corresponding with this company.

An alternating current central station plant of incandescent electric lighting is about to be established in Waycross, Georgia. The company organized there has awarded the contract for the apparatus to the Westinghouse Electric & Manufacturing company. The plant will have a capacity of 750 lights, and the installation will be at once commenced.

According to the local paper the people of Blacksburg, S. C., and all the country 'round had a general rejoicing over the introduction of the electric system in that place. The colored portion of the population took to the woods when the lights were flashed on them, evidently thinking the last day had come. The plant is of the Schuyler type and is giving satisfaction.

The Traylor Electrical company has been chartered at Richmond, Va., capital stock $100,000. The company will establish electric light plants, manufacture electrical apparatus, both for light and power, and engage in a general electrical business. The officers of the new company are, President, A. W. Garber; vice-president, Thomas Potts; secretary, J. E. McKinney.

The Eastern Electric Company of St. John, N. B., has adopted the Edison system for incandescent lighting in that city. The same company will furnish the power to propel the street cars, which will immediately be equipped with Sprague apparatus. It is also proposed to introduce the electric motor on a large scale for manufacturing purposes, and the town just now is giving electrical interests quite a boom. A. A. Knudson is the electrician of the company.

The following paragraph from a letter of a Madrid, Spain, correspondent of an English paper shows the preference of the Spaniards for American electric light apparatus: An interesting installation of electric light is being built at the thriving town of Aviles. A rich inhabitant (the Marquis of Pinaz del Rio) is going to present the town a complete central electric lighting station. The town is favorably situated for coal, so that altogether the cost per unit to the inhabitants will be remarkably small. The plant has been ordered in the United States.

The Steuben Electric Manufacturing company has been incorporated by Charles Adsit and John O. Adsit, Hornellsville, N. Y.; Geo. A. Bronson and Frank E. Bronson, of Painted Post, and E. P. Gleason, H. K. Thurber and James C. DeLong, of New York city. The company will establish its plant in the Rawson shops in connection with the Hornell Iron Works at Hornellsville.

Kansas City is fast becoming one of the best lighted cities in the West. In addition to a half dozen electric light companies, who furnish arc and incandescent lights as well as electric power, there are no less than thirty isolated lighting plants owned by private individuals. One of the most complete and perfect of the latter will undoubtedly be that in the dry goods house now about completed for Bullene, Moore, Emery & Co. The system of electric lighting will be the Westinghouse, using both incandescent and arc lights. The contracts for the electric work were awarded about ten days ago, and the engine contracts were let the past week to English, Morse & Co. of Kansas City. There will be two engines of the Ide pattern, having a combined capacity of 200 horse power. A special feature will be Hill clutch pulleys fitted to each engine shaft, and so arranged that part of the dynamos can be stopped at will without the necessity of stopping the engines. Connections will also be made from either engine to an automatic exhaust fan, which operates pneumatic tubes throughout the entire building, for handling cash from the various counters.

At the recent meeting of the London Institution of Electrical Engineers at Edinburgh, where the members met to hold a general meeting and to inspect the electrical exhibition in the city, Dr. R. Mullineux Walmsley read a paper relating to the features in the exhibition. Dealing with electric lighting, he said the actual lighting of the exhibition did not offer any particularly novel feature. The arc lighting was in charge of the Brush Electrical Engineering company, who used their well-known double carbon 10-ampere lamps The bulk of the glow lighting had been carried out by King, Brown & Co. The only purely American lighting exhibit was a 30-arc light dynamo, together with 30 arc lamps of the Western Electric company of Chicago. Visitors would, he thought, be interested if they would compare various details connected with that machine with English built machines. The lamp was a well-made and simple clutch lamp. Perhaps the only point about its mechanism was the very small amount of travel and the strong pull required on the armature of the series magnet to strike the arc. It was fed with a current of 18 amperes at 30 volts.

THE ELECTRIC MOTOR.

The laying of track on one of the routes of the Rochester, N. Y. street car system which is being transformed into an electric road, has been completed, the poles are in position, and it is expected within a short time the new order of things will prevail.

In view of the early termination of the charter of the Toronto Street Railway company and probable changes that will be made in the provisions of a new one, the problem of improved methods of street car propulsion is assuming considerable importance, and is being earnestly discussed by the Canadian press. It is universally conceded that an improvement upon horse power is desirable, both on the score of humanity, cleanliness, and to meet the modern requirements of rapid service. Steam and cable are not under consideration—the former being too noisy and dirty, and the latter too expensive to maintain. Electricity will therefore be employed

Considerable activity in motor circles is noticeable across the water. The Metropolitan Board of Works at Buda-Pest has agreed to grant the local tramway company a concession for a trial line for the use of the Zipernowsky vertical system, and the grant of a permanent concession for lines on this principle will depend on the results obtained on this trial line. Meantime, the Buda-Pest electric City Line is making constant progress in the construction of new lines. It has already at its disposal an extensive system of lines. The first electric tramway in a Hungarian provincial town will shortly be commenced in the celebrated Hungarian watering-place, Herkules-Bad. The royal Hungarian minister of commerce has granted the concession for the technical preparations for an electric line leading from the railway station Herkules-Bad to the watering place of the same name. The concession is for one year.

According to a newspaper correspondent the electric railroads at Springfield, Ill., "cut a figure" in the world's fair legislation. The writer says: "But a little side issue did much to simplify the proceedings of the day, and to kill the amendments, too. The matter referred to is in no wise a part of the legislative proceedings, but just one of those happy little coincidences that occasionally knit up the raveled sleeve of care, and this is it: Springfield has two railroads operated by electricity, and the improvement is of recent origin, too. The city has three street roads, and one of them is still worked by mule power. The mules used here in moving street cars are not bigger than jack rabbits. They very frequently stumble and fall down, and the cars run right over them without hitting them at all. The electric cars are the pride of the city, and use the biggest, 'yellowest' cars one ever saw. They make splendid time, too; much better than the little mule cars that run by the Leland to the statehouse. The legislators, city and country alike, have been spending their leisure time and small change in patronizing the electric roads and to-day the superintendent of the institution invited the legislature and the press to take a ride on the road. There was an implication of a lunch with the invitation, and it was promptly accepted. Who could do less? The time for starting was fixed at 5 o'clock, and 5 to a minute three electric cars were ready to take the guests for an airing. The Chott amendment was under consideration then and the members were impatient to get away and have a trip over the road. So they applied the previous question, beat the amendment, sat down on some other propositions, and sent the bill to third reading in less than no time after they were told the cars were in waiting. The proposition for a little jaunt by electricity had much to do with the dispatch of business late this afternoon."

Miscellaneous Notes.

At Houston, Tex., a new fire-alarm electric system will be put in operation.

C. P. Gaboury, of Centreville, R I., president of the Electro-Chemical Amalgamating company, will erect an electro-chemical amalgamating and smelting works at Hot Springs, Ark.

The English journals must have additional light on the cause of the Western Union fire at New York. The London *Electrical Review* says the fire was caused by an "explosion in the battery room."

The telephone company of Toronto has commenced what is evidently intended to be a very comprehensive system of underground distribution. The conduits are of creosoted plank grooved and laid one over the other to form a pipe 3 inches in diameter, through which it is intended the cable shall be drawn. The company evidently considers the institution permanent, as the extent and number of tubes being laid afford provision for an immense increase in the number of wires.

The Edison phonographic toy has been taken hold of by a company of English promoters, who offer to capitalize it at the enormous figure of $1,500,000. They say the manufacture of dolls in Europe exceeds 26,000,000 per year, and they think they can arrange for the disposal of 4 per cent. of this number. The company proposes simply to manufacture the doll bodies at a cost of $1.75 and sell them at $3 each to the firms already in the business as toy makers, who, it is thought, will be able to find a ready market for the completed automatic speaker at $15.

A correspondent in an English electrical journal, W. J. S. Barber-Starkey, writes concerning an experience with storage cells: "Last year I filled in the spaces between the plates of my accumulators with plaster of Paris and sawdust in a dry state, intimately mixed, and then put in the usual dilute acid to which a little carbonate of soda had been added. I used these cells in conjunction with a dynamo driven by a turbine for lighting purposes; they were last charged early in November of last year, and on returning here late in June, I found that they burnt the lamps at their usual brightness, and that the e.m.f. of each cell was just under 2 volts. I also found that the cells had lost very little of the liquid through evaporation."

The business manager of a prominent electrical firm, whose office is in Wall street, carries every evening to his home in the country a package which has excited some curiosity among those of his friends ignorant of its nature, says the New York *Sun*. It resembles a despatch box, and contains a number of phonograph cylinders. The overworked official has at home in his study a phonograph, by means of which he can in half an hour dispose of work that would ordinarily take him an hour or two to get through. He puts his cylinders in and talks at any speed he likes until he has finished his correspondence. That is nearly all he has to do, for the cylinders are taken back to the office next morning and handed to the typewriter, who transcribes and delivers them ready for signing. There is now such a demand for these phonograph despatch boxes that the manufacturers cannot turn them out fast enough.

The commission of management of the Technological Trade Museum, Vienna, will establish a special school for electrical engineering with theoretical and practical instruction and a four-years' course of training. Its object is to train young men, having a sufficient preparatory education, as workmen of superior grades, foremen, etc., for lighting installations, etc. This special school will be the first of its kind, either in Austria or Germany; it will possess a complete and excellent equipment, and it will be under the influence of a special committee of eminent practical men. If it is sanctioned by the minister of public instruction, the first and second session of this school will begin in October next, the third on October 1st, 1891, and the fourth on October 1st, 1892. A similar school, though on a more limited scale, has existed for some years, in the Royal Hungarian Trade school at Kaschan, provided with a small workshop, which enables the pupils to gain practical experience.

The San Francisco *Chronicle* says: The popularization, so to speak, of electricity has been one of the most fruitful sources of word-making, and is a cause of the exercise of as much invention as is required in the naming of a new patent medicine. We are familiar with the telephone, but it will take some time before our ears and eyes are accustomed to the telautograph, which is what Prof. Elisha Gray calls his machine for the reproduction by telegraph of pictures, devices and maps. Then, as if the type-writer itself was not a sufficient word-puzzle, there comes a young Philadelphia electrician who has invented an electric typewriter which he styles a dynamograph. Some little time ago Edison put together a queer combination of electromagnetic coils, discs, pipes, armatures, wire, etc., and gave to it the queer name of the pyromagnetic dynamo, claiming it would supersede steam. Either the name was too much or the "wizard of Menlo Park" has not been able to give his pyro-etc. attention—at any rate, steam still manages to struggle along in a vaporish, boilerish sort of a way. Then we have electrolyzed and electrodes, electrization, electrolysis, electrophorous, electrophysiological, electropuncturation, electrothermancy, electro-tonic, electrochronographic, electrophone, electrotherapeutics and a dozen other polysyllables, which will be as A B C's to our children and children's children.

THE TELEGRAPH.

Work has been begun on the extension of the Postal telegraph line from Wellsville to Hornellsville, N. Y. The line is to be continued to Canisteo, Addison and Corning. The addition to Hornellsville's telegraphic communication will be greatly appreciated.

An interesting experiment in the transmission of photographs by electricity is reported from Paris. The police bureau of that city have been experimenting with a device of this kind, by means of which a photograph, about the size of a silver dollar, may be transmitted. It appears only in outline and without shading, but with all requisite clearness and accuracy. The most satisfactory of such telegraphically transmitted photographs are those taken in profile. Those interested in the work telegraphed the photo of the head of the police of Paris to Lyons, and after a time it was sent back by the same means. It was then thought advisable to give it a practical test, and a photo of a criminal was sent, with instructions to arrest the original at the railway station. The detective who was given the photo had no trouble, it is stated, whatever in discovering his man on the arrival of the train.

Personal Mention.

Nelson W. Perry of Cincinnati, was in Chicago for several days last week.

William H. Abel, for many years chief auditor of the Western Union Telegraph company, died last week in New York city, aged fifty-four years. He was born at Rockaway, L. I., and educated at the College of the City of New York, from which he was graduated with high honors. He was a professor in that institution for two years. He then entered the service of the old American Telegraph company as one of its officers, and remained with it through its various changes until it was finally merged in the Western Union. Mr. Abel was appointed chief auditor of the Western Union, which post he held until ill-health compelled his resignation.

Business Mention.

Gilbert G. McDuff, general western agent of the Fred H. Whipple company of Detroit, has located his office at 407 Rookery building, Chicago.

The Moore & White company of Philadelphia, reports a fine business in friction clutch pulleys and cut off couplings Simplicity of structure and effective work recommend the clutch to users.

The Fibrone Manufacturing company of 300 Monroe street, New York, reports a steadily increasing trade in insulator specialties. It has recently added two floors each 50x100 to its building.

The Edward P. Allis company of Milwaukee, Wis., has issued a new catalogue of engines manufactured at the Reliance Works. These engines are thoroughly described and the illustrations are of a high order.

The Electrical Supply company of Chicago has issued a neat advertising card after the form of an enlarged postal card—one side of which calls attention to a few of the specialties handled by this company.

The headquarters of the Western department of the Easton Electric Light company, are at 411 and 412 Royal Insurance building, Chicago. J. H. Reed, who will give the Western business his personal supervision, is located here.

The Edison Manufacturing company has issued a neat catalogue describing the Edison-Lalande battery, and thoroughly explaining its operation. The catalogue is fully illustrated and will prove highly interesting to all who are interested in this subject. James F. Kelly, New York, is general sales agent for the battery.

The Crosby Electric company of Fifth avenue and 16th street, New York, in a circular states that it has purchased the Eclipse Electric company of New York City, with its business and stock on hand, together with the patents under which the Hussey Eclipse and the Duplex batteries are manufactured, and that, hereafter, the business and manufactures of the latter company will be carried on under its management.

Some handsome electric vestibuled cars are in the process of construction at the factory of the John Stevenson company which the District of Columbia will point to as the finest of their kind yet constructed. The Georgetown & Tenallytown Street Railway company have contracted for a number of these. The business of the Stevenson company covers a vast territory even in the electric line Spokane Falls, Butte City, and Chicago are the destinations of present shipments of electric cars.

Lemuel William Serrell, M. E., of 115 Broadway, New York, reports he is meeting with great success in selling the Milliken patent pole for electric railways. He says that he recently closed with Murray Verner, of the Verner-McKee syndicate, for poles for the entire city of Buffalo; that he has received orders from the Rapid Transit Street Railway company, Newark, N. J., Troy & Lansingburgh Street Railway company, Troy, N. Y., Essex Passenger Railway company, Newark, N. J., Buffalo Street Railway company, Buffalo, N. Y., Pittsburg & Birmingham Traction company, Pittsburg, Pa., Passaic, Garfield & Clifton Street Railway company, Passaic, N. J., and Jersey City & Bergen Street Railway company, Jersey City, N. J., and that he has taken orders for over 6,000 poles during the last three months.

Manager Cutter's energetic efforts in arranging the establishment of the great Western Electric Supply company are beginning to tell. Already the salesrooms have a busy appearance, and with customers and employes hurrying about, one is impressed with a realization that there is in Chicago one place, at least, where, so to speak, grass will not grow this summer. The second floor, which is in the main devoted to the various offices of the company, is beginning to present a finished appearance. The partitioning is almost complete, and several of the rooms are now occupied. Mr. Cutter has already taken possession of what he calls his "den." It may be mentioned too that in planning the arrangement of the offices on this floor, there was left one room adjoining the "den," which will be used by Mr. Cutter for private experiments and test work of the company. From this little laboratory we will doubtless see issue numerous useful specialties, the product of Mr. Cutter's leisure moments.

The numerous excellent qualities of the Triumph valveless compound engine form the subject of an excellent pamphlet issued by the manufacturers. The pamphlet contains a complete description of the engines manufactured by this company, fully illustrated, and besides offers many valuable suggestions and presents considerable general information in this line. The company has received several complimentary letters lately from purchasers of its engines. One of these is from the John Kauffman Brewing company, an extract of which is herewith presented: "While running under conditions that caused constant repair on our former engine, we have no trouble with yours, and although it is placed only on a capstone, without foundation below, it runs smoothly and quietly under greatly varying loads. We believe that you have the most simple and compact engine on the market; indeed, no other engine of the same power could be placed in the contracted space this occupies in our brewery."

Electrical Patents.

Issued Aug. 5, 1890.

433,445. Registering System for Telephone Exchanges. Joel C. Clark, Morristown, N. J.

433,451. Thermo-Electric Element. Edward N. Dickerson, New York, N. Y.

433,459. Lightning-Rod Tower. Isaac M. Ferrell, Stone Creek, Ohio.

433,485. Municipal Signal System. Bernice J. Noyes, Boston, Mass.

433,486. Municipal Signal Apparatus. Bernice J. Noyes, Boston, Mass.

433,504. Municipal Signal Apparatus. John C. Wilson and Bernice J Noyes, Boston, Mass.

433,505. Light Signal System. John C. Wilson, Boston, Mass.
The invention is designed for police signaling purposes, a series of light signals being arranged on a single wire and operating independently from the central office.

433,523. Commutator for Dynamos. James W. Easton, New York, N. Y.
The first claim follows:
"A commutator provided with a groove or channel to limit the width of its contact surface, such groove being filled with insulating material."

433,514. Electric Railway. Abraham A. Shobe and William Embley, Jerseyville, Ill.

433,554. Electric Release for Target Traps. Lorenzo L. True, Bismarck, N. D.

433,557 Dynamo Electric Machine. Charles F. Winkler, Troy, N. Y.

433,560. Electric Alarm Letter Box. William B. Detwiller, Radnor, Ohio.

433,561. Cleat for Electric Wires. Lawrence Furlong, Hartford, Conn.

433,584. Electric Fire Alarm and Night-Call. Charles J. Vining, Cleveland, Ohio.

433,611. Trolley for Electric Motor Cars. Foree Bain, Chicago, Ill.
The trolley connection for the motor is designed to insure contact with the lines of the overhead or lateral circuit notwithstanding irregularities in the latter, as in the case of unequal sagging thereof and the like.

433,619. Electrical Communication. James L. Cutler, Piketon, Ohio.
The invention relates to the art of electrical communication by means of a series of signals or other devices connected with and operated from a central station.

433,636. Multiple Switch-Board System. Ernest P. Warner, Chicago, Ill.
The invention consists in providing on each of the multiple switch-boards a socket or terminal for each line, which is permanently connected with one side thereof. The limb over which the subscriber sends his signal extends from ground at the subscriber's station through the subscriber's bell and generator to a key, which key on being depressed connects with the branch extending through the subscriber's drop at the exchange, and thence to ground.

433,637. Electrical Measuring Instrument. Edward Weston, Newark, N. J.
The first claim reads:
"In an electrical measuring instrument, a stationary coil and a coil oscillating or vibrating on inclosed pivots in the field of force of said stationary coil, said coils being electrically connected."

433,671. Electric Soldering Iron. Charles E. Carpenter, Minneapolis, Minn.
The invention consists of the combination with the hollow body and the tapering core fitting within said body, of the resistance disposed about the core, and electrical insulations interposed between said resistance and the core and body.

433,682. Fusible Cut-Out. William J. Jenks, Nyack, N. Y.

433,687. Electrolier. Everett W. Little, New York, and James T. Robb, Mount Vernon, N. Y.

433,698. Incandescent Lamp Socket. Thomas G. Roebuck, Jersey City, N. J.

433,700. Alternating Current Electro-Magnetic Motor. Nikola Tesla, New York, N. Y.
The third claim is given:
"In an alternating current motor having two energizing circuits, the combination, with the magnetic cores and the coils of one of the circuits which energize the said cores, of magnetic shields forming closed magnetic circuits around the coils and interposed between the coils and cores."

433,701. Alternating Current Motor. Nikola Tesla, New York, N. Y.
The last claim follows:
"4. In an alternating current motor, the combination, with a set or series of field-poles and energizing coils wound thereon, of an intermediate set of pole pieces forming portions of closed magnetic circuits and coils thereon in a circuit derived from the same source of alternating currents as the other."

433,702. Electrical Transformer or Induction Device. Nikola Tesla, New York, N. Y.
The first claim is appended:
"In an electrical transformer or induction device, combination, with the main magnetic core and the primary and secondary coils or circuits, of a magnetic shield or screen interposed between said coils."

433,703. Electro Magnetic Motor. Nikola Tesla, New York, N. Y.
This invention is an improvement in alternating current motors, and has for its general object to produce a single circuit alternating current torque motor of economical and simple construction.

433,706. Electric Circuit Coupling for Railway Trains. Watson P. Widdifield, Uxbridge, Ontario, Canada, and Alexander H. Bowman, Allentown, Pa.

433,738. Galvanic Battery. Samuel W. Maquay, Fulham, County of Middlesex, Eng.

433,744. Electric Current Controller. Milton O. Sargent, Malden, Mass.
Claim 1 reads:
"The combination of an electric current controlling device consisting of a coil of wire having a central metallic tubular core, partially filled with fluid, as described, one end of which is secured to a support while its other end is free and curved, the said coil being normally in a main circuit, and a normally-open grounded branch circuit adapted to be closed by means of said core."

433,758. Current Converting Apparatus. Carl Zipernowsky and Maximilian Deri, Buda-Pesth, Austria-Hungary.
The first claim is as follows:
"An apparatus for converting alternating electrical currents into continuous currents, or vice versa, said apparatus consisting of a combination of a subdivided core having two or more coils conveying alternating currents with relatively shifted phases with another coil or coils, a commutator for the latter, and an iron armature carrying two or more brushes working on the commutator to convert the alternating currents into a continuous current, or vice versa."

433,770. Fuse and Fuse-Block. Joseph G. S. Cunnington, Covent Garden, County of Middlesex, Eng.

433,834. Induction Motor. Charles J. Van Depoele, Lynn, Mass.
The first claim reads as follows:
'The combination, with the field magnets of an electric motor, of an armature having its armature coils permanently included in a closed circuit, a commutator having its plates connected with different points in the length of the armature coils, and a closed circuit electrically uniting the brushes applied to said plates."

433,835. Telegraph Key. John B. Van Deusen, Saratoga, N. Y.

433,839. Trolley for Electric Street Cars. Franklin C. Wheeler, St. Joseph, Mo.

433,851. Device for Unloading, Recharging and Reloading Electric-Car Storage Batteries. Jacob C. Chamberlain, New York, N. Y.

433,883. Switch. Sigmund Bergmann, New York, N.Y.

433,896. Support for Electric Wires. Albert L. Hallbauer and Edward L. Hiller, Lynn, Mass.

433,903. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn.

433,904. Electric Motor Mechanism. Samuel E. Mower and George J. Spencer, New Haven, Conn.

433,908. Electric Arc Lamp. Samuel P. Parmly, Chicago, Ill.

433,915. Ceiling Block for Incandescent Electric Lamps. Alfred T. Tregurtha Everett, Boston, Mass.

433,917. Method of Manufacturing Electric Conductors. Ernest P. Warner, Chicago, Ill.
The invention consists in making the different strands semi-cylindrical, placing the plane surfaces together, and binding them together.

433,918. Electric Railway Conduit System. Malone Wheless, Nashville, Tenn.

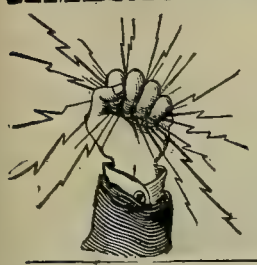
433,920. Joint for Electric Conductors. George L. Wiley, Arlington, N. J., and Edward G. Acheson, Pittsburg, Pa.

433,921. Joint for Electric Conductors. George L. Wiley, Arlington, N. J., and Edward G. Acheson, Pittsburg, Pa.

433,922. Joint for Electric Conductors. George L. Wiley, Arlington, N. J., and Edward G. Acheson, Pittsburg, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

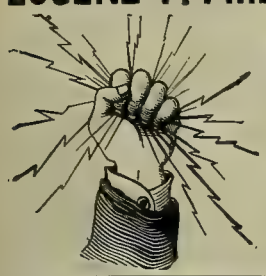
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS
4 LASALLE AVE
MAKE ANYTHING IN BRASS. CHICAGO.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

THE SUNBEAM

MAINTAINS ITS RATED CANDLE POWER.

SEND FOR PRICE LIST.

SUNBEAM INCANDESCENT LAMP CO.,

Corner Randolph and Canal Sts., CHICAGO, ILL.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue 1--66 of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

OKONITE TRADE MARK.

INSULATED WIRES AND CABLES.

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

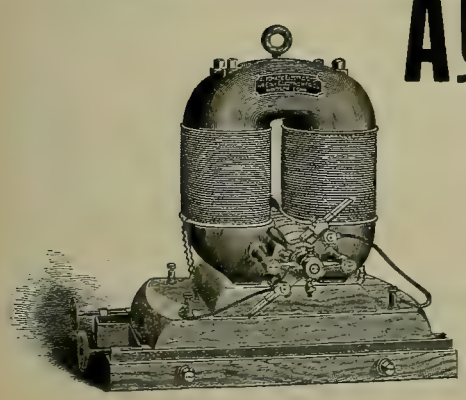
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, to Building. NEW ORLEANS, 107 Camp St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor. Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

Binders FOR THE Western Electrician $1.00.

YOU make a mistake if you don't buy your Electrical Supplies from F. & E., Cleveland, O.

LOOK AT THESE PRICES:

$2 00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1 00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1 50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FRANK T. BROWN, Late
PRINCIPAL EXAMINER ELECTRICITY,
U. S. PATENT OFFICE, NOW OF
Butterworth, Hall, Brown & Smith,
Patent Attorneys,
25-26 HONORE BUILDING, - - CHICAGO.
Two complete sets of U. S. Electrical Patents.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental
MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

WANTED.

A second-hand 2-horse power 210 volt incandescent motor. Address

"MOTOR,"

Care of WESTERN ELECTRICIAN

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

—— Electric Light and Street Railway Goods a Specialty. ——

SEND FOR CATALOGUE AND SPECIAL PRICES.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

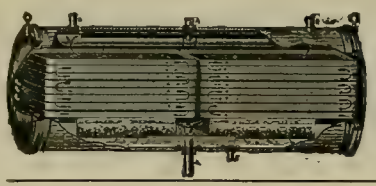
Standard and Special Devices for use on all roads
IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



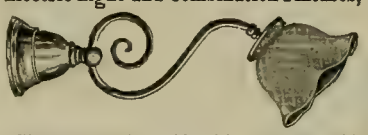
Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

BLECKERT & NELSON,

MANUFACTURERS OF
Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:
85 and 87 FIFTH AVENUE, CHICAGO, ILL.
Send for New Descriptive Circulars.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

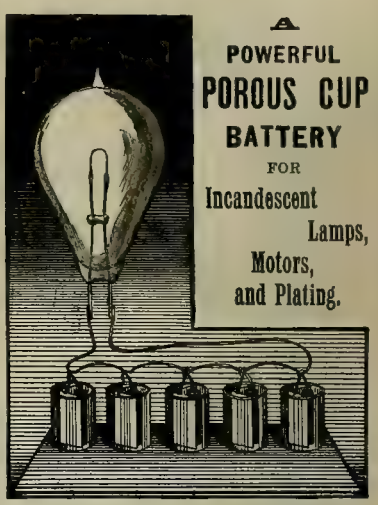
I. W. COLBURN & CO.,

FITCHBURG, MASS.

WANTED.

At once, experienced armature winders. Best of reference required.

COLUMBIA ELECTRIC CO.,
207 E. Fourth St.,
ST. PAUL, MINN.



A
POWERFUL
POROUS CUP
BATTERY
FOR
Incandescent Lamps,
Motors,
and Plating.

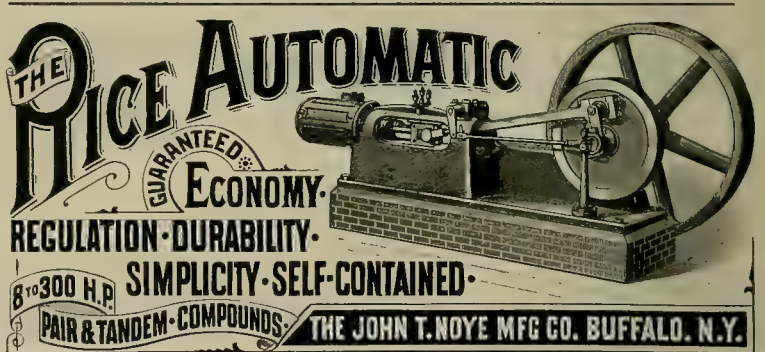
E. M. F. full 2 volts Battery will last from two to four months, according to work required.

Price for Cell	$1 25
Incandescent Lamps, each	1 00
2 Cells and 1 C. P. Lamp	3.50
3 Cells and 3 C. P. Lamp	4.75
4 Cells and 4 C. P. Lamp	6.00
5 Cells and 6 C. P. Lamp	7.00

Battery has been in successful use for ten months, and guaranteed as represented.

E. K. GLASS,

CITY HALL,
RICHMOND, IND.
Electrical Supplies of All Kinds.



FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

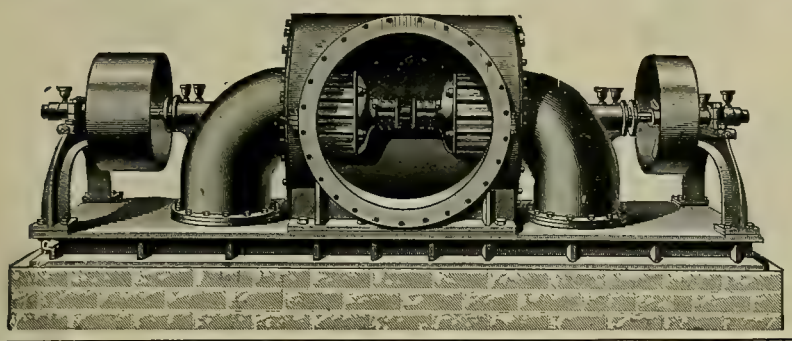
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ENGINES

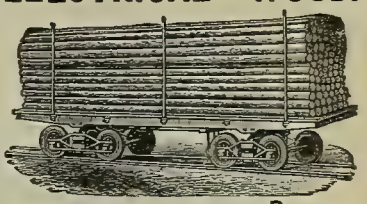
CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,
Room 410, Com'l Bld'g, St. Louis, Mo.

WILLIAM S. BATES,
PATENT LAWYER,

204 Dearborn Street, CHICAGO.

17 YEARS EXPERIENCE IN THE PATENT OFFICE AND THE COURTS.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,
Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

E-D-I S-O-N

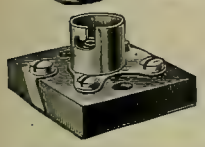
Miniature Incandescent

ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions



How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

COLUMBIA
Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

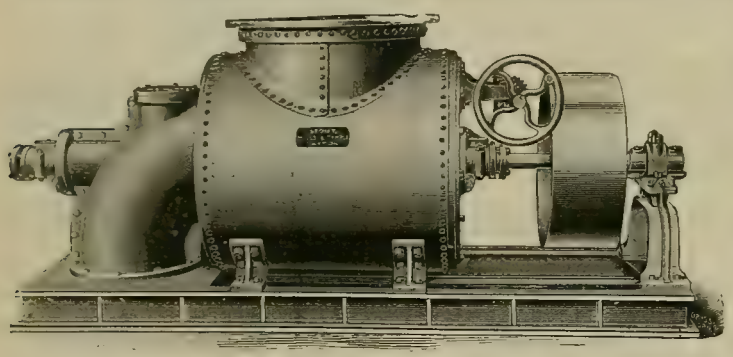
Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the con truction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

THE SPERRY ELECTRIC CO.,

D. P. PERRY, Vice-President and General Manager,

—MANUFACTURERS OF THE—

SPERRY IMPROVED SYSTEM

—OF—

ARC LIGHTING,

HIGH OR LOW TENSION.

WE GUARANTEE:

1. The new Sperry apparatus free from repairs for twelve months.
2. That the new Sperry improved Dynamos can be coupled in series with perfect safety.
3. That any number of lamps from one to capacity of dynamo can be cut in or out of circuit, singly or in groups, with perfect safety, and without sparking at the brushes.
4. To absorb power in exact proportion to number of lights burning.

WE BELIEVE:

1. The new Automatic Sperry Dynamos and Lamps surpass in efficiency those of any other make.
2. That there is greater economy in operating the new Sperry System than any other.
3. That our automatic regulation has no equal; no rheostat, no wall boxes, no solenoid or dash-pot.
4. That if you will visit our factory we can show you the best arc lighting apparatus in existence.

We invite correspondence with electrical engineers, intending buyers, and interested people everywhere.

THE SPERRY ELECTRIC CO., 195 to 207 South Canal Street, CHICAGO ILL.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

HELMET WATER PROOF WEATHER PROOF BRAND.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

Cleverly 1018 CHESTNUT ST. PHILA.

"Improved" Automatic Burner.

PATENT LIFT-OVER PENDANT BURNER.
AUTOMATIC BURNER KEYS.
SPARK COILS.
DESK PUSH BUTTONS.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

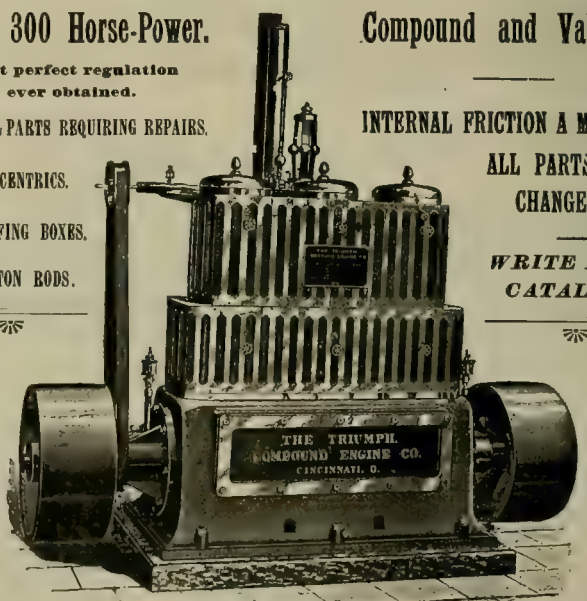
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

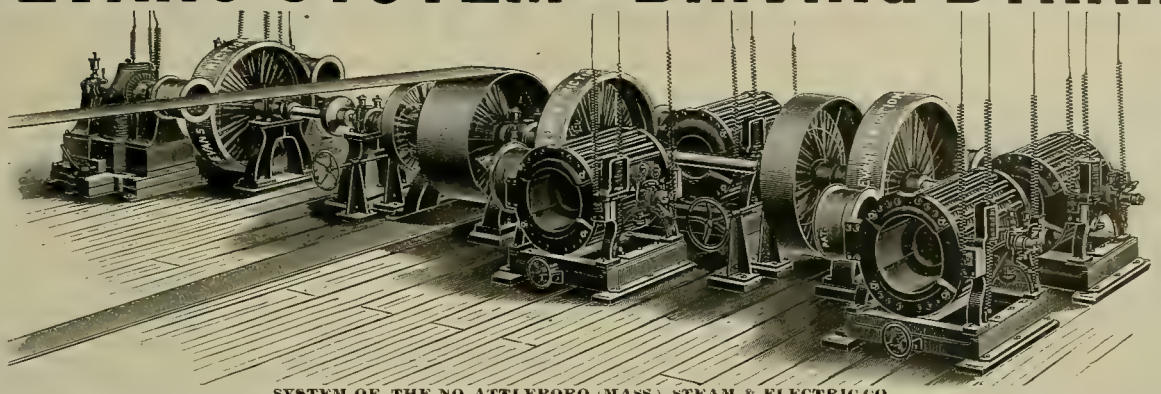
THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

Two 60 H. P. Ry. Generators and four 50 Arc Light Dynamos have been running night and day since March, 1890.



We guarantee less pressure on the bearings for the same power, than with ordinary belting.

SYSTEM OF THE NO. ATTLEBORO (MASS.) STEAM & ELECTRIC CO.

{THIS AD. WILL BE CHANGED AUG. 30.} Send for Catalogue "D" to THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,

MANUFACTURERS OF THE

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets

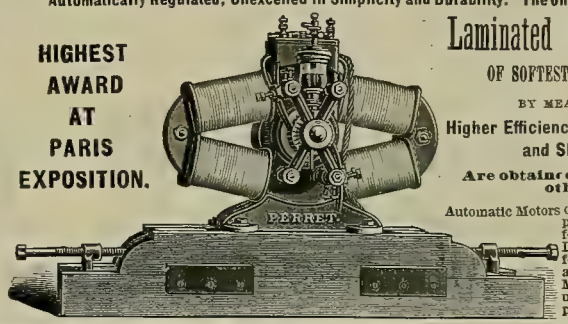
OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting, Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

CINCINNATI HEADQUARTERS

ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.

WEATHERPROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE
FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.

The JONES-BROS-ELECTRIC-CO. 28 30 & 32 WEST COURT ST.

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD W LKINS

—TRADING AS—

PARTRICK & CARTER,

Manufacturers of and Dealers in Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

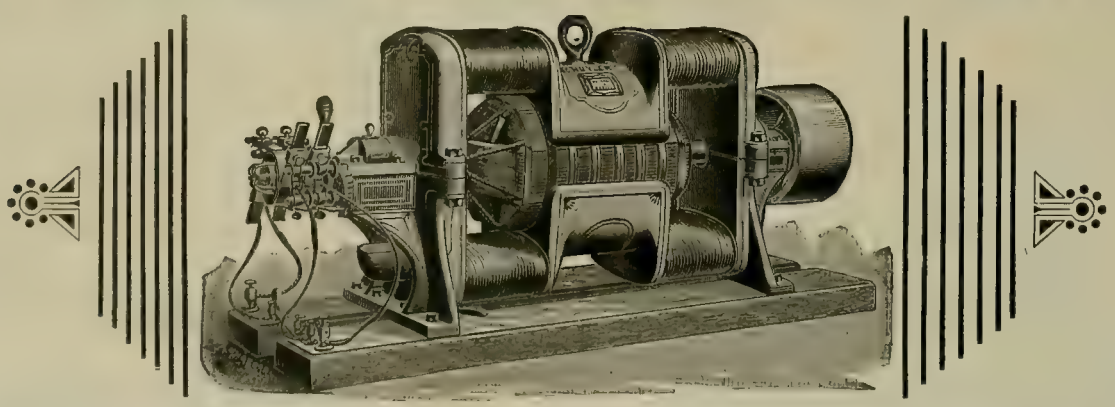
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



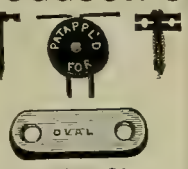
Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.

THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S



Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

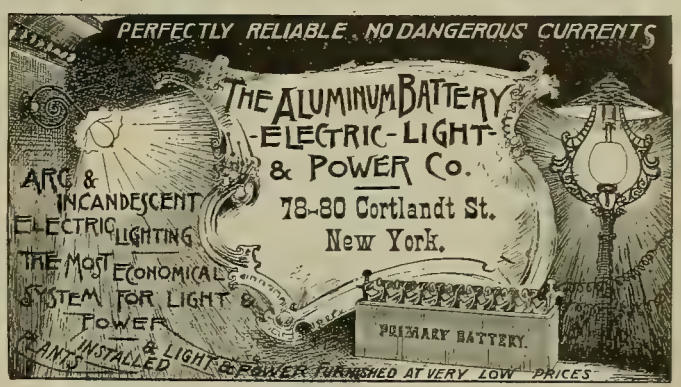
WIRES, CABLES, TAPE and CORD FOR PROMPT SHIPMENT.

HOGGSON'S

IMPROVED
Door Spring.
Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

WHEN YOU BUY A MOTOR

From ANY Manufacturer or Dealer,
State that you WANT IT SUPPLIED WITH the
Whittingham Automatic Switch.
Send for Catalogue.
Automatic Switch Co.,
No. 8 Keyser Building,
BALTIMORE, MD.



POND ENGINEERING CO.,
ST. LOUIS, CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.
ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.
COMPLETE STEAM PLANTS CONTRACTED FOR.
ERECTED READY FOR SERVICE.
SPECIALTIES:—The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, Etc.
SEND FOR LATEST CATALOGUE.

TRADE GONDA MARK.

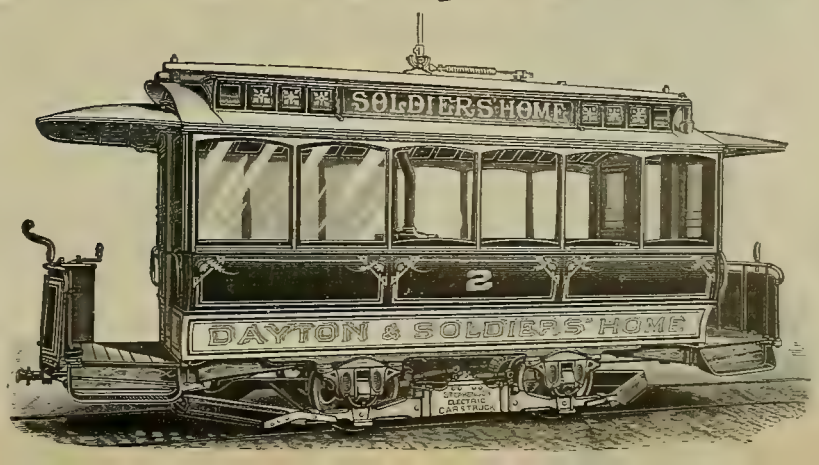
PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,
149 West 18th Street, - - NEW YORK.

BRANCHES: 161 Summer St., Boston, Mass.; 225 Pearl St., New York City; 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St. Louis, Mo.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.
STREET CARS
FOR
ELECTRIC MOTORS
CARS ADAPTED TO ALL SYSTEMS.

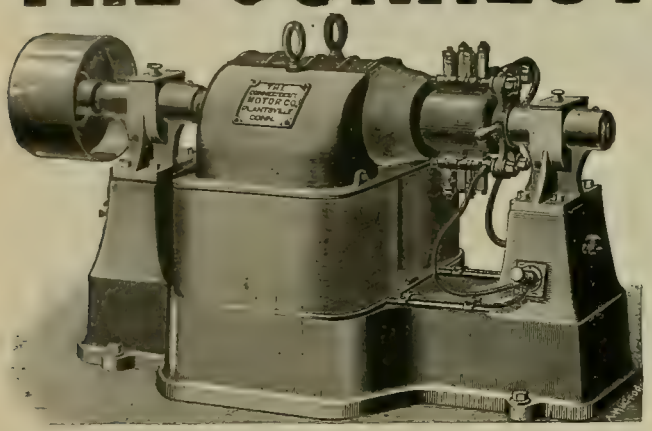


Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 N. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

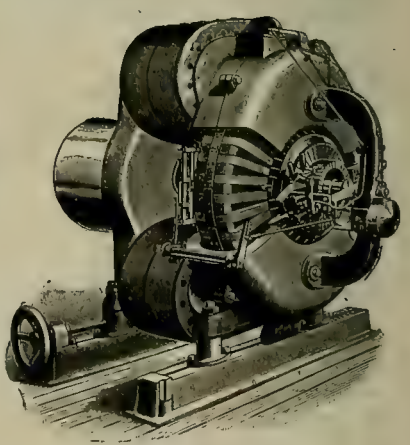
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)

MANUFACTURERS OF

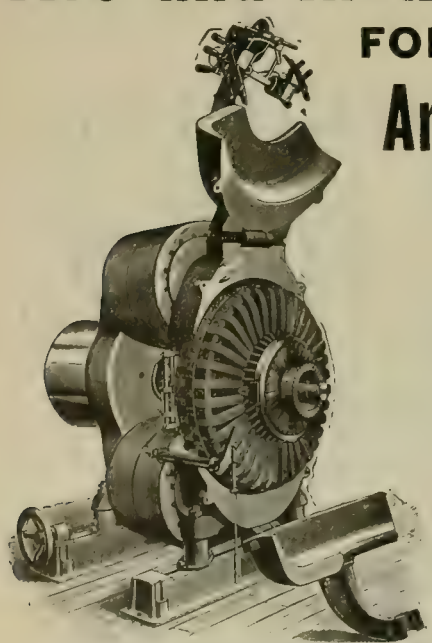
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

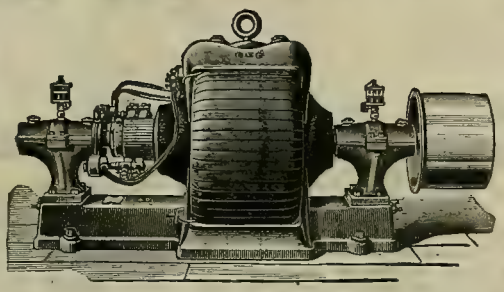
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

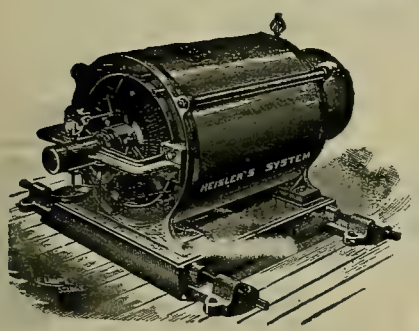
Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.



UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.

"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS

EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

NOTICE

—TO—

Eletcric Light Contractors.

Office of the Clerk of the Village of Cambridge, Ohio.

Sealed proposals will be received at this office until Saturday, September 20th, 1890, at 12 o'clock M., for lighting the streets of said village with Electricity for a term of five years, according to specifications on file in this ofice. The right to reject any or all bids is reserved. Proposals must be sealed and endorsed Bids for Lighting the Streets of Cambridge, Ohio.

JOHN S. BLACK,

Village Clerk.

WHIPPLE'S

Electric, Gas & Street Railway

FINANCIAL REFERENCE DIRECTORY

FOR 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO.

LEWISOHN BROS.,

81 and 83 Fulton St, NEW YORK.

SOLE AGENTS

Tamarack Osceola Copper Manufact ring Company,

DOLLAR BAY, MICH.

BARE COPPER WIRE

Guaranteed made from Best Lake Superior Copper.

HARD DRAWN WIRE

For Telephone and Electric Railway Use a Specialty.

Soft Annealed Wire for Electrical Purposes.

GEORGE P. BARTON,

LAW OFFICE,

225 DEARBORN STREET CHICAGO, ILL

PATENT AND TRADE MARK CASES.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS

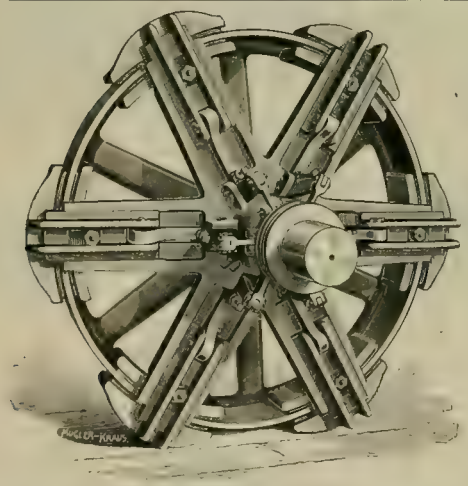
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE, out August 1st.



COPYRIGHTED BY H. W. HILL.

HILL

Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

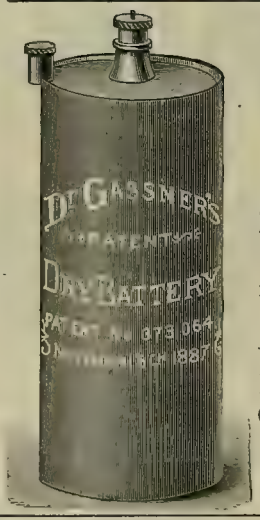
CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.



DR. GASSNER'S

DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3½ in.
17.	"	7⅜ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19	Oval,	6½ "	3⅜ in x 1⅞ in.
02.	Rectangular,	4½ "	2½ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer.
111 Chambers St., New York.

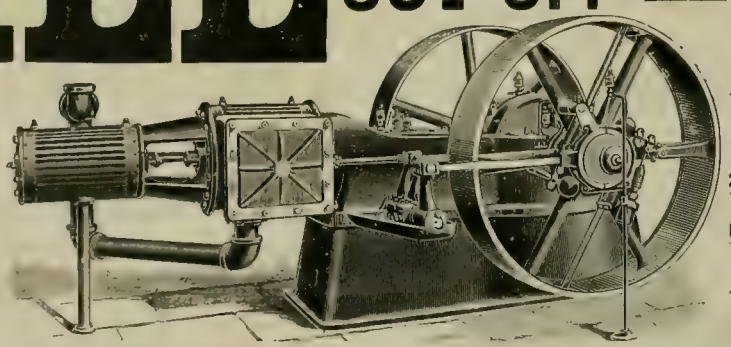
BALL AUTOMATIC CUT OFF ENGINE

Standard.

Cross Compound.

Triple Expansion.

Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER,
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Build'g, CHICAGO, ILL.

OMAHA ENGINEERING COMPANY,
Sheeley Building, OMAHA, NEB.

KANSAS CITY ENGINEERING CO.
KANSAS CITY, MO.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

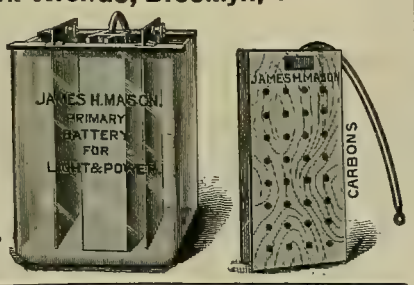
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

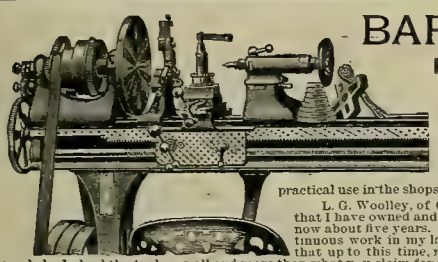
JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.





BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St, Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

Over 105 Roads operated under Our System, and that Successfully, both financially and electrically.

EDISON
GENERAL ELECTRIC
COMPANY,

Edison Building, 44 BROAD STREET,
NEW YORK CITY.

STREET ELECTRIC RAILWAYS.

Our Electric system for Street Railways has been found to be the most durable, reliable, economical and convenient.

New roads in course of construction going on in all parts of the country.

Railroad Managers and Others interested in this business are earnestly requested to correspond with us, to *get facts* and *data* showing the advantages and possibilities to be obtained by Electric Traction over any other existing methods.

DISTRICT OFFICES:

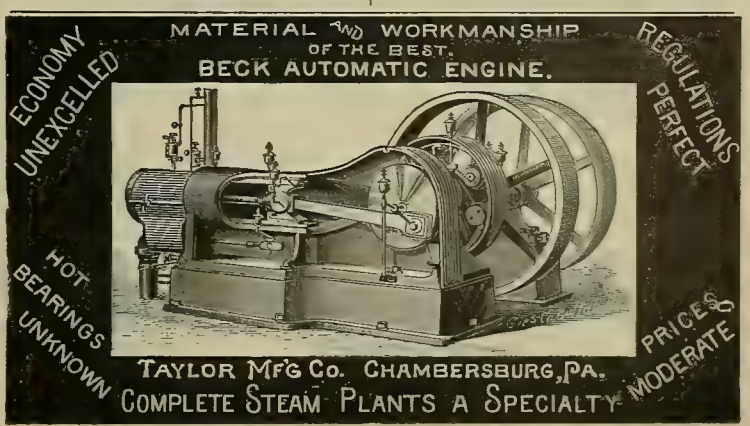
NEW YORK, Edison Building. CHICAGO, Rialto Building.
SAN FRANCISCO, Chronicle Building. NEW ORLEANS, Cotton Exchange.
PORTLAND, ORE, Washington Bldg. DENVER, Masonic Building.
TORONTO, CAN., Bank of Com. Building.

WANTED.

Man to take charge of Detail Department of Electrical Factory. Must be a good mechanic, and have had experience in managing men.

Applications should state experience and salary expected. Address MECHANIC,
Care of WESTERN ELECTRICIAN.

C., B. & Q. R. R.
—IS THE—
Best Appointed Line
—FOR REACHING THE—
West, Northwest and Southwest.



ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. THE THOMSON-HOUSTON RAILWAY SYSTEM only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

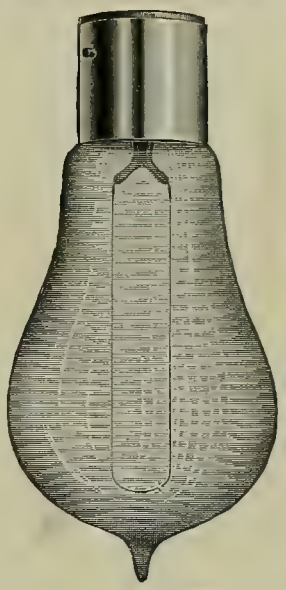
THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,
ALL CANDLE POWERS,
ANY VOLTAGE,
ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT CO., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER CO., Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

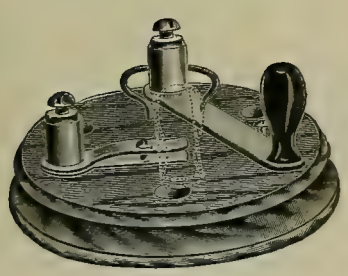
GRIMSHAW WHITE CORE
WIRES AND CABLES.

=FOR=

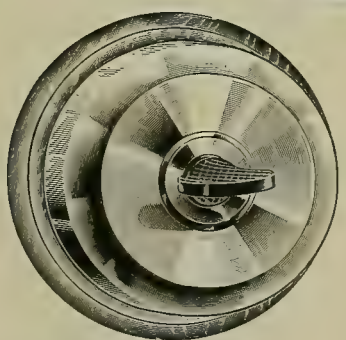
TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

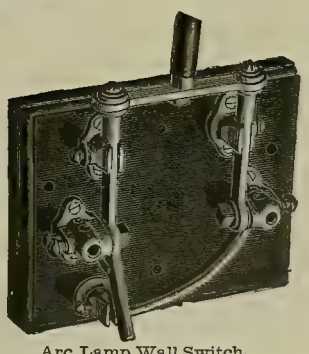
Switch-Board Cables,
Grimshaw White Tape,
Grimshaw Black Tape,
GRIMSHAW SPLICING COMPOUND.



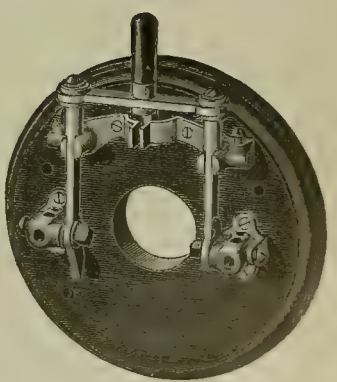
McLennan Switch.



Paiste Switch.



Arc Lamp Wall Switch.



Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.,* CHICAGO, ILL.

TO OUR FRIENDS

Of the National Electric Light Association
assembled in convention at Cape May
and those who stopped at home
or lingered by the wayside:

GREETING

QUESTION.

How can the National Electric Light Association best serve the interests of Central Station Companies?

ANSWER.

By seeing that they are supplied with our illustrated Electric Light Catalogue, and strongly recommending that they write us regarding their requirements, and thereby make sure of securing first-class material at bottom prices.

We take pleasure in calling your special attention to the merits of Shield Brand Insulation.

We recommend its use for all overhead circuits, and especially where it is necessary to run through foliage, or where other wires are likely to be encountered.

We point with pride to its uniform good quality, and a record free from failure.

It is in use to-day in connection with all leading Systems—Arc and Incandescent—continuous and alternating.

Those who have had it longest in service are best pleased with results obtained.

Unsolicited testimonials reach us frequently.

Cost is not prohibitory.

Samples and quotations furnished upon application.

We invite our Western friends to call and examine our stock on their way home and give us an opportunity to shake hands.

THE
ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

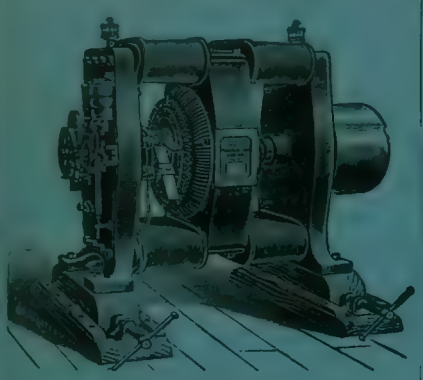
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



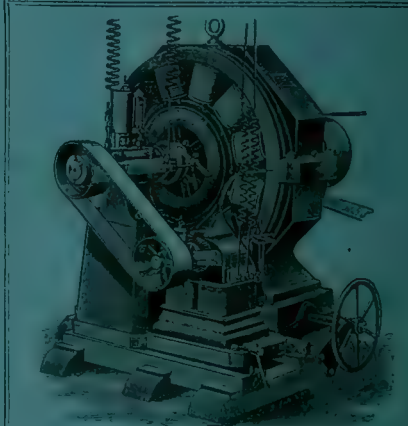
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO. - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

THE MITCHELL VANCE CO.,

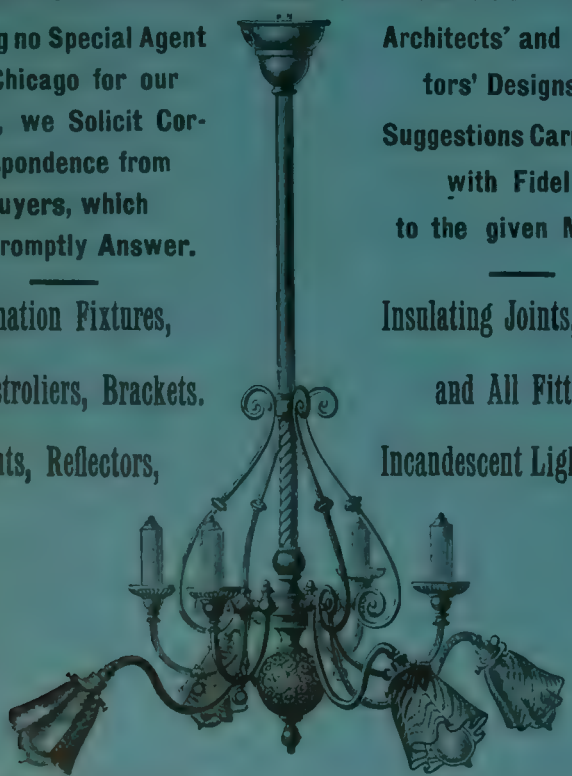
(Successors to MITCHELL, VANCE & CO.)

DESIGNERS AND MAKERS OF

ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.



Combination Fixtures,
Electroliers, Brackets.
Pendants, Reflectors,

Insulating Joints,
and All Fittings for
Incandescent Lighting.

MANUFACTORY,
24 and 25th St. and 10th Ave.,

SALESROOM,
836-38 Broadway and 13th St.,

NEW YORK CITY.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 18, Chicago, Ill.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, AUGUST 23, 1890. No. 8.

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { BAKER, BALCH & CO., Seattle, Wash. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufactures can be found at our Agencies.

To Make YOUR TELEPHONES TALK

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

ROOT'S WATER-TUBE BOILER.

ROOT SECTIONAL SAFETY BOILER.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

ELECTRIC PLANT BOILER.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff Street, New York.

BRANCHES: BOSTON, PHILADELPHIA, NEW ORLEANS, DALLAS and CHICAGO.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use.

Concealed Wiring in all Locations

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

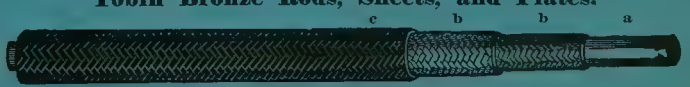
ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.



CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

MANUFACTURERS OF

Weather Proof Wire, Insulated Iron Wire, Magnet Wire, Rubber-Covered House Wire,
Annunciator Wire, German Silver Wire, Office Wire, Flexible Brush Holder Cable,
Gas Fixture Wire, Arc Lamp Cords, Tinsel Cords, Flexible Cords,
Telephone, Telegraph and Electric Light Cables.

PARAGON TAPE.

Please address all communications to the nearest District Office

EDISON BUILDING, BROAD ST., NEW YORK.

MAIN DISTRICT OFFICES: EASTERN DISTRICT, EDISON BUILDING, NEW YORK. CENTRAL DISTRICT, "THE RIALTO" BUILDING, CHICAGO.
MOUNTAIN DISTRICT, MASONIC BUILDING, DENVER. PACIFIC COAST DISTRICT, CHRONICLE BLDG., SAN FRANCISCO.
NORTH WEST DIST., WASHINGTON BLDG., PORTLAND, ORE. SOUTHERN DIST., COTTON EXCHANGE BLDG., NEW ORLEANS. CANADIAN DIST., BANK OF COM. BLDG., TORONTO, CAN.

WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave., Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment.
Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964		3,964
Westinghouse		27,710	27,710
Edison		10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734		734
Ball	613		613
Western Electric	566	250	816
Indianapolis Jenney	794		794
Fort Wayne Jenney	[illegible]	750	935
Jenney (Ind. or Ft. Wayne not specified)	324		324
Van Depoele	285		285
Waterhouse	222		222
Heisler	[illegible]	500	[illegible]
Remington	159	300	459
Sperry	130		[illegible]
Excelsior	90		90
Hochhausen	60		60
Weston	30		30
Fuller	10		10
Total	21,313	55,890	77,303

Grand total of Arc and Incandescent lights, 77,303.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	[illegible]
Westinghouse	321	49,067
Edison	..	13,853
American	1,537	175
United States	632	6,141
Schuyler	1,166	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,003
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	[illegible]	.....
Excelsior	205	30
Hochhausen	70	.....
Weston	138	.....
Fuller	10	.....
Reliance	30	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889.	[illegible]
Number of gas companies operating electric lights	266	[illegible]
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Automatic Switch Co.....xxvi
Ansonia Brass & Copper Co.... i
Allis, E. P. & Co.....xxvi
American Electrical Works. ... xvii
Abendroth & Root Mfg. Co...i, viii
Aluminum Battery, Electric Light & Power Co.... xxvi
Ball Engine Co.....xxix
Baggot, E.....xviii
Barton, Geo. P.....xxiii
Bernstein Electric Co..... xxi
Brush Electric Co.....xxxiii
Butler Hard Rubber Co. xxii
Bain Foree.....xviii, xxviii
Brown, Frank T.....xviii
Bates, W. S xix
Barnes, W. F. & Jno.....xxix
Baxter Electric Motor Co.....xxxiv
Bleckert & Nelson.....xviii
Bunnell & Co., J. H..... xvi
C. B. & Q. R. R.....xxix
Chalmers, Spence Co viii
Cleverly Electrical Works... xxvii
Colburn & Co., I. W. xviii
C. & C. Electric Motor Co.... xxv
Central Electric Co..... xiii
Continental Dynamo Co.....xxvi
Connecticut Motor Co..... xxv
Columbia Incandescent Lamp Co xv
Crosby Electric Co..... iv
Davidson, M. T..... viii
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xx
Electrical Supply Co xxxii
Empire City Electric Co..... xx
Eastern Electric Cable Co. xvii
Edison General Electric Co.,— Railway Dept.. xxix
English, Morse & Co..... xix
Excelsior Electric Co..... ...xxiv
Elektron Mfg. Co..... xxi
Eddy Electric Mfg. Co..... xvii
Electric Construction & Sup. Co viii
Electricians' Time Co..... xviii
Edison Mfg. Co..... xxv
Evans Friction Cone Co..... xxi
Edison General Electric Co.,— Lighting Dept..... x
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co.....—
Eureka Tempered Copper Co.. xix
Easton Electric Co iv
Electric Merchandise Co.....xviii
Electrician Publishing Co.....—
Empire China Works xviii
Fibrone Mfg. Co.....xvii
Forest City Electrical Works. xxviii
Fort Wayne Electric Co..... xxxiv
Fairbanks, Morse & Co.....xviii
Fletcher & Fletcher Electric Co xviii
Globe Carbon Co xix
Greeley & Co., E. S.....—
Gibson Gas Fixture Co..... xx
Giles Bros.....xxviii
Great Western Electric Sup. Co. v
Hazelton Tripod Boiler Co....xxiv
Heisler Electric Light Co.....—
Holmes, Booth & Haydens..... xix
Harmount, G. A.....xviii
Hazazer & Stanley..... xvi
Holtzer-Cabot Electric Co..... i
Hawkeye Electric Mfg. Co.... iv
Holmes & Co., C. H..... xix
Ireson, Chas. L.. i
Interior Conduit & Insulation Co. xxi
India Rubber & Gutta Percha Co. i
Ide & Son, A. L..... xvi
Illinois Electric Material Co.... xvi
Jewell Belting Co.....xvii
Jones Bros. Electric Co.....xxvi
Knapp Electrical Works. xxxi
Law Telephone Co..... xvii
Leclanche Battery Co.....xxviii
Lewisohn Bros.....xxiv
Laminar Fibre Goods Co..... xix
Mitchell Vance Co... .....—
Monitor Electric Co.....xviii
Munsell & Co., Eug..... xvii
Munson Belting Co., Chas..... xvi
Mason, Jas. H.....xxix
Magnolia Anti-Friction Metal Co—
N. Y. Belting & Packing Co... xvi
National Carbon Co..... iv
National Electric Mfg. Co..... xii
Noye Mfg. Co., Jno. T..... —
Northwest Thomson-Houston Co. ix
Ohio State University.....xxiv
Ostrander & Co., W. R. xx
Okonite Co.....vi, xvii
Partrick & Carter.....xxii
Phoenix Glass Co.....xxxiv
Paiste, H. T..... xvi
Pond Engineering Co..... xx
Powell Co., Wm..... xx
Pumpelly Storage Battery Co. xxiv
Phillips Electrical Works, E. F xvii
Page Belting Co.....xxiii
Purdue University.....xviii
Queen & Co..... iv
Roeblings' Sons Co., Jno. A... xi
Shultz Belting Co.... .....—
Stilwell & Bierce Mfg. Co.xviii, xix
Standard Carbon Co. xxii
Stephenson & Co., Jno.....xxiii
Schuyler Electric Co.....xxii
Southern Electrical Supply Co.xxiii
Sperry Electric Co.....xxvii
Sawyer-Man Electric Co..... xiv
Schoverling, A .....—
Standard Paint Co..... xvi
Standard Underground Cable Co. i
St. Louis Electrical Exposition xi
St. Louis Electrical Supply Co.xxiv
Standard Electrical Works... xviii
Sunbeam Incandescent Lamp Co.xvii
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department xxx
Taussig, S... xix
Taylor Mfg. Co.....xxix
Triumph Compound Engine Co xxvi
Turner Brass Works..... xvii
Union Hardware Co. xvi
United Electric Traction Co...xxix
United States Electric Lighting Co..... xix
Woodbridge & Turner..... xix
Westinghouse Electric Co. xv
Wollensak, Jno. S.....xxix
Western Electric Co..... xx
Weston Electrical Instrument Co.....vii
Western Power Construction Co.xxiii
Wanted. .....xvii, xxiii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co.
Pumpelly Storage Battery & Elec. Motor Co.

Aluminum.
Aluminum Brass & Bronze Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Aluminum Battery Electric Light & Power Co.
Bunnell & Co., J. H
Central Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Boiler and Pipe Coverings.
Chalmers, Spencer Co., The

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Lewisohn Bros
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Lewisohn Bros.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Automatic Switch Company.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Mitchel-Vance Co.

Electroliers and Combination Fixtures.—Continued.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
American Electrical Works.
Ansonia Brass & Copper Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Mitchell-Vance Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Electricians' Time Co.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamp Hangers.
Forest City Electrical Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.

Lamps, Incandescent—Contd.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.
Bates, Wm. S.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Pumps, Steam.
Davidson, M. T.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Aluminum Brass & Bronze Co.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Lewisohn Bros.
Partrick & Carter.
Roebling's Sons, Jno. A. Co
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

P. MINTURN SMITH, Pres't. WILLIAM D. PERRY, Vice-Pres. JAMES W. EASTON, Electn. S. N. ROBINSON, Secretary. CHARLES TREMAINE, Treas.

THE EASTON ELECTRIC CO.

ELECTRICAL APPARATUS FOR ARC AND INCANDESCENT LIGHTING

FACTORY BROOKLYN.

OFFICE 45 BROADWAY, NEW YORK.

J. H. REID, General Manager, 411 & 412 Royal Ins. Bldg CHICAGO.

ELECTRICAL Testing Instruments.

WE INVITE SPECIAL ATTENTION TO OUR

NEW PORTABLE COMBINATION TESTING SETS,

DESIGNED FOR CONVENIENCE, PORTABILITY AND ACCURACY.

AMMETERS AND VOLTMETERS OF ALL TYPES,

FOR DIRECT AND ALTERNATING CURRENTS.

SEND FOR ILLUSTRATED CATALOGUE OF TEST INSTRUMENTS 1-66.

QUEEN & CO., Philadelphia.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE.

SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

—OF FOR—
TELEPHONE ONE DOES THE WORK FOR LONG OR SHORT DISTANCE

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

THE HAWKEYE

ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station

AND

ISOLATED PLANTS,

ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps,*** Famous for long life without discoloration.

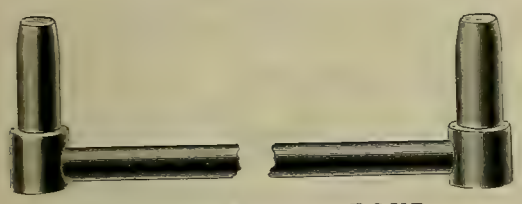
ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192
FIFTH AVE.,
CHICAGO.

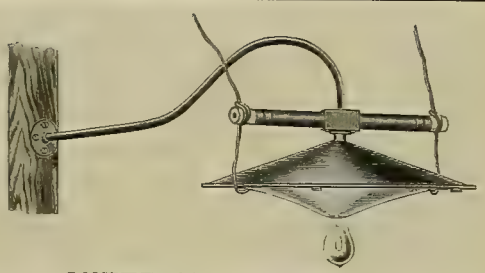
Makers of the Choicest Electrical Supplies.



ALL COPPER RAIL BOND.

THE WIRE FOR
Thoroughly Weatherproof
CIRCUITS.

SIMPLEX



CUTTER'S STREET HOOD.

ELECTRIC HOUSE GOODS:

Full Line of Gas Lighting Apparatus.
New District Telegraph Apparatus.
New Designs of Push Buttons.

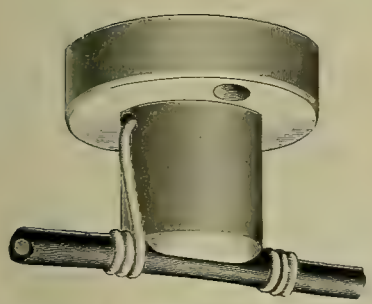
THE NEATEST AND MOST UNIQUE SWITCH MADE.

THE WIRE FOR
All Mining Work.

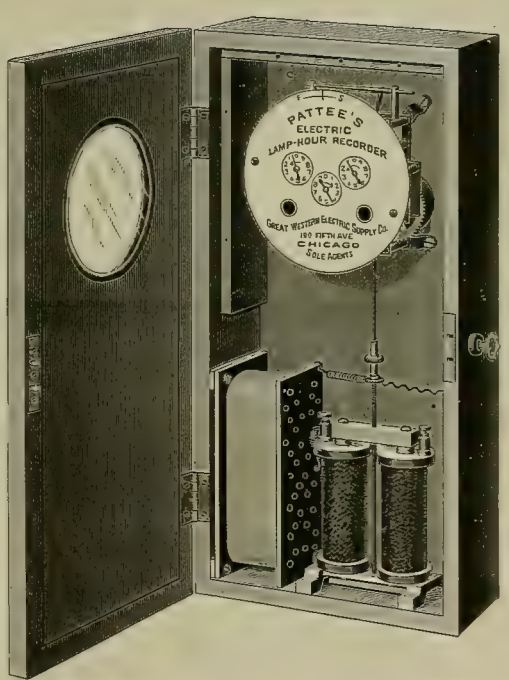
OUR ELECTRIC SPECIALTIES,

STEADILY GROWING IN NUMBER
AND IN PUBLIC FAVOR,
ARE DESCRIBED IN

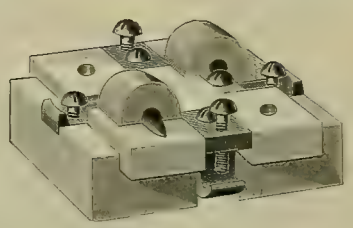
OUR SPECIAL CIRCULARS.



CUTTER'S E. L. PORCELAIN INSULATOR.



PATTEE'S LAMP-HOUR RECORDER.

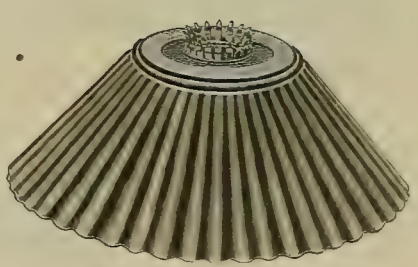


PORCELAIN BRANCH CUT-OUT.

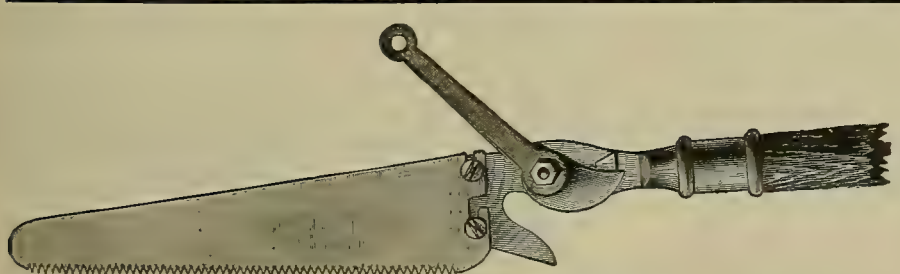
NEW MAKE OF ARMATURE PINIONS.

NEW DESIGN OF POLE TOP,
POLES AND INSULATORS

A FULL LINE OF
ELECTRIC RAILWAY SUPPLIES.



COMBINATION CONE SHADE.



COMBINATION TREE TRIMMER.

ELK HEAD ELECTROLIERS. MANY NOVEL DESIGNS.

ELECTRIC FIXTURES.

MOTOR CAR FIXTURES. SEND FOR CUTS.

Sir WILLIAM THOMSON, F. R. S.

The University, Glasgow, June 19th, 1890.

I have tested the insulation of two specimens of Okonite Wire sent to me recently, and have found thoroughly satisfactory results for all ordinary temperatures and potentials.

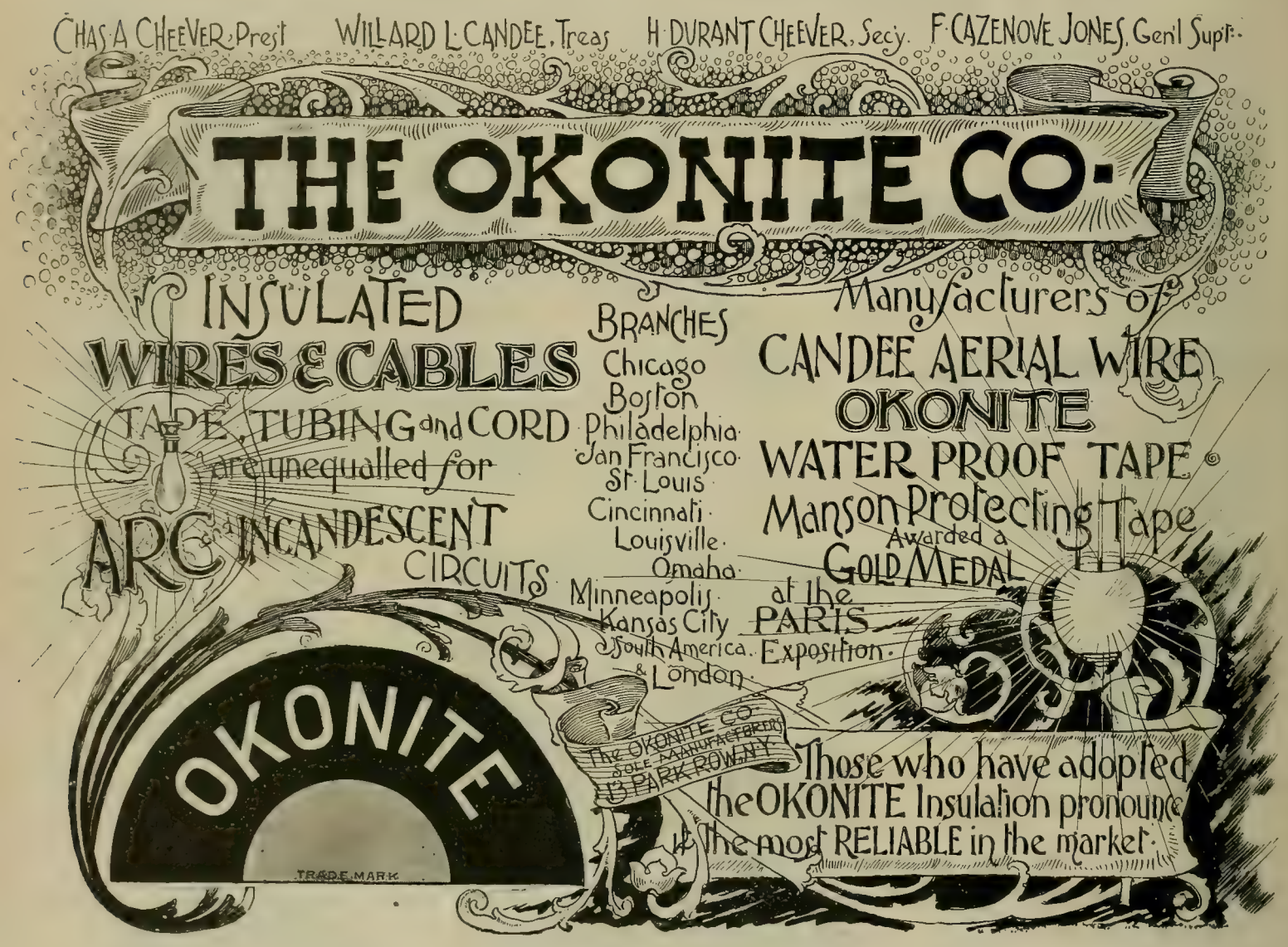
The thickness of the Okonite in these specimens was 1.8 millimetres (.072 of an inch), and its insulation resistance held good up to 7,500 volts. After the passing of current through it at this very high potential for some time, I found the insulation resistance for ordinary potentials only reduced from 6,700 (its original value) to 4,500 megohms per statute mile at 16° Cent.

I am well acquainted with Dr. Hopkinson's tests of December, 1886, which were submitted to me early in 1887, and I know the results of his recent tests of the same specimens, showing no deterioration, but actually an improvement, in the insulating quality after three-and-a-half years' keeping.

I have also seen the published certificates of many practical men of different dates from March, 1886, to December, 1888, which give trustworthy evidence of the practical success of Okonite Wire for telegraphs, telephones, and electric light and power.

With this evidence before me, in addition to my own electric tests and examination of the insulating material in respect to toughness and other mechanical qualities, I believe Okonite to be a very valuable material for the insulation of electric conductors in a large variety of practical uses.

(Signed) **WILLIAM THOMSON.**



Dr. JOHN HOPKINSON, F. R. S.

Westminster Chambers, 5 Victoria Street, S. W., June 19th, 1890.

In December, 1886, I made a series of careful and somewhat elaborate experiments upon Okonite Wire, and fully reported upon the same. My report, of which I append a copy, was as complete as it could be at the time. One point it was then impossible to determine, and that practically, the most important point of all, namely, the question of the durability of the insulation.

It is almost impossible, in most instances, to judge of the suitability of any particular insulating compound for wires until it has stood the test of time for some years. It so happened that samples of Okonite Wire that I tested in 1886 had been left with me, and have remained in my possession ever since, parts of the same having been used in my laboratory and for various other purposes.

I have now again tested these samples, and append the tests, together with the results obtained in 1886. In the case of A and C, the test is after one minute's electrification; in the case of B_1 and B_2, the test is a mean during an interval from one-half minute to five and one-half minutes from first electrification; the temperatures are practically the same, viz.: 15°.5C. in 1886, 15° C. now. Samples A and C had been immersed in water for five days, B_1 and B_2 for a shorter time. B_1 is a sample which had been twisted in 1886 for the purpose of ascertaining whether the material would stand mechanical disturbance. B_2 has six kinks made in it for a similar purpose.

A, in 1886	6,180	A, now	7,000	Megohms per statute mile.		
C, in 1886	7,590	C, now	11,680	do.	do.	do.
B_1 in 1886	5,485	B_1 now	11,740	do.	do.	do.
B_2 in 1886	4,750	B_2 now	13,700	do.	do.	do.

In my last report I stated that I was most favorably impressed with the qualities of the wire, both on account of its high insulation and mechanical reliability. Tests on the samples proved that the insulation was practically perfect, both for high and low potentials, and that the insulation would stand very rough handling and a considerable temperature, without injury, and indeed with but slight reduction of its insulation resistance. I can now add that the result of time has shown that not only is the insulation excellent when made, and that it will stand mechanical disturbance, but that for a term of three-and-a-half years it is perfectly durable, and remains as good as at the first.

(Signed) **J. HOPKINSON.**

THE WESTON STANDARD VOLTMETERS AND AMMETERS.

WESTON'S PORTABLE DIRECT-READING VOLTMETER. WESTON'S PORTABLE DIRECT-READING AMMETER.

FOR DIRECT CURRENT CIRCUITS.

Used by all the prominent Electrical Companies and Schools of Electrical Engineering. Accuracy of measurement, heretofore attained only by the use of expensive absolute instruments, now placed within the reach of all users of electrical apparatus. Can be left in circuit for any length of time without any appreciable error. Scale readings begin at zero and extend over a wide range.

SOME RECENT TESTIMONIALS.

BRUSH ELECTRIC CO.

CLEVELAND, O., June 21, 1889.

Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:— * * * We wish to say that we are greatly pleased with these Voltmeters of yours, and regard them as decidedly superior to anything we have ever had before.

Yours truly,
THE BRUSH ELECTRIC CO.,
By J. Potter, Treasurer.

BRUSH ELECTRIC CO.

CLEVELAND, O., May 19, 1890.

Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:—We are now using a number of your Standard Ammeters and Voltmeter in factory work and outside engineering work, and find them to be very satisfactory indeed.

Truly yours,
THE BRUSH ELECTRIC CO.,
By J. Potter, Treasurer.

THOMSON-HOUSTON ELECTRIC CO.

LYNN, MASS., June 7, 1890.

M. M. Garver, Esq., Weston Electrical Instrument Co., Newark, N. J.

DEAR SIR:—Replying to yours of the 31st ult., concerning your (Weston) Voltmeters, would say that I know of no reason for changing my views as expressed in my letter to you of Aug. 21, 1889. Longer experience with your Voltmeters tends to emphasize the statement I made at that time, and can say that they are in every way satisfactory to us.

Yours very truly,
THOMSON-HOUSTON ELECTRIC CO.,
By A. L. Rohrer.

Office of A. J. DAY,
16 Dey Street,
NEW YORK, June 23, 1890.

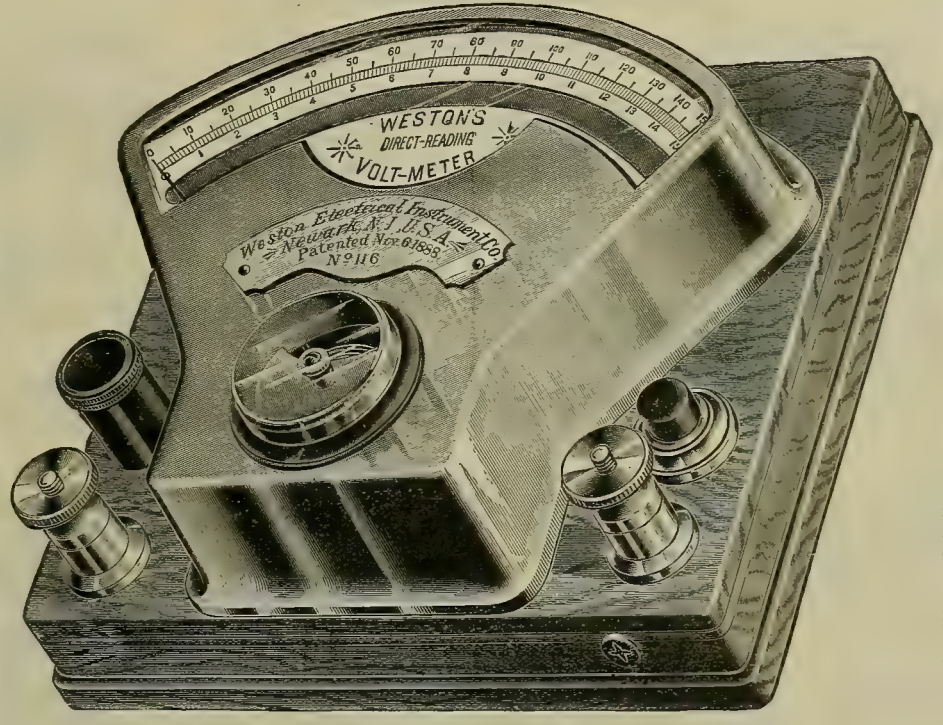
George B. Prescott, Jr., Gen. Agent.

Mr. Edward Weston,
Weston Electrical Instrument Co., Newark, N. J.

DEAR SIR:—In reply to your favor of the 20th inst., it affords me pleasure to state that additional experience with your ammeters and voltmeters, during the sixteen months which have passed since I last expressed my favorable opinion of them, has more than confirmed that opinion. For precision, reliability, portability and general convenience, I know of no instruments manufactured here or abroad, that can stand comparison with the Weston Voltmeters and Ammeters.

* ** ** *

Yours very truly,
GEORGE B. PRESCOTT, JR., Gen. Agt.



THREE-QUARTER SIZE.

Electricians Having Once Used these Instruments will not be Satisfied with Any Others.

SAWYER-MAN ELECTRIC CO.

NEW YORK, Oct. 2, 1889.

Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:—We are using a number of your Voltmeters in our factories and also in connection with our outside work, and it gives us pleasure to state that we have found them very accurate and reliable.

Yours truly,
SAWYER-MAN ELECTRIC CO.,
By P. H. Alexander, Gen. Man.

UNITED EDISON MFG. CO.

Leonard & Izard Co., "Rialto," Chicago.

CHICAGO, ILL., May 31, 1890.

M. M. Garver, Manager Weston Electrical Instrument Company, Newark, N. J.

DEAR SIR:—I have been using the Weston Standard Portable Voltmeters and Ammeters ever since they came into use, and I must say that they are the most reliable portable instruments I ever used. I simply could not get along without them.

Truly yours,
F. B. BADT, Superintendent.

UNION ELECTRIC CAR CO.

BOSTON, May 19, 1890.

The Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:—In reply to your inquiry of the 17th inst., we would say that the satisfaction expressed in our communication of Aug. 21, 1889, continues; and can only add that all of the instruments of various capacities since purchased by this company, and also the N. E. Weston Electric Light Co., have demonstrated by actual service the reliability, accuracy, and convenience of transportation and application of your instruments to the various purposes of commercial work.

Very truly yours,
UNION ELECTRIC CAR CO.,
E. H. Hewins, General Manager

JOHNS HOPKINS UNIVERSITY.

BALTIMORE, MD., April 28, 1890.

My Dear MR. WESTON:—I have been intending for some time to write you about the Voltmeter you sent us some time ago. It has been in constant and rather rough use for six or eight months. The constant has varied only a small fraction of one per cent. Its wide range, accurate reading, and general adaptability make it the most satisfactory instrument for commercial purposes that I am acquainted with.

Very truly yours,
LOUIS DUNCAN, Ph. D.

Every Electrical Plant should be supplied with them as Standards for checking the accuracy of station indicators.

At present we are prepared to supply Ammeters up to 100 amperes, and Voltmeters of any desired range.

WESTON ELECTRICAL INSTRUMENT CO.,

Office and Factory, 114 and 116 FRANKLIN STREET,

CORRESPONDENCE SOLICITED.

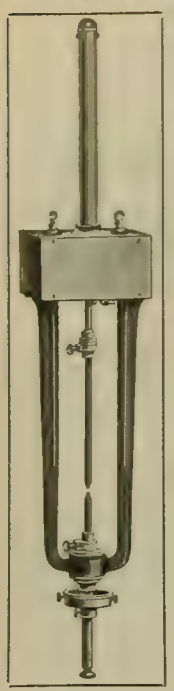
NEWARK, NEW JERSEY.

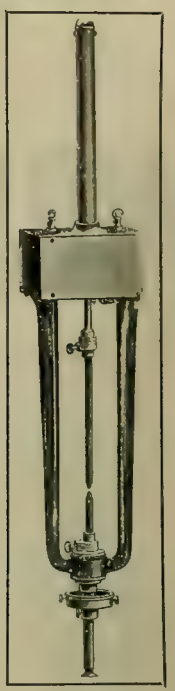
THE

ONLY COMMERCIAL ARC LAMP

FOR

INCANDESCENT CIRCUITS.





Burning two in Series on Circuits of 100 to 120 Volts.

WILL USE EIGHT AMPERES OF CURRENT.

WE ARE PREPARED to furnish SERIES LAMPS for any PRESSURE, CONSTANT POTENTIAL.

These Lamps, when burning TEN IN SERIES, on 500-VOLT CIRCUITS, use 8½ amperes, and give a CLEAR, STEADY LIGHT.

We guarantee our Lamps, Electrically and Mechanically.

PLEASE STATE SYSTEM AND VOLTAGE USED. ADDRESS

ELECTRIC CONSTRUCTION & SUPPLY CO.,

18 Cortlandt Street, NEW YORK.

BOILER AND PIPE COVERINGS

Made in Sections Three Feet Long to Fit Every Size of Pipe.

FIRE-PROOF NON-CONDUCTING COVERINGS

FOR **STEAM PIPES, BOILERS,** AND ALL **HOT SURFACES.**

Copyrighted by THE CHALMERS-SPENCE CO.

ASBESTOS MATERIALS, FIBRE, BRAIDED PACKING AND CEMENT.

THE CHALMERS-SPENCE CO.,

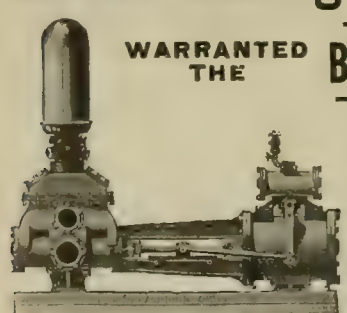
59 and 61 Liberty Street, NEW YORK.

BRANCHES:—CHICAGO, 86 E. Lake St.; BOSTON, 19 Pears St.; PITTSBURG, 414 Lewis Block; ST. LOUIS, 741 N. Main St.; PHILADELPHIA, 24 Strawberry St.

THE M. T. DAVIDSON

Direct Acting Steam Pumps.

WARRANTED THE **BEST MADE** FOR ALL SITUATIONS.



Electric Plant Pumps

A SPECIALTY.

Manufactured by

M. T. DAVIDSON.

Principal Office and Works:

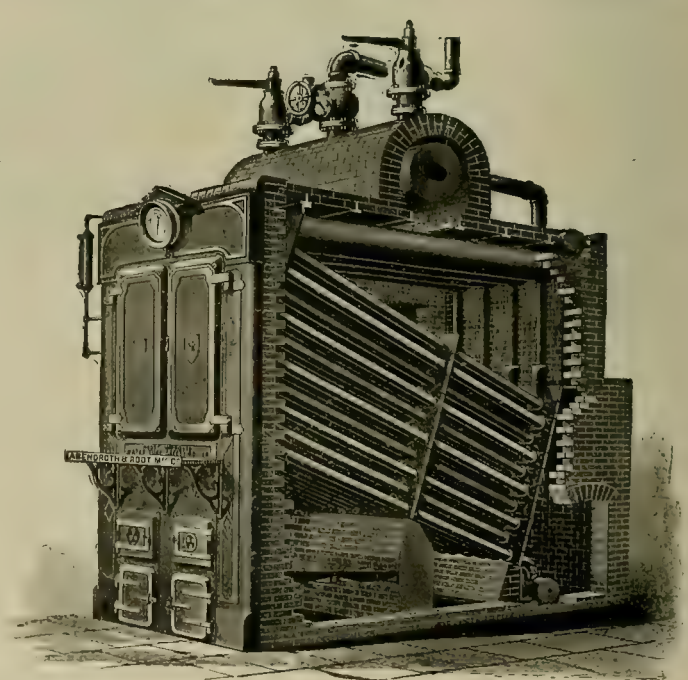
43-53 Keap Street, BROOKLYN, N. Y.

Branches: 77 Liberty Street, New York. 51 Oliver Street, Boston.

ROOT'S NEW WATER TUBE

STEAM BOILER

Absolutely Safe, Simple in Construction,



Easily rected, Very Economical.

Adopted by the Edison Electric Light Companies of Detroit, Cincinnati, Louisville, Columbus, St. Paul and many others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., NEW YORK.

BRANCHES:—BOSTON, CHICAGO, PHILADELPHIA, DALLAS, NEW ORLEANS.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

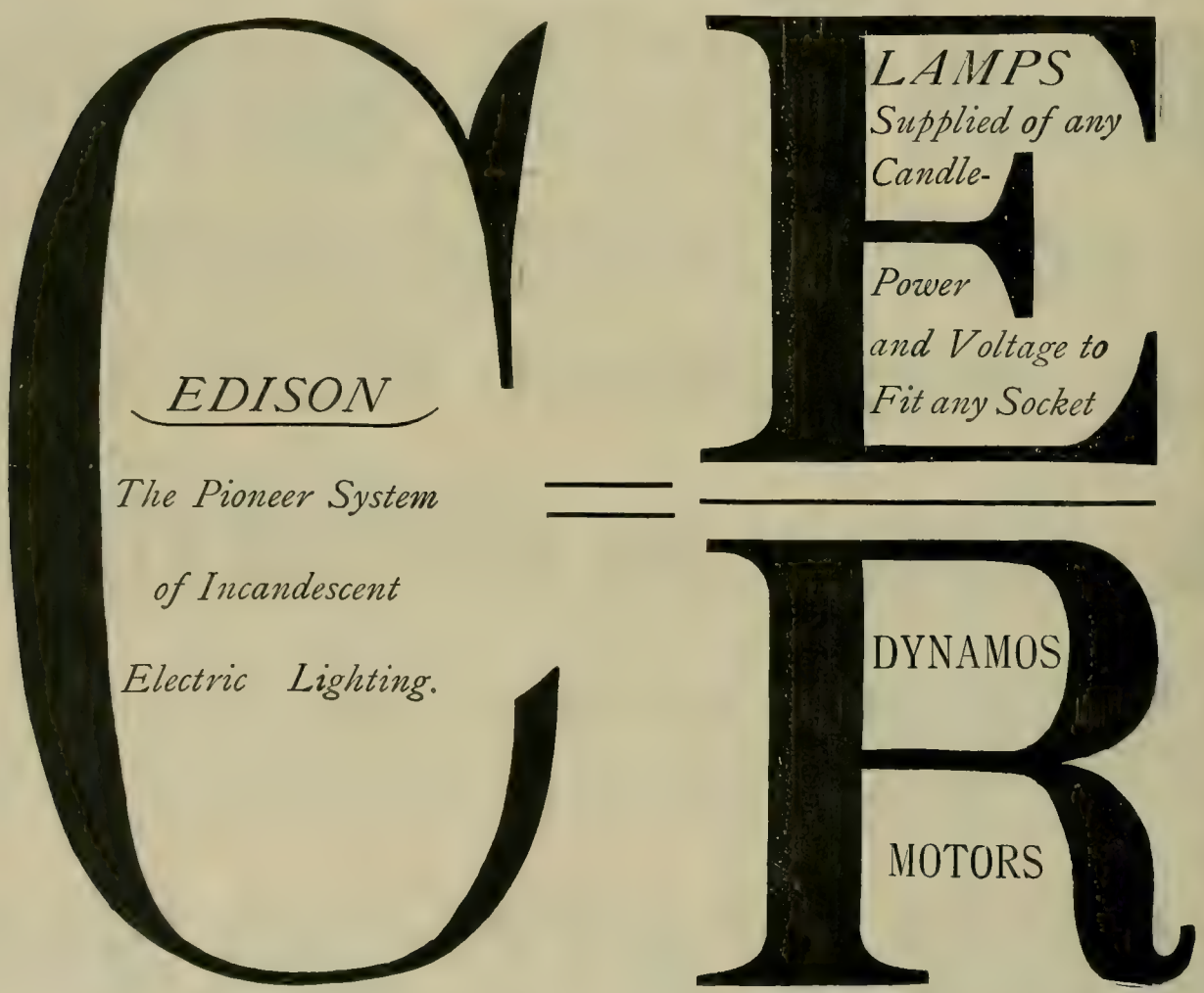
EDISON GENERAL ELECTRIC

COMPANY.

LIGHT AND POWER DEPARTMENT,

Edison System.

COMPLETE INSTALLATIONS CONTRACTED FOR ANY CAPACITY.



CHIEF EXECUTIVE OFFICE:

Edison Building, Broad St., New York City.

DISTRICT OFFICES:

CHICAGO, Rialto Building.
SAN FRANCISCO, Chronicle Building.
NEW ORLEANS, Cotton Exchange.
DENVER, COLO., Masonic Building.
PORTLAND, ORE., Washington Building.
TORONTO, CAN., Bank of Commerce Building.

FACTORIES:

New York City. Harrison, N. J. Schenectady, N. Y.
Sherbrooke, Quebec. Hamilton, Ontario.

ST. LOUIS ELECTRICAL EXHIBITION,

Sept. 3,--Oct. 18, 1890.

Parties desiring space at the coming exhibition should apply **AT ONCE**, as the number of applications already received occupies nearly all the available space.

FREE SPACE, FREE POWER AND FREE FREIGHTS

Are offered to all, and an attendance of over one million people is assured.

GOLD MEDALS Will be awarded by a competent committee, and everything done to advance the interests of Electricity. All the leading manufacturers have secured space, and the exhibit will surpass anything of the kind ever seen in America.

WRITE FOR PARTICULARS TO

FRED. H. WHIPPLE,

GENERAL MANAGER, DETROIT, MICH.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

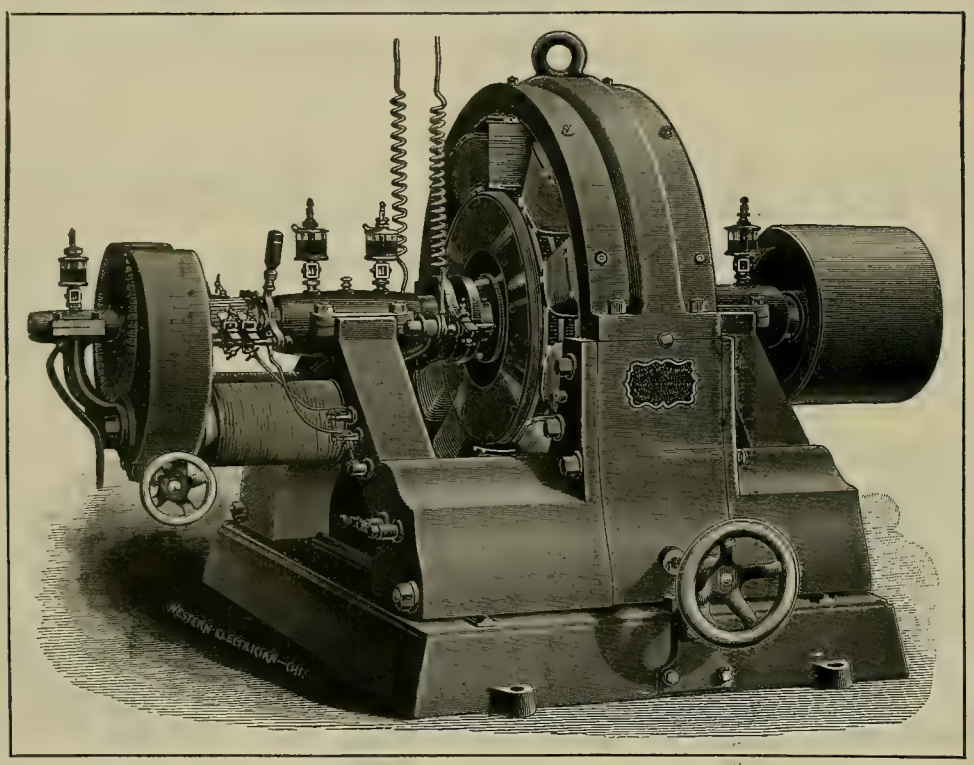
We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BEST OF ALL

THE NATIONAL
TRANSFORMER SYSTEM
OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts.,
Seattle, Washington.
THOMAS WOLFE, Southwestern Agent,
Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.,
141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.,
1517 Larimer St., Denver, Colo.

CHAS. M. BLANCHARD, Agent,
Girard Building, Philadelphia, Pa.
L. N. COX, Agent,
16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent,
Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts.,
531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable Co.

WHY Do Wire Manufacturers claim that their wire is as good as Okonite ?

BECAUSE THEY know that Okonite is the greatest insulated wire ever made, and they only hope to equal it.

WHY Do Weatherproof Wire Dealers say they have a wire equal to Candee ?

BECAUSE Candee is the King of Weatherproof Wires, and THEY know it.

OUR OKONITE BOY KNOWS IT TOO.

SEE HOW IT MAKES HIM FEEL.

Our other specialties hold the same positions in their respective classes. Among them are:

THE BRADY MAST ARM,
THE BRADY SLEET PROOF PULLEY,
THE GLOBE FAN,
THE BURNLEY DRY BATTERY,
THE BUTLER HARD RUBBER GOODS.

Send us a sample order if you want it filled promptly and satisfactorily.

CENTRAL ELECTRIC CO.,
116 & 118 Franklin Street, CHICAGO.

LOOK OUT!!

FOR

NOVELTIES

IN

ELECTRICAL SUPPLIES

DISPLAYED BY THE

SAWYER-MAN ELECTRIC CO.

AT THE

CAPE MAY CONVENTION.

DIRECT CURRENT ARC LIGHTING

THE Westinghouse Electric COMPANY, PITTSBURGH, PA.

No further need for Double Carbon Lamps. The problem solved by this company.

One pair of carbons one inch wide and three-eighths of an inch thick, with a single mechanism, will run eighteen hours.

All Double Carbon Lamps may be improved and simplified.

The substitution of a single flat carbon will effect great economies and greater certainty of operation.

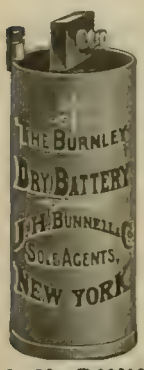
The Westinghouse Electric Company is prepared to grant licenses for the use of this valuable improvement on reasonable terms.

Lamp experts can be sent to overhaul your lamps at moderate expense. Send sample of double lamp you desire to have made over.

CORRESPONDENCE SOLICITED.

THE WESTINGHOUSE ELECTRIC COMPANY, PITTSBURGH, PA.

Boston, New York, Cincinnati, Chicago, St. Louis, San Francisco, Portland, Dallas, Charlotte.



BURNLEY DRY BATTERY

PATENTED January, 1890.

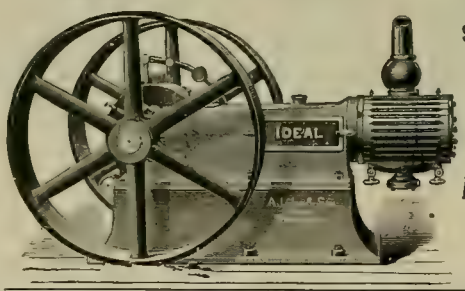
STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:—Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,
32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

Messrs. Hazazer & Stanley.

GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

Yours truly, *CHAS. E. GOODRICH, Electrician,*
503 Eighth Avenue.

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.
Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.

WHO KNOWS

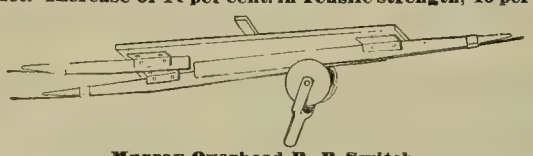
WHAT IT IS WILL BUY IT!

CANVAS JACKET

THE ONLY MOISTURE FIRE-PROOF WIRE on the Market. Increase of 11 per cent. in Tensile strength, 40 per cent. longer life for Insulation.

BISHOP
RUBBER COVERED WIRES
The ne plus ultra of all Rubber Wires.

POLES.



Murray Overhead R. R. Switch.

Trolley Hanger.

CONVENTION INCANDESCENT SWITCH. (See Illustration this issue.)

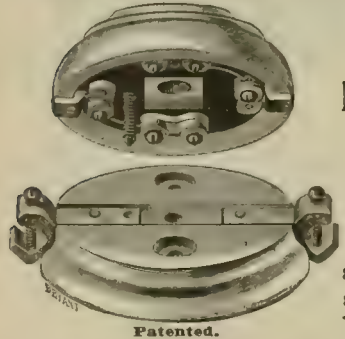
THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

DEALERS IN ELECTRIC LIGHT AND RAILWAY SUPPLIES

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.



DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

Patented.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.
Kept in Stock and for Sale by all Prominent Supply Houses.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co.

MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guarantee to be pure Oak-tanned, short lap, and to give perfect satisfaction.

GET THE BEST!

P. and B.

INSULATING COMPOUNDS,
ARMATURE VARNISH,
INSULATING TAPE,
INSULATING PAPERS,
MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, AUGUST 23, 1890. No. 8

The Electrical Section of the World's Columbian Exposition.

No class of persons has taken a greater interest in the World's Columbian Exposition of 1893 than the electrical fraternity. Their interest is natural, for it is conceded that the electrical exhibit will be one of the most important departments of the fair. It will illustrate far more completely the great advance in the art than any previous international exposition. The electrical department of the Paris exposition was exceedingly interesting, especially that portion of it contributed by Americans; but that of 1893 will be incomparably superior in every particular.

Electrical apparatus was distributed in several buildings in the Champs de Mars, and those who were particularly interested in this department had hard work finding exhibits. The representative of the WESTERN ELECTRICIAN at the Paris exposition made these statements in his letters at that time: "The various electrical exhibits are scattered all over the buildings of the exposition, and they may be found here and there in all manner of unexpected places * * * There are twenty-three exhibits of accumulators and they are scattered about among the exhibits of three nations in the machinery hall and in one of the industrial buildings. At least one day of hard work will be required to find and give a cursory glance at these exhibits."

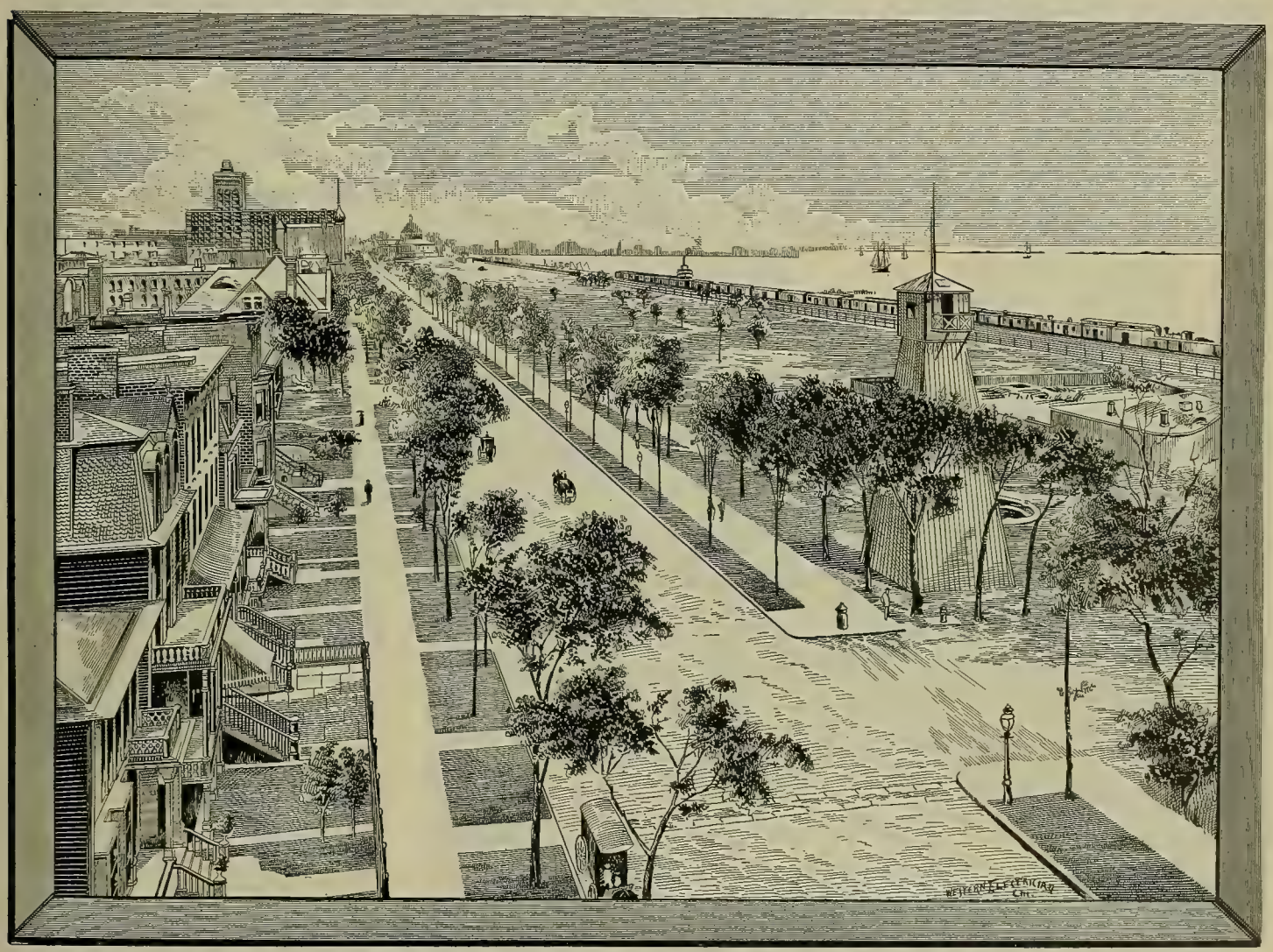
It is true that no definite arrangements have yet been made in regard to the exhibits for the World's Fair of 1893, but it is safe to assume that there will be no difficulty in finding the electrical displays. In all the plans of the authorities of the fair up to the present time, it has been assumed that the electrical exhibits will be grouped in one magnificent building and form one of the crowning features of the fair. It has also been assumed that the electrical section would be located on the Lake Front, of which a view is presented in the engraving.

The view is taken from Park place looking north on Michigan boulevard. In the engraving the view stops at the Exposition building at the foot of Adams street. In reality the Lake Front extends four blocks north to Randolph street. The Exposition building and the other structures on the ground will be removed if it is determined that the land is needed for fair purposes. If additional land is needed and filling-in is resorted to, the tracks of the Illinois Central would be removed further east. The Lake Front park is about two-thirds of a mile in length. Its width is not much more than that of a city block.

The difficulties attending the selection of a site in Chicago have become notorious. The obstacles in the way of the directors have been countless. At this writing it is generally believed, that at least a portion of the Lake Front will be used. In this case the Government building, the art gallery and the electrical exhibit would be located at this point.

It is also thought more than likely that a considerable part of Jackson Park will be used for a site. The park, as will be noted on the map which appears on the following page, is situatedon the lake shore, a little over six miles south. Illinois Central Railroad trains running on the lake shore would carry visitors from the site at the Lake Front to Jackson Park in twenty minutes.

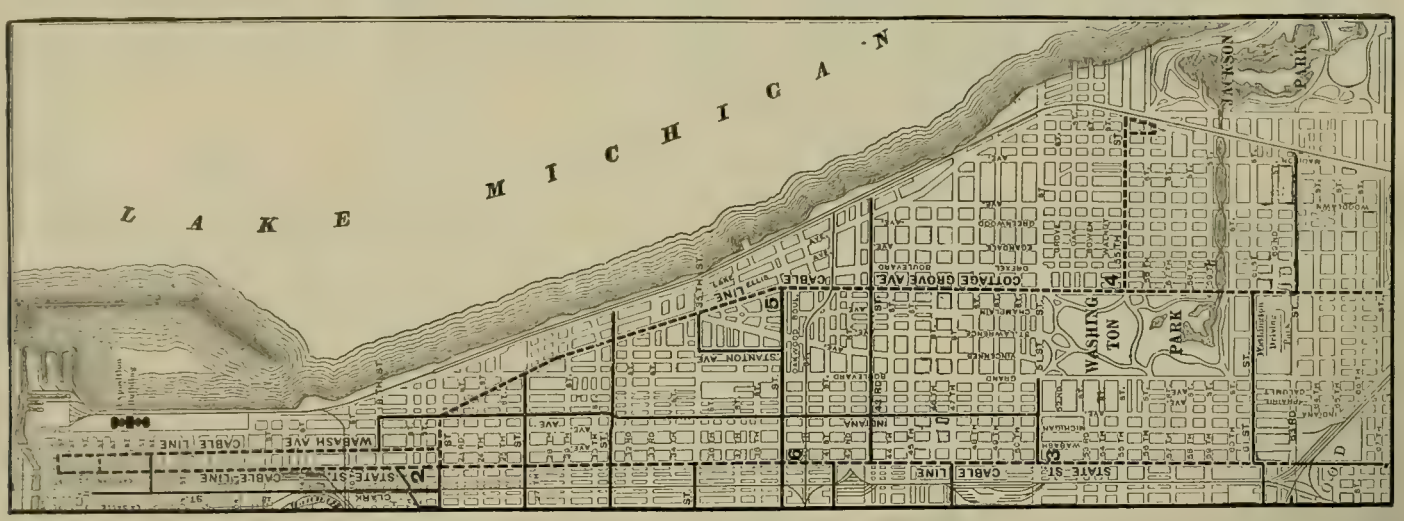
It has been reported by experts that there is not sufficient ground suitable for buildings to be found at Jackson Park. If this report is found to be true, it is not unlikely that parts of Washington Park, the Midway Plaisance, which connects Jackson and Washington Parks, and the grounds of the Washington Park Driving Club



ELECTRICAL SECTION OF THE WORLD'S COLUMBIAN EXPOSITION.—VIEW OF THE LAKE FRONT.

will be selected. The relative positions of these several sites can be seen on the map.

It has been suggested that the Midway Plaisance could be used for a series of buildings, such as was constructed at the Paris exposition, and that Jackson and Washington Parks could be joined by an electric railway. This scheme



ELECTRICAL SECTION OF THE WORLD'S COLUMBIAN EXPOSITION.—PROPOSED SITES.

of transportation would be decidedly better than the noisy, dirty, little trains that transported passengers on the Belt line at the Centennial Exposition in 1876.

The obstacles attending the selection of a site were inevitable; but they will be overcome in due season. There is not the slightest doubt that the exposition will be marvelously successful and that one of its most interesting and instructive departments will be the electrical section.

Electric Tramway in a Coal Mine.

In the last number of the WESTERN ELECTRICIAN appeared two views of an electrical

FIG. 1. ELECTRIC TRAMWAY IN A MINE.—FIFTEEN CARS HAULED AND SIDE TRACKED BY ELECTRIC LOCOMOTIVE.

mining locomotive in use in a coal mine at Lykens, Pa. In the accompanying cuts additional views, illustrating the use of this electric machine in the mines, are given. In Fig. 1 is shown a train of 15 cars hauled out of the mine and sidetracked by the locomotive. It will be noticed that the machine takes its current from a 25-pound rail supported on posts. The coal cars carry a load of about 5 tons each.

In Fig. 2 is a view of the locomotive within the gangway of the mine, about 3,300 feet from the opening.

In Fig. 3 is shown the latest mode of arranging the conductors. The style of overhead switch is also shown. The trolley used in this case is self-supporting. It was at first attached to the locomotive by one cable. At the present time two cables are used, a separate well-insulated wire, with suitable couplings, being used to convey the current to the motor. A trolley of this peculiar construction is used in order that the conductor rail may be shifted from one side of the gangway to the other, as may be desirable or necessary. The cuts are reproduced from photographs furnished the WESTERN ELECTRICIAN by the Schlesinger Electric Mining company of Columbus, O.

The Copper Market.

"The copper market is steady and the indications all point to an advance," said the Chicago representative of one of the largest copper houses in the country to the representative of the WESTERN ELECTRICIAN. "The demand for copper wire," he continued, "is so great that manufacturers find it difficult to fill orders on time."

"How do you explain this condition?" he was asked.

"The activity in electrical fields far surpasses anything ever known before. The demands of the electric lighting companies are increasing steadily, but the new field opened by the application of the electric motor to manufacturing, not to mention the electric railway, has increased the demand for copper wire beyond the wildest hopes of the manufacturers of copper wire."

Truly, the copper interests owe much to electricity, but the same is true of many other departments and humanity in general.

Memorial to Congress.

A memorial was presented Congress August 5, containing the resolutions adopted by the National Electric Light association at its Kansas City convention, and requesting that an appropriation of $50,000 be authorized for a special census investigation and report on electrical industries. Attention is called to the fact that "in Volume IV of the report of the tenth census, there are three chapters on telegraphs and telephones in the United States, and postal telegraphs in Europe. These chapters include all there is in the nature of a report on electricity or its uses. Since the tenth census, the improvements made in the art of telegraphing and telephoning are very marked, while the art of practically applying electricity to the uses of light and power is a new creation. When the tenth census was taken that vast section of the electrical industry was unknown that now employs hundreds of thousands of persons, and

FIG. 3. OVERHEAD CONSTRUCTION AND SWITCH.

hundreds of millions of capital in commercial enterprises for the purpose of supplying electric light and power. This fact makes it evident that Congress, when the act authorizing and providing for the eleventh census was adopted and approved, could not have contemplated the requirements for a complete and accurate investigation of the electrical industry and furnishes the reason why a special investigation of that industry should now be authorized and provided for."

The Execution of Kemmler.

At the meeting of the American Microscopical Society at Detroit last week, the president, Dr. George E. Fell of Buffalo, read a paper on the "Influence of Electricity on Protoplasm." Dr. Fell was present at the execution of Kemmler by electricity at Auburn last week, and his paper referred at length to the new death penalty. He said:

On the application of the current death resulted instantly. The electrode of the skull cap did not leak, as asserted by the newspapers, for one-half hour later the saturating fluid was still there. There were no horrible writhings as pictured by the honest newspaper man.

There was no question of imperfect contact raised. The electrode on the spine did not fit as tightly or hold the fluid so securely, but even then it did its work; but after the third application of the current dried up the saturated sponge, the edge of which burned away, allowing the brass plate to touch the skin at the upper edge; a burn of course resulted, but Kemmler was a corpse some time before the second application of the current. Will any one question, even if they do not desire to admit that Kemmler died in the first twenty seconds, that he was dead at this time, 100 seconds after the first application of the current? Dead without physical suffering also. This is the truthful statement of the result of the first electro-execution by one who, during its enactment, was from two to six feet from the culprit. The true history of the first electro-execution should read thus: Current applied; unconsciousness; death immediately resulted; current kept on about ten seconds too short a time.

Within 20 seconds of the first application of the current, no pulse could be detected at the wrist. Shortly afterward two or three short movements of the chest took place; as to their import see Dr. Tatum's results on dogs, namely, in 21 out of 23 dogs killed by the application of electricity, effective respiration survived the final heart arrest. Fair respirations were recorded in several cases as long as four or five minutes after the dose, which lasted only one second, but after which the heart had not executed a single beat that could be detected. This is why I disagree with Dr. Shrady as to possibility of resuscitation of Kemmler at this time.

There is plenty of evidence to show that respiration following heart arrest has been kept up in individuals subjected to powerful electric stroke for some time, where resuscitation was impossible. However, the current was reapplied within seventy second, sas stated. As might be expected, when its influence reached the muscular coats of the stomach a contraction took place, causing a small amount of mucus to ooze forth from the mouth. This is a good indication of death also. One hundred seconds had now elapsed at farthest since the application of the first current.

FIG. 2.—ELECTRIC TRAMWAY IN A MINE—VIEW OF THE LOCOMOTIVE TAKEN 3,300 FEET FROM THE OPENING.

St. Louis Electric Railways.

The construction work in the extension of the St. Louis electric street railways and the task of equipping old lines with electrical apparatus is proceeding rapidly, and soon the residents of that city will have all the advantages of rapid transit. George D. Capen, president of the Lindell Railway company, said that he hoped to have one-half the entire line, including the recent extension, open for traffic by Oct. 1. The company has been delayed by the non-arrival of material, as there is an unusual demand for electric railway equipments this season, and all manufactories employed on electric railway equipment are overcrowded with work.

The company is having high-speed Armington & Sims engines constructed at Providence, R. I., for its power plant on Compton avenue, near the Missouri Pacific railroad, which is to be the largest and most complete street railway power plant under one roof in the world. Boulevard poles in the middle of the street are to be used on Washington avenue, between Third and Seventeenth streets, and every third pole will be surmounted by an arc light. Part of Finney avenue and the track on Page avenue are also supplied with boulevard poles. The portion of the road from Vandeventer avenue to Taylor avenue, south to Delmar avenue, and out Delmar avenue to King's highway is now in operation.

President Capen and the Board of Public Works do not agree on the construction of the law which regulates electric roads. The company wishes to erect a line of poles in the western part of the city for the purpose of carrying a "feed wire." The board wishes the company to place its feed wire on poles that are already in position. The question of the jurisdiction of the board in the premises has been raised by the company, and the board claims that this right has been delegated to it.

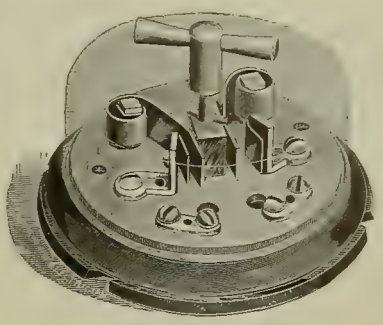
Chicago City Electric Light Plant.

Work on the South Side power station is progressing under direction of the commissioner of public works. The contracts for the electrical apparatus and engines have not yet been awarded.

The construction division of the electrical department has been installed in new quarters at the north end of the city hall building. The room formerly occupied in the telegraph headquarters was too small for the needs of this branch. William Carroll, superintendent of construction, is in charge of this department.

Snap Switch.

The incandescent snap switch and fuse box, shown in the cut, were designed by A. Shillinglaw, electrician of Armour & Co., Chicago. The



SNAP SWITCH.

switch is exceedingly simple, as will be seen by the cut. It is manufactured by the Knapp Electrical Works, Chicago.

Triple Carbon Lamp.

The cut presented herewith illustrates a new 16-hour lamp, recently introduced by the Sperry Electric company of Chicago. It is claimed for this lamp that the light is as perfect as that obtainable from a standard double carbon lamp, and that it is more easily cared for, as it has

TRIPLE CARBON LAMP.

only one carbon rod and one mechanism, while the life of the carbons is the same. Among the advantages claimed for the lamp is that the carbons can be arranged to furnish light for thirty-two consecutive hours, if necessary.

It is also asserted that either double or single lamps of any make can be fitted with this carbon holder.

Manufacture of Insulated Wires.

The new factory of the Okonite company at Passaic, N. J., is an exceedingly interesting institution. It contains an immense amount of ingenious machinery for the manufacture of insulated wires and cables. The factory is a three-story brick building, 380x60 feet, with wing, 50x120 feet, and engine and boiler room, 80 x50 feet, adjoining. There are also carpenter, machine and blacksmith shops on the premises. The entire group of buildings and plant cover an area of about six acres. Four hundred hands or more are employed, who turn out about 60 miles of insulated wire per day. Water power is used for driving the machinery. It is furnished by the Dundee canal, on which the factory is situated. In case the water power from any cause should fail, an engine of 250 horse power proves an efficient substitute. In the engine room are located the dynamos for lighting the factory. The establishment is under the supervision of F. Cazenove Jones, superintendent, and Chris. Klotzbach, assistant superintendent.

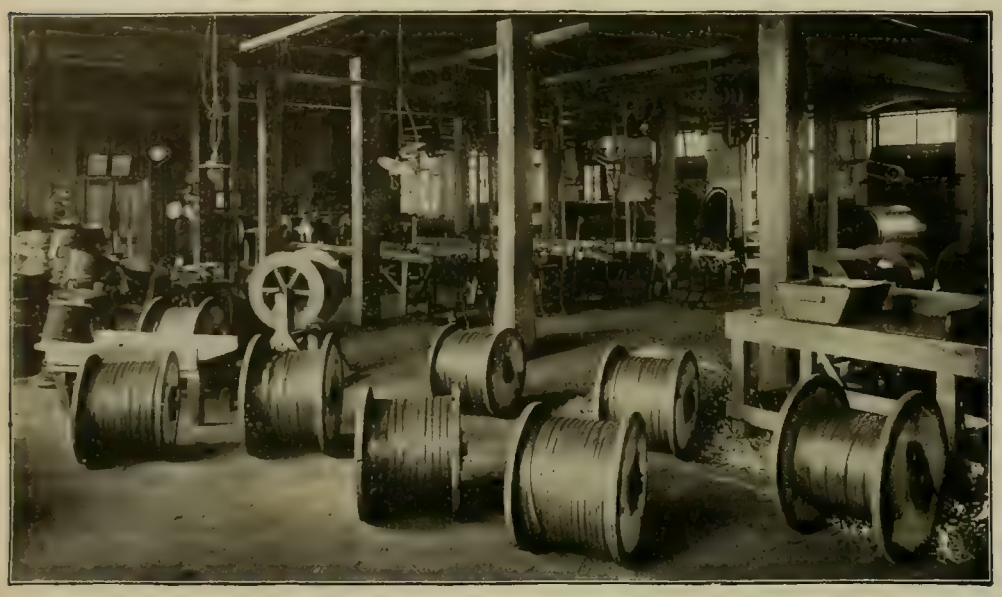


FIG. 1. MANUFACTURE OF INSULATED WIRES—COVERING MACHINES.

In Fig. 1 are shown the covering machines where the okonite insulation is put upon the copper wire. The covering process is very interesting, and is accomplished in a most thorough and ingenious manner. Wires of all sizes can be covered with these machines.

Fig. 2 shows the cabling and armoring machines. The cabling machine has been brought to a high state of simplicity and efficiency by Superintendent Jones, and resembles very little the original machine used for this purpose. By a rotating movement it combines any number of wires into a solid, well-insulated cable. If this cable is intended for submarine use, it passes to the second machine, where it is armored and finished.

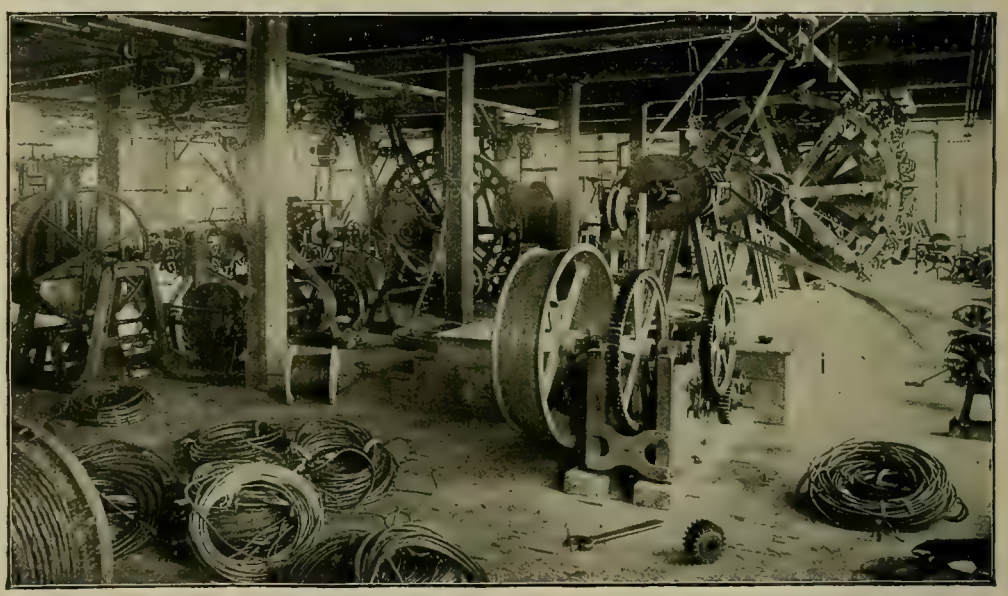


FIG. 2. MANUFACTURE OF INSULATED WIRES—CABLING AND ARMORING MACHINES.

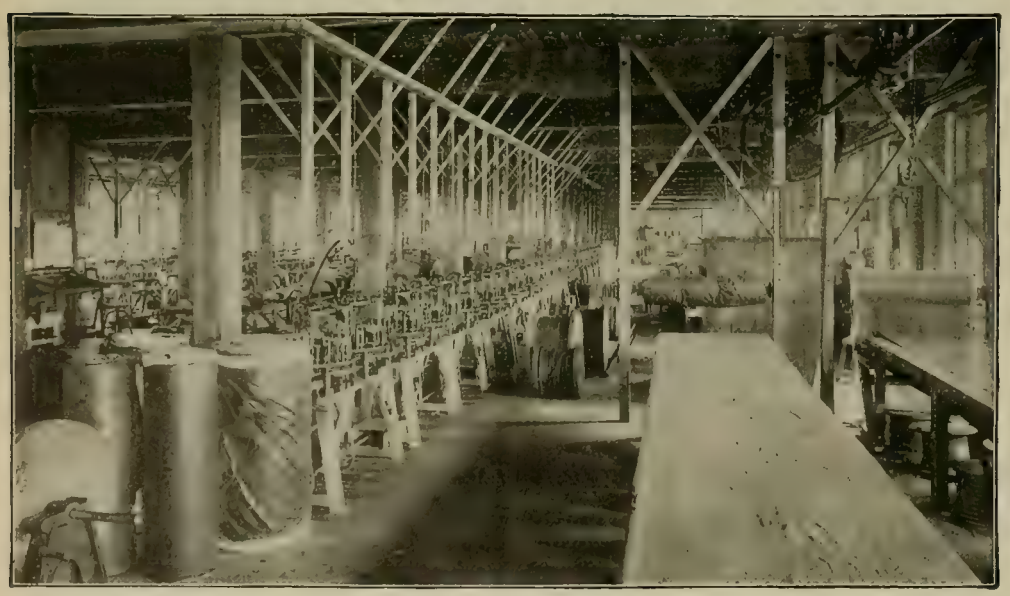


FIG. 3. MANUFACTURE OF INSULATED WIRES—BRAIDING MACHINES.

Fig. 3 shows over 175 braiding machines, which under the deft manipulation of female operators, cover the okonite insulated wire with silk braid or cord, when it is to be used for inside incandescent lighting.

Fig. 4 gives a good idea of the appearance of the testing room in the factory. Here one electrical expert and four assistants are continually at work testing okonite wire by the aid of delicate Thomson galvanometers.

The recent organization of the International Okonite company and its purchase of the interests of the Okonite company, New York City, and of Shaw & Connelly, wire manufacturers of Manchester, Eng., for the manufacture of Okonite insulated wires and cables, are now generally known to electrical readers. It will not be long before okonite will be manufactured abroad—in fact, this will be done as soon as the necessary machinery and appliances are installed.

Col. R. C. Clowry Honored.

Col. R. C. Clowry has been chosen a member of the board of directors of the World's Fair. The selection will be approved by the electrical fraternity of the country. He has been in the telegraph service since he was a boy, and has worked his way through the several departments gaining his present position by his ability, persistence and application to his duties. In 1852 he entered an office at Joliet, Ill., to learn telegraphy, working six months before he received any salary. At the expiration of that term, however, he proved himself so valuable that he was given the management of an office at Lockport, Ill., and later at Springfield, Ill. This was the beginning of an industrious career which won the confidence of all who were associated with him. In 1881, when the re-organization of the Western Union was perfected, Col. Clowry was placed at the head of the Central division, which embraced the territory west of Buffalo. Since that time the importance of this district has increased beyond all expectation, but Col. Clowry has shown himself equal to the task of managing it, and he is thoroughly familiar with the details of the entire system. In 1885 the Board of Directors appointed Col. Clowry acting vice-president of the company. Col. Clowry's headquarters are at Chicago. An old associate said Gen. Stager once referred to Col. Clowry as the most thorough telegraph man in the country. It will, therefore, be readily seen that in his selection for the position of director of the World's Fair, the exposition gained the services of a gentleman of recognized ability. The honor is certainly deserved.

The Hartford Base Ball club has made arrangements with the local electric light company to place six big lights on the ball grounds immediately, provided that evening championship games can be arranged with visiting clubs. The managers of the club have arranged for a game by electric light with the Baltimores.

Electric Lighting in a London Theater.

In the accompanying diagram is presented a plan of the boiler and dynamo rooms in D'Oyly Carte's theater in London. The electric light will be used exclusively in every part of the house and for every purpose, including 1,000 lights for stage lighting, footlights, battens, projectors, etc. In the dynamo room there are three Willans compound engines, each indicating 135 horse-power. On the bedplate of each is carried a Siemens shunt-wound dynamo driven direct at a speed of 350 revolutions per minute, giving an output of 650 amperes at 110 volts. Each engine has a steam separator fixed on its own bedplate. The engine foundations are completely isolated from the walls for the purpose of insuring freedom from vibration in the main building.

Steam is supplied by three powerful locomotive boilers, at a working pressure of 140 lb. per square inch. The flue from each boiler is carried by a downtake into the main flue under the floor; the dampers are in the downtakes, and are worked with a long rod from the firing end of each boiler. The steam main is of wrought iron with copper expansion joints between the boilers, and copper branches to each engine.

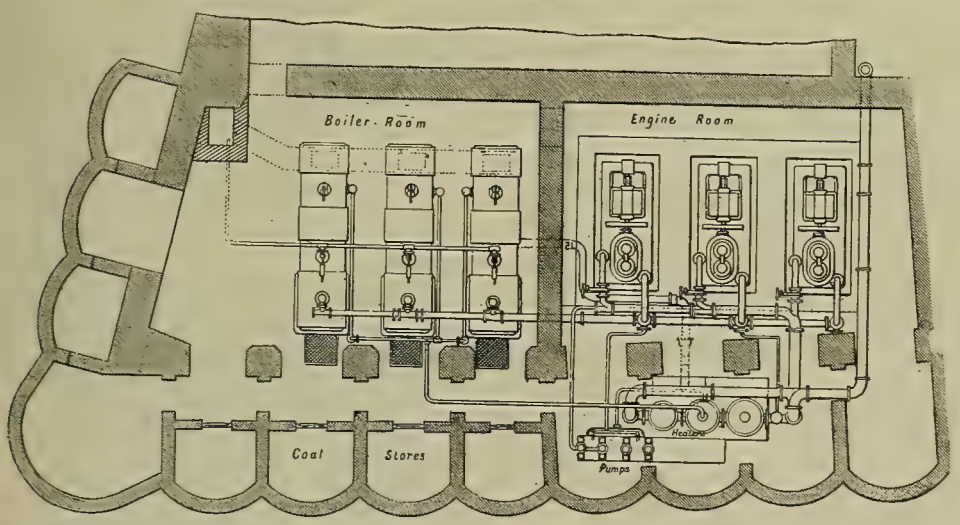
Three Berryman heaters have been put in, one for heating the boiler feed water, and the other two for circulating hot water for heating coils and lavatories. Behind the heaters is a wrought iron feed tank, arranged with a grease-separating apparatus, and on one end of this tank the boiler feed pumps are placed. These are quadruple-acting and are in duplicate, each set being capable of supplying the boilers under full load. They are arranged to pump through the heater at boiler pressure, but alternate connections are provided for pumping direct into the boilers should necessity arise.

The exhaust main is of cast iron, and a separate branch from each engine conducts the steam to the main, whence it may be passed either through the heaters or directly to the atmosphere, the manipulation of two simple valves effecting the double purpose. When the engines are not running, live steam can be used in the heaters.

FIG. 4. MANUFACTURE OF INSULATED WIRES—TESTING ROOM.

Two sets of storage batteries are used for supplying current to the offices, during the daytime, and are so arranged that they can be connected up into three sets of 72 volts each, so that they may be charged off the 110 volt circuit during the night and discharged at 110 volts in the daytime.

Three air fans are used, each driven by an independent electro-motor, two of them exhausting foul air from the auditorium and one for forcing fresh air into the building. After leaving the fan the air passes over a coil of pipes and along conduits in the basement, and enters the auditorium at suitable places. The coil can be used either for heating or cooling the air.



ELECTRIC LIGHTING IN AN ENGLISH THEATER.

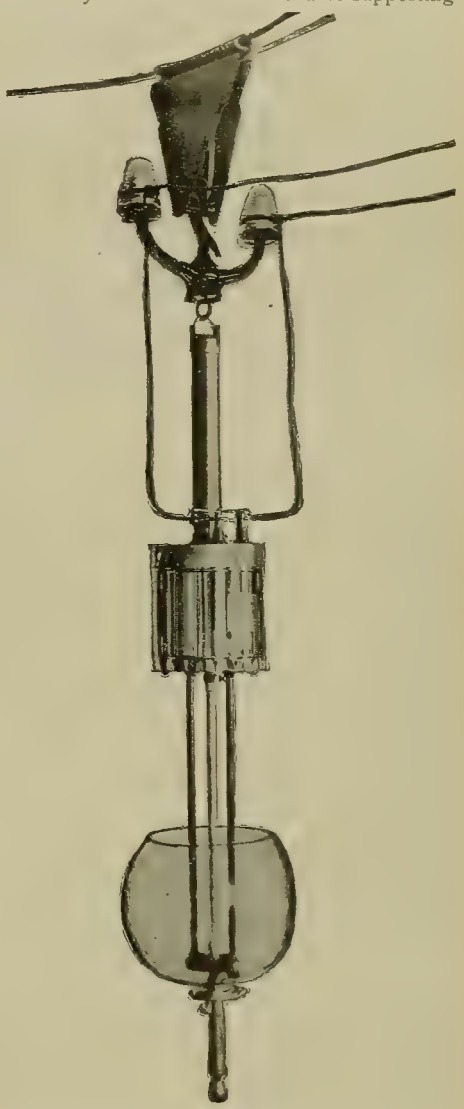
The cut is reproduced from *London Engineering*.

An Electrical Counting Machine.

In an interesting article on the work of the census department at Washington, Amos J. Cummings refers to an electric counting machine used by the clerks to verify their work. It is estimated that the use of these machines will save the government over $500,000. Each machine is worked by a young man. Upon the table to his left there is a pile of punched cards. In his front you see a commutator or circuit closer, bristling with pins. It has a pin for every hole that might be punched in the card. A plate perforated with holes to correspond with the pins is beneath the commutator. There is a hole for every pin. A glass case containing a large number of indicators stands back of the plate. Each indicator has a dial and hands like a clock. The operator places a punched card, resembling the diagram above, over the perforated plate, and pulls the commutator down upon it by pressing a pedal. All the pins are brought in contact with the card. Where there are no holes they will stop at the card and go no further. Where there are holes the pins pass through to an electrical contact below. Each pin passing through a hole closes an electrical circuit. This circuit controls the hands of the dial on the indicator. The unit hand moves a point to the music of an electric bell, and all the information conveyed by the holes is distributed and aggregated at a touch of the finger. As the cards are run through the machines they are thrown into an electric sorter which distributes them according to their peculiarities. Just now these machines are employed in tabulating special claims.

Lamp Hanger.

In the accompanying cut is illustrated a new form of lamp hanger. The lamp is entirely supported by a hook on the line wire supporting



LAMP HANGER.

frame, which engages with a steel pin in the hood, thus taking all strain off the raising and lowering cord. The cord is not in use except when employed for raising and lowering and will therefore last much longer than if used to support the lamp. Cutting or untying the cord maliciously cannot drop the lamp, because to disengage it from the hood, the lamp must be raised about six inches by the cord.

When used to support a lamp over the street, the sheet steel hood is supported by cross wire or cable and held in position by a small wire or cord running to the pole. This makes it possible to place the lamp at any point over the street. If it is desired to trim the lamp at one side of the street as in case of wires interfering, the position cord can be released and the raising and lowering cord will draw the hanger to one side of the street and release the lamp which will then come straight down. When trimmed it can be pulled into engagement with the hood. The hanger with lamp is then drawn along the cross wire to its proper position over the street. The hanger is manufactured by the Forest City Electric Works of Cleveland, O.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building, - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
The Electrical Section of the World's Columbian Exposition. Illustrated	89, 90
Electric Tramway in a Coal Mine. Illustrated	90, 91
The Copper Market	90
Memorial to Congress	90, 91
The Execution of Kemmler	91
St. Louis Electric Railways	91
Snap Switch. Illustrated	91
Triple Carbon Lamp. Illustrated	91
Manufacture of Insulated Wire. Illustrated	92, 93
Col. R. C. Clowry Honored	92
Electric Lighting in a London Theater. Illustrated	93
An Electric Counting Machine	93
Lamp Hanger. Illustrated	93
Editorial	94
Photographing the Electric Spark. Illustrated	95
Maintenance of High Tension Circuits. By Alexander Dow	95, 96
Wall Bracket. Illustrated	96
Switch for Incandescent Circuits. Illustrated	96
Oil Purifier. Illustrated	96
Wood or Metal Poles for Electric Railways	96, 97
Victory for the Brush Company in Its Double Carbon Lamp Suit	98, 99

DEPARTMENTS.

Correspondence	99, 100
The Electric Light	101
The Electric Motor	101
The Telegraph	101
Electrical Patents	102

IT has happened in the history of the National Electric Light association that action has been taken too hastily in matters of the highest importance. In view of the fact that such a vast number of resolutions is hurled into the convention, ill-advised action is by no means surprising. An illustration in connection with the World's Fair question will be clearly remembered by those who attended the convention at Niagara Falls a year ago. The association by hasty action virtually committed itself in favor of New York City as the site for the fair, in spite of the urgent protest of many members that no partisan action be taken. The heated talk in convention stirred up quite a little ill-feeling and no good end was subserved by the passage of the resolution. If matters relating to the World's Fair come before the association at Cape May we trust that no hasty action will close the consideration of the subjects discussed. If resolutions are introduced, pledging the hearty co-operation of the association in making successful the electrical section of the exposition, they will doubtless receive the hearty indorsement of the members. The same thing may be said of all resolutions of a general character relating to the fair; but when it comes to specific matters we trust that every caution will be exercised. For example, we trust that the association as a body will not make any petition or recommendations to the authorities of the fair to endeavor to influence the latter in their selection of persons to fill any of the offices in their gift. Such action, we think, would be ill-timed, and might tend to cause dissension in the association. By all means let the association do everything to advance the interests of the World's Fair, but let no resolutions be introduced that might jeopardize the unity of spirit in which the members should dwell together. The association has an opportunity to gratify the wishes of Chicago and in fact, the entire West, by conforming to their earnest desires in this respect.

THE next issue of the WESTERN ELECTRICIAN will contain a stenographic report of the convention of the National Electric Light association, which meets at Cape May, August 19th, 20th and 21st.

COL. R. C. CLOWRY, Chicago, has been chosen a director of the World's Columbian Exposition. Col. Clowry's life-long experience in the telegraph service makes his appointment especially fitting. The electrical fraternity has in him a capable representative, and he will undoubtedly look after its interests in the preparations for the great event.

ON account of the convention of the National Electric Light association the WESTERN ELECTRICIAN is printed this week several days in advance of the date which it bears. A considerable amount of matter appearing in this issue, was prepared especially in view of the meeting. The WESTERN ELECTRICIAN trusts that the convention will be one of the most interesting and enjoyable in the history of the association.

FROM time to time mention has been made in these columns of the applications of electricity in mining work. Readers of the WESTERN ELECTRICIAN recognize the fact that electrical workers are devoting more and more time to this field. In the present number is illustrated an electric toamway in operation in a Pennsylvania coal mine and some account of its working is presented. The inventor of the locomotive used on the line was recently asked whether in his tests with the machine he had noticed an increase in traction as a result of the passage of the current from the wheels to the rails. He replies in the affirmative. He had instituted a long series of experiments with the object of settling the question to his satisfaction. Some of the grades that were ascended by the coal trains were so steep that he was convinced that they could not have been surmounted had there not been increased traction due to the passage of the current to the rails.

WE present in another column an article containing facts and probabilities in regard to the electrical section of the World's Fair. A view of the Lake Front where it has been thought the building containing the electrical exhibit would be located, and a map showing several of the proposed sites are given in connection with the article. Innumerable obstacles have been encountered by the authorities in their efforts to secure proper sites. Such difficulties in view of the magnitude of the undertaking were inevitable, although, perhaps, they were not expected. There is no reason for believing that the difficulties already encountered and the obstacles which still remain to be discovered will jeopardize in any respect the success of the World's Columbian Exposition. The fair, in the great majority of its departments, will be infinitely superior to any exposition ever organized. We believe this to be particularly true of the electrical exhibit, with which the display at the Paris exposition will be able to hold no comparison. There is every reason for believing that electrical companies throughout the country will co-operate to make the electrical section represent most completely the advance which has been made in the art.

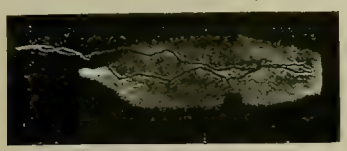
IN this issue is presented an unusually interesting and practical paper by Alex. Dow, on the maintenance of insulation on high tension overhead circuits. Insulated wires of good quality can be had in abundance, says Mr. Dow, but the trouble commences ofttimes when they are put into the hands of linemen. "What shall it profit," it is asked, "if the insulation be one megohm per mile for ninety-nine feet between poles and the last six inches of such stretch be split and wired by a too tightly twisted tie wire?" After a good wire is selected it should be well stretched. To attain this result good workmen must be employed. Mr. Dow follows with a number of practical suggestions which will, we think, commend themselves to every one interested in the maintenance of overhead wires. Unquestionably a very large per cent. of the faults in aerial circuits are traceable to a disregard of practical precautions such as those suggested in the paper.

AN interesting question has been raised at Rochester, N. Y., where the street railway lines are being changed into an electric system. The residents of Lake avenue, a very handsome drive, petitioned the council to allow the street car company to erect steel poles instead of wooden supports, as it was thought the former would not be so conspicuous. The superintendent of the fire alarm system opposed the measure on the ground that public safety demanded wooden poles. He said, while the current employed in the operation of street cars was not dangerous to life, the chances for fatal or serious accidents in cases of broken electric light wires coming in contact with the trolley wires would be greater with steel than with wooden poles. With proper connections, however, there should be no danger from this source, and if the construction of the overhead lines was not first-class, the substitution of wooden poles would not help matters much. The council committee took this view of the question after much discussion, and granted the property owners the request.

ELSEWHERE in this issue is presented an extract from the paper issued by Dr. Fell at the meeting of the microscopical society at Detroit. The topic which he discussed is the execution of Kemmler by the application of electricity. Dr. Fell was present when the condemned murderer was put to death, and his ideas are given as a matter of news, not because we sympathize with them. Dr. Fell, we believe, was the inventor of the chair in which Kemmler met his death, and if for no other reason it might be assumed that he would naturally desire to put himself on record as believing that the first experiment with "electro-execution"—to use his word—was entirely successful. Nothing in the doctor's paper leads us to change in any way the views which we expressed last week. The execution was in every respect a failure, and we trust that no further experiments of the kind will be made. We hope the Electric Light association at the Cape May meeting will express its condemnation of electrical execution in unmistakable terms. It is interesting at this time to look over the action taken at the last meeting of the association in regard to electrical execution. In its report on the matter the committee on state and municipal legislation, stated that while its members believed the electrical execution act should be repealed, yet they thought if it was to be enforced the punishment should be conducted in accordance with humane ideas. The committee therefore recommended that a special dynamo delivering current at a pressure of 10,000 volts be constructed specially as a death-inflicting machine. After some discussion the recommendation was adopted by the convention. No further action was taken, we believe, to secure the adoption of the recommendation in New York state, for the reason that it was deemed inadvisable to move in the matter, while the constitutional question was still undetermined. After that was disposed of it was too late for the committee to take any action which would have led to an amendment in the law.

Photographing the Electric Spark.

At a recent meeting of the London Photographic Society Sir Henry Trueman Wood read a paper on photographing the electric spark. He referred to the instances in photographs in which bright flashes of lightning were represented by dark lines in the position. These dark flashes were noticeable in photographs of lightning flashes of which reproductions appeared in the WESTERN ELECTRICIAN of July 26th. They



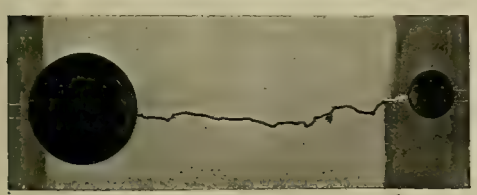
PHOTOGRAPHING THE ELECTRIC SPARK.

were not as plainly marked, however, in the engravings as in the photographs. Sir Henry Trueman Wood said it had been suggested that the dark lines might be due to oxides of nitrogen, produced by the flash and remaining in its path, the line of nonactinic material thus produced appearing in the photograph against the background, illuminated perhaps by subsequent flashes. The paper continues as follows:

The idea occurred at the time to myself, and

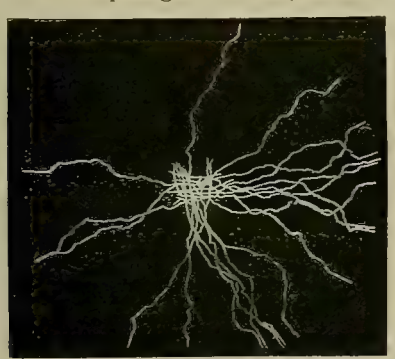
PHOTOGRAPHING THE ELECTRIC SPARK.

probably to a good many others, that the matter might be solved by means of the Wimhurst induction machine, the powerful sparks of which form no bad imitation of lightning flashes. Mr. Clayden probably settled the matter as to the way in which the "black flashes" were produced by taking photographs of the spark and exposing the plate before development to diffused light, when darkened lines were the result, thus showing, it must be admitted, to the surprise of



PHOTOGRAPHING THE ELECTRIC SPARK.

many, myself among the number, that it was merely a case of reversal of the image. I had not the chance of using a Wimhurst machine until a short time ago, but I thought it would be interesting to try whether one could get anything which would justify the theory. It seemed to me that if the plate were exposed immediately after the passage of the spark against an illuminated background, supposing the spark marked out its passage in the air, as has been



PHOTOGRAPHING THE ELECTRIC SPARK.

suggested, then some record ought to be found on the sensitive plate. I made a good many trials to this end, making the exposure immediately I could see the spark, which, of course, was really after it had passed; but I was not able to discover the faintest trace of anything on any of the plates exposed. Subsequent experiments, however, showed that it was very easy to get the image of the spark, either in its usual condition or entirely reversed, if the spark was photographed with an illuminated background behind it, and the exposure on the background continued for a sufficient time after the passage of the spark; or if, when the spark was photographed against a dark background, a subsequent exposure to an illuminated background was made. The illuminated background was simply a screen of tissue paper with an arc lamp behind it. It was placed a few inches behind the terminals of the machine. The cuts show the most perfect reversal was obtained by a preliminary exposure of two or three seconds, and a subsequent exposure of about five. By a still longer continued exposure a re-reversal took place, and the spark in the print was again indicated by a white line. There were also many cases of partial reversal, in which the image was reversed at one end and not at the other, or reversed at the sides, and not at the center. That is to say, the positive print showed a white central line or core, bounded by dark edges. It appears a rational conclusion that in these cases the reversal had commenced along the sides, but had not reached the center.

Where a background was employed, of which half only was illuminated and half dark, the reversal took place only in that portion of the spark which had behind it the illuminated portion.

All the experiments, it appears to me, go to confirm the theory put forward by Captain Abney, and elaborated by Professor Meldola, as to the cause of the reversal of the photographic image—namely, that the bromine set free by the action of light begins, as soon as a certain quantity has been liberated, to combine with the reduction product originally formed, thereby forming fresh bromide of silver, and re-sensitizing the portion of the plate where the effect is produced.

It may be worth mention, as a reminder to those who may be inclined to try experiments with the Wimhurst spark, that the analogy between it and the lightning flash must not be pushed too far. For instance, when some photographs were shown, in which the lightning flash was shown broadened out by motion of the camera, it was naturally objected that photographs of the induction spark taken on a rapidly revolving plate, showed no apparent movement. The observations which Mr. Preece has caused to be taken in thunder storms by the Post Office telegraph instruments, indicate that lightning flashes have often a duration of definite amount, quite sufficient for movement of the camera to blur or enlarge the photographic picture.

Another interesting result obtained by photographing the electric spark is that a measure of its duration may be obtained. I am able to show you some photographs of the spark taken on a rapidly rotating plate. The plate, or film, for many of the photographs were taken on paper, was mounted on a disc which was rotated by an electro motor at a speed in some cases exceeding 2,000 per minute. The largest disc was 20 inches in diameter; the smallest about 4 inches. Of course, the larger the disc the greater the circumferential speed, but in practice the motor I was using could not drive the large discs at a very high speed, and the greatest speed I got was with a disc of 8 inches in diameter (effective) running at 1,500. This gave a speed of 600 inches per second at the point when the outer end of the spark was photographed. There is no perceptible difference in the width of a spark taken when the plate is stationary and that of one taken when the plate is running full speed, and certainly it is not displaced to the extent of the twenty-fifth of an inch. It follows from a simple calculation that it does not last the 10,000th part of a second.

Lebanon, Mo., is to have an electric street railway. At a meeting of the city council, an ordinance presented by W. N. Allen of Clinton, Mo., was unanimously adopted, granting to the Lebanon Light & Water company a street railway franchise for a period of 40 years. The line will run on the principal streets of the city to the magnetic well and the new hotel, making about five miles of street railway within the city limits. Work is to be commenced within 60 days, and the road will be completed and in operation in two or three months. The electric light plant being put in by the same company will be completed by October. The company is also building a $100,000 hotel near the magnetic well.

Maintenance of High Tension Circuits.

By Alex. Dow.

The rule that high insulation is a necessity to the operation of high tension circuits is generally accepted. The occasional publication of a series of insulation tests made, not on laboratory samples of wire, but on actual circuits, is evidence that some managers are trying to live up to the rule, and the figures sometimes show that success is secured. But it will not be denied that there is room for improvement; that the stations where leaks and grounds and short circuits are the order of the day (and night) outnumber two to one those where fairly high insulation of circuit is maintained.

Please note the word *maintained*. It is not *attained*. There are few new circuits these days which do not give a perfect test when first completed. The attainment of high insulation is an everyday occurrence. Its maintenance for many days under ordinary conditions of operation is rare.

The stations operating high-tension underground circuits must be exempted from these strictures. With such stations high insulation is an absolute necessity. They have no option between maintaining it and shutting down entirely.

A few of the causes which tend to make trouble on ærial circuits are noted in this paper, and some suggestions made, which may aid those seeking improvement.

First in order comes the insulation next to the wire; the covering in which it is enveloped. Underwriters' wire is out of fashion now, and there is a wide choice of superior insulations. The claims made for some of these wires form an interesting part of the advertising columns in electrical journals; and doubtless we will soon have an insulation capable (as per advertisement) of automatically pulling off fallen telephone wires, chopping down trees, and removing the debris, shaking out crosses, and daily reporting its own resistance as a megohm or more. Our friends, the manufacturers, will furnish now (for a consideration) wires that do not fall much behind that ideal. But our friends do not go far enough. They furnish the wire and leave it to the tender mercies of our linemen, to be put up according to their own light, and the results are not always as expected.

Linemen's methods vary about as linemen do; and it is not too much to say that a circuit of underwriters' wire strung by one lineman, according to his ideas, will test as high and operate as well as a circuit of the best "million-foot order" wire strung according to another man. For what shall it profit if the insulation be one megohm per mile for 99 feet between poles, and the last six inches of each stretch be split and ruined by a too-tightly twisted tie wire? Or, if every joint be a leaking place, and the leaks be united in one continuous streak of surface conduction by the weather-bleached and rain-saturated outer braiding?

The theory of the insulating covering is that it shall be a non-conductor, and shall interpose itself continuously between the copper and any conductor which might divert current from its proper course. The covering of any good wire is a non-conductor, but does it continue so while in use? As to its body, we can say, yes; as to its outer surface, no. The outer braid or tape bleaches under the action of sun and rain, or becomes filled with smoke and dust; and so ceases to repel moisture as it did in its first glossy newness. When moist it is a partial conductor. Then if the covering be cracked or split in handling, or badly re-insulated at joints, moisture may communicate from the outer surface to the copper, and the partially conducting outer surface so become charged throughout its entire length, which condition is not according to theory. The moral is, that after a good wire is selected, it must be well strung. Do not let stretches lie in the street before pulling them up, while wagons drive over and split the insulation. That is a common occurrence. If you have a contrary opinion, just watch your men string the next loop down town. Do not drag the wire around corners and over guy wires by main strength and awkwardness. Put a man at the turn to ease it round. Do not tie it with a Western Union tie of the same size wire, and twist up the tie with 8-inch pliers till

both tie and line wires strip. Use a long tie, two sizes smaller than your line wire, and make the Helvin or crossed tie, and your wire will be held perfectly firm, while your braiding will be intact. Do not wrap three or four layers of sticky tape round the joints, and imagine that you have thereby restored the original insulation. You have not; even if a multitude of linemen testify by their works that they so believe. First, you want a good tape. There is a wide choice in tapes, and two-thirds of them are of no account. Then you want to consider the nature of your insulation. It is probably a braid saturated with a waxy compound. The braiding is something you cannot reproduce with linemen's fingers; but the tape is a sufficient substitute. The compound you can obtain from the wire makers in shape of a paint. If your particular maker does not supply a paint, some of the other paints will do. There are several of them; and the insulating power is not necessarily proportional to the badness of the smell. When the wire was insulated in the factory, it had first a coat of compound, then a braid; another layer of compound and another braid; and so on until the necessary thickness was obtained. You can insulate your joint in just the same way, and it will be well insulated. And if the end of the tape should seek to unwrap, a few inches of twine will make it secure.

The next consideration is the insulation of supports. The glass insulator is about as satisfactory a support, mechanically and electrically, as can be devised; especially if it be of the double petticoat pattern. Those who have had experience with long telegraph lines know that the shape of the insulator has much to do with the insulation resistance; and the adoption of the double petticoat shape by the British Government Telegraph department is a strong indorsement of its advantages. Porcelain knobs are not fit for high tension work. Their enamel cracks, and they absorb moisture. Their shape is convenient sometimes, but glass insulators of the same shape can be had, and are much superior.

The glass is usually the last insulation of the circuit. This need not be, for the pin and cross-arm which support it are wood; and dry wood is a very good insulation. The pin and arm when they come from the factory are usually dry, but they absorb moisture from every rain, and form an earth connection through the wet pole. Linemen, who have to handle live circuits, will tell you so. Of course the pin and arm are painted, and should not absorb moisture, but the painting is very perfunctory, and the base of some of those red paints is iron oxide, which is not quite an insulator. If, instead of buying the red-painted pins and arms, you will buy them unpainted; dry them, and paint them thoroughly with the paint you use for joints, you may feel sure that they are aiding in the insulation instead of, as heretofore, reducing it. Some manufacturer of cross-arms, who has room in his dry-kilns to bake the wood, and space elsewhere for a dipping tank for insulating paint, might put such "high resistance" arms and pins on the market to his pecuniary advantage.

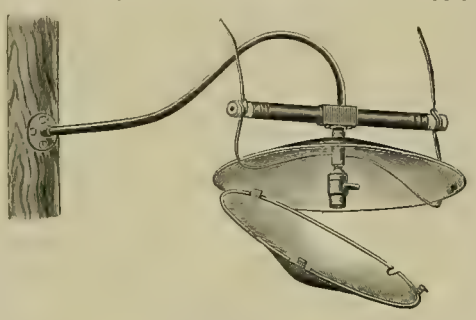
An alternate current primary circuit was being moved one day this summer. A stretch of wire, covered with one of the best insulations, was left for the night lying on a red-painted cross-arm. Over night there was rain, and the "detector" showed the circuit grounded. In the morning the linemen found a deep groove burned in the arm. That pine cross-arm had conducted enough current to burn it like a blow-lamp flame.

A guard wire strung on top of the poles will prevent a lot of trouble; not stapled to the pole like a fence wire, as is too often done. Those stapled wires will pull loose, and make crosses instead of preventing them. String a No. 6 steel wire on glasses in good shape, and it will not only stop falling telephone wires, but will brace up the whole line. If your circuit is much exposed to lightning, you can make your guard wire act as a lightning rod by grounding it every 500 feet. The ground wire should not be run right down the pole, but should be led diagonally, like a guy, to a point as low as possible on the next pole of the line.

Finally, there is something wrong in a station when the linemen are unable to keep the "trouble hook" clear. The criterion of a good lineman is not the prompt location and removal of circuit troubles, but the freedom from interference of the circuits for which he is responsible. Perhaps he has too much to do, and cannot find time to strengthen the weak places until they compel attention by breaking down. If so, the fault is false economy. A lineman should have time to patrol his circuits, and should have every facility for their maintenance. A good man will not be idle, even if his work does not show a direct return in revenue. The smallness of the repair and rebate accounts is his credit. Troubles will come while there remain with us bad weather, and telephone men, and the total depravity of inanimate things; but the troubles that are due to bad construction, and the ordinary wear and tear, and causes that may be foreseen, should disappear for ever.

Wall Bracket.

The steady demand for higher insulation, which has led to the production of good weatherproof wires, has also resulted in the design of a better quality of insulators and of surer means of supporting them. The supporting device, or "Springfield bracket," shown in the cut, is manufactured by the Great Western Electric Supply



WALL BRACKET.

company, Chicago. Being made of malleable iron, with a ribbed arm and a hollow screw, it is very light, strong and tough. The split screw has a slight give to it and grips the insulator tightly. The wall plate is so shaped as to give a large spread with very little metal.

Switch for Incandescent Circuits.

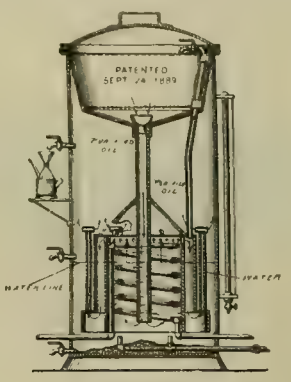
Simplicity of construction, efficiency in operation and cheapness are claimed for the incandescent double pole switch, shown in the accompanying cut. The illustration shows the contact bar resting on the insulated ratchets. To close the circuitit is only necessary to turn the handle to the right and the bar will climb the grade and take a horizontal position

SWITCH FOR INCANDESCENT CIRCUITS.

on the brushes fixed on both sides. A second turn gives an instantaneous break, the bar being thrown by the force of the spring about 3-16 of an inch. The ratchets are made of insulating material, as is also the block supporting the contact bars. Small slots cut sideways in the center block aid in throwing the contact bar of the ratchet the necessary distance. To convert the switch into a single pole switch it is only necessary to remove the outer contact brush. The device is made by the Illinois Electrical Material company, Chicago.

Oil Purifier.

The accompanying cut illustrates the Perfection oil purifier recently introduced by the Illinois Electrical Material company of Chicago. It is stated that this device serves for the storage



OIL PURIFIER.

of oil as well as purifying it, and that by adopting it oil tanks, cabinets, etc., may be discarded. The inventor also asserts that it will effect a considerable saving and relieve engineers of the work of cleaning oil tanks, etc.

Wood or Metal Poles for Electric Railways.

The introduction of electrically operated street cars in Rochester, N. Y., has raised the question of safety of steel and iron poles for supporting the trolley wires, and an interesting controversy is now in progress in that city. The original ordinance granting the company the right to change its system from horses to electricity, provided that iron poles should be erected in the business districts and wooden poles in residence portions of the town. This provision was opposed at the time by the superintendent of fire alarm, but his protest was not heeded. The question has again been raised by the application of the company for permission to erect steel poles on Lake avenue, one of the finest drives in the Flower city. This request was made on behalf of the taxpayers, who desired steel instead of wooden poles. The committee of electrical control, acting under instructions from Superintendent Barnes, advised the council to refuse the request. In a communication to the committee on this subject Superintendent Barnes says:

Accidents in the use of electricity, as in the use of everything else, are inevitable. It is our duty to insist that everyth'ng shall be done that can be to render the use of electricity harmless, especially as regards human life in the event of the occurring of an accident. If iron or steel poles are erected and used by the railroad company, and if an electric light wire should, by reason of a high wind or o herwise, break and fall upon any suspension, guy or other wire attached to an iron or steel pole, or come in contact with any iron or steel pole in any other manner, the inevitable result will be that the high current used in electric lighting will flow through the iron or steel pole with which contact is made, and any person touching such pole is almost certain to be killed. Of course, in the event of iron or steel poles being erected, there might be no fatal accident in Rochester for many years. The point that I make, however, is that when iron or steel poles are erected the conditions are all made perfect to cause fatal accident.

It is proper that I should call the attention of your committee to the fact that although, population being considered, there are more electric lights in Rochester than in any other city of the country, and although our streets have been lighted for more than ten years with the arc light system, we have failed thus far to have any fatal or serious accident caused by the electric current All of the wires erected and used by the various electric companies in this city have been erected and used under my supervision. In other cities fatal or serious accidents caused by the arc light current have been more or less numerous. I believe these facts give me the right to claim that these suggestions which I have made with reference to the manner of putting up the system of wires now in use have been valuable.

When the matter came up for consideration in the council, a resolution was presented, providing that wooden poles be used throughout the city, but it was not adopted, the aldermen dividing even on the subject.

It should be borne in mind that there is no question as to the safety of the current used in the street car systems, and it would seem that, with proper construction, there should be no danger from contact with other wires.

The committee on electrical control after the

meeting of the council granted the street car company the right to erect steel poles on Lake avenue. As the company has 500 steel poles on hand the work will be pushed ahead immediately, and the officers say cars will be running on this line within three weeks. This will complete the line from the center of the city to Ontario Beach, a distance of about ten miles. A generator will be placed temporarily in the Brush company's station at the lower falls, and current will be supplied from this point for the operation of the line until the company's permanent power house at Center street is completed.

National Electric Light Association.

Appended is a list of topics prepared by the committee on papers of the National Electric Light association for the convention at Cape May August 19th. The name following the topic is that of the member who has been asked to prepare a paper or open the discussion on the subject. The list follows:

Electrical Industries and the World's Columbian Fair—J. P. Barrett, Chicago

Electric Light as Supplied to Steam Railroads—W. H. Markland, Altoona, Pa.

Standard of Economy in the Generation of Power and Steam Under Best Conditions—Editor of *Power-Steam*, New York.

Triple Expansion High Speed Engines for Central Station Work—E. F. Williams, Beloit, Wis.

The Model Boiler-Room and the Duties of a Fireman—Jarvis B. Edson, New York.

Ferranti Station, London, Eng.—Caryl Haskings, Lynn, Mass.

The Proper Care and Management of Alternating Currents—T Carpenter Smith, Philadelphia.

Distribution of Energy by Alternating Currents and Transformers, and the Proper Method of Proportioning Conductors—A. H. Rohrer, Lynn, Mass.

The Proper Basis for Determining Electric Motor Rates—H. L. Lufkin, New York.

Actual Cost of Furnishing Arc Lighting (1,200 Candle Power and 2,000 Candle Power Lamps) Under the Best Possible Conditions—J. C. Ayer, St. Louis.

Municipal Ownership of Electric Lighting Plants—M. J. Francisco, Rutland, Vt.

Accidents in Electric Lighting Stations and Plants—Prof. Charles R Cross, Boston.

Care and Labor in Electric Light Stations, and Its Value—A. J. DeCamp, Philadelphia.

How Can the National Electric Light Association Best Serve the Interests of Central Station Companies?—C. R. Huntley, Buffalo, N. Y.

The reports of the following committees will be considered by the convention:

Committee on National Insurance Rules, George Cutter, chairman; Committee on Electrical Data, A. J. DeCamp, chairman; Committee on Copper Tariff, Charles A. Brown, chairman; Committee on Underground Conduits and Conductors, Joseph E. Lockwood, chairman; Committee on Revision of Constitution, M. J. Francisco, chairman; National Committee on Legislation, Allen R. Foote, chairman; Committee on Relations between Manufacturing and Central Station Companies, Marsden J. Perry, chairman; Executive Committee, C. H. Huntley, chairman; Finance Committee, John A Seely; Secretary and Treasurer's Report, Allen R. Foote.

At each session of the convention a call will be made for the proposal of questions and for the introduction of resolutions to be considered at subsequent sessions.

Members desiring to take part in the discussion of any subject stated or proposed, who send their names to the secretary previous to the time appointed for its consideration, will be called upon by the president, and be given time before the subject is opened to the convention. By this means every member can secure recognition and time to express his views fully on any subject that may come before the convention.

An announcement of an order of proceedings will be made for each day on the preceding day. The subjects and reports will be taken up in the order there named, and will be held under consideration until finished. Each afternoon session will be prolonged until the calendar for the day has been cleared.

Secretary Foote has prepared a neat little hand-book for the use of visitors to the convention. It contains information about Cape May, time tables, lists of the officers of the association, etc.

Giles, Bro. & Co. of Chicago, have designed a neat little button for members of the association. It is a solid gold front and hard enamel. The design represents four of the electrical fields of usefulness.

It will be of special interest to all those at the convention to learn that the 12th annual Rhode Island clam dinner, tendered to the electrical fraternity by the American Electrical Works of Providence, R. I., will take place at the Vue de l'eau Club on Saturday, August 23d. Lunch is set for 11-30, A. M., and the clam bake opens at 3 P. M. The reception committee comprises Marsden J. Perry, Providence; J. J. Carty, New York; Henry B. Cram, Boston; John I. Sabin, San Francisco; E. B. Baker, New Haven and W. H. Sawyer, Providence.

Victory for the Brush Electric Company in its Double Carbon Lamp Suit.

Below will be found the full text of the decision of Judge Brown of the United States Circuit Court in the case of the Brush Electric company against the Western Electric Light and Power company of Toledo, and others. The suit was instituted to secure an injunction restraining the defendant from using an arc lamp manufactured by the Western Electric company of Chicago, alleged to be an infringement of the plaintiff's patent for a double carbon arc lamp, issued to Charles F. Brush in 1879. The case was argued in the first part of July before Judges Brown and Ricks. The decision of the court is in favor of the plaintiff, an injunction being granted. Judge Brown's opinion with which Judge Ricks concurs, is as follows:

This was a bill in equity to recover damages for the infringement of letters patent No. 219,208, issued September 2, 1879, to Charles F. Brush for an electric lamp. In the introduction to his specifications he states that his invention relates to electric lamps or light regulators; and it consists:

1. In a lamp having two or more sets of carbons adapted by any suitable means to burn successively, that is, one set after another.

2. In a lamp having two or more sets of carbons, each set adapted to move independently in burning and feeding.

3. In a lamp having two or more sets of carbons, adapted each to have independent movements, and each operated and influenced by the same electric current.

4. In a lamp having two or more sets of carbons, said carbons, by any suitable means, being adapted to be separated dissimultaneously, whereby the voltaic arc between but in a single set of carbons is produced.

5. Is immaterial.

To effect this result, he employs and shows a system of mechanism, of which a lifter "D" is a prominent feature. This lifter has a movement imparted to it by magnetic attraction due to the current operating the lamp and in being raised, lifts the upper or positive carbon of each set, not simultaneously, but one after the other, in such manner that the arc is formed between carbons last separated, which burn until they are consumed, when the carbon first raised is automatically lowered and the arc formed between the carbons first separated, which also burns until these are consumed. By multiplying the sets of carbons, this process may be continued until the last ones are consumed and the light thus indefinitely prolonged. While this mechanism is elaborately explained and described, the patentee is careful not to limit himself to that or any other, and in his specification says expressly, "I do not in any degree limit myself to any specific method or mechanism for lifting, moving or separating the carbon points or their holders, so long as the peculiar functions and results hereinafter to be specified shall be accomplished."

The claims alleged to be infringed were the first six, which are as follows:

1. In an electric lamp, two or more pairs or sets of carbons, in combination with mechanism constructed to separate said pairs dissimultaneously or successively, "substantially as described and for the purpose specified."

2. In an electric lamp two or more pairs or sets of carbons in combination with mechanism constructed to separate said pairs dissimultaneously or successively, and establish the electric light between the members of but one pair (to wit, the pair last separated), while the members of the remaining pair or pairs are maintained in a separated relation, substantially as shown.

3. In an electric lamp having more than one pair or sets of carbons, the combination with said carbon sets or pairs of mechanism constructed to impart to them independent and dissimultaneously separating and feeding movements, whereby the electric light will be established between the members of but one of said pairs or sets at a time, while the members of the remaining pair or pairs are maintained in a separated relation, substantially as shown.

4. In a single electric lamp, two or more pairs or sets of carbons all placed in circuit, so that when their members are in contact, the current may pass freely through all said pairs alike in combination with mechanism constructed to separate said pairs dissimultaneously or successively, substantially as and for the purpose shown.

5. In an electric lamp wherein more than one set of pair of carbons are employed, the lifter, 'D,' or its equivalent, moved by any suitable means and constructed to act upon said carbons or carbon holders dissimultaneously or successively, substantially as and for the purpose shown.

6 In an electric lamp whereby more than one pair or set of carbons are employed, a clamp, C, or its equivalent, for each pair or set, said clamp C adapted to grasp and move said carbons or carbon holders dissimultaneously or successively, substantially as and for the purpose shown.

Complainant was the assignee of this patent from Brush. The answer set up several patents, which were claimed to be anticipations, and denied infringement in general terms. The case was argued before Judge Ricks of the Northern District of Ohio, and Judge Brown of the Eastern District of Michigan. L. L. Leggett and H. A. Seymour for the complainant; John W. Munday, Ephraim Banning, George P. Barton, for the defendants.

The progress of the art of electrical illumination has been marked by successive and well defined steps from the early experiments of Sir Humphrey Davy in 1810 to its present perfected condition. Sir Humphrey seems to have succeeded, with the aid of a galvanic battery of 2,000 cells, in producing an arc-shaped light between two pencils of charcoal, but owing to the rapid combustion of his charcoal points, to the want of proper mechanism for adjusting his electrodes to compensate for wear, and to the great cost of his battery, his experiments were of no practical or commercial value. The first of these obstacles was removed in 1844 by Foucault who substituted for the soft charcoal points of Davy the hard gas carbon electrodes now in use; the second in 1848 by Archereau, who devised an imperfect and clumsy regulating device, by which two vertical carbon electrodes were maintained in the same relative position, notwithstanding their combustion; and the last in 1870 by the invention of the dynamo-electric machine of Gramme, wherein a current of sufficient strength to render electric lighting commercially practicable, is generated at a comparatively small expense. These discoveries and in particular the dynamo of Gramme opened up to electrical experimentalists new and unsuspected possibilities of usefulness, and henceforward inventions multiplied with great rapidity. Most of them, however, were directed to improvements in the material of which the carbons were made; in the brilliancy and steadiness of the light itself; to improvements upon the dynamos, and in the mechanism by which the carbons were held in the same relative position during the process of combustion. One difficulty, however, remained to be overcome The electrical resistance of the carbons was such as to preclude the employment of very long rods and their consumption by burning away was hastened by their adjacent ends becoming highly heated to a considerable distance from the arc. This difficulty was partially remedied by covering the carbon pencils with a thin film of copper, electrically deposited thereon, by which the electrical resistance of the carbons was materially decreased; much longer rods were possible and the light maintained continuously for from six to ten hours. This was insufficient, however, for all night lighting and necessitated the extinguishment of the lamp and a renewal of the carbons at some time during the night, in order to keep up a continuous light.

To obviate this inconvenience Mr. Brush invented the device embodied in the patent in suit, the most prominent feature of which is the use of double sets of carbons in such manner that when the first pair is consumed, the arc is automatically established between the second pair, and is continued until they are consumed. This is accomplished by the use of certain helices, "E" which when the current is turned on, are energized and operated to raise a lifter "D." This lifter acting upon two ring clamps CC, surrounding the carbon holders tilts them and causes them to clamp and lift the two carbon holders DD, not at exactly the same instant, but in a quick but perceptible succession; whereby the arc is established between the pair last separated and held there until they are consumed: (the first pair being meanwhile retained in their position) when the first pair automatically descend and take their place. By this means, a steady light can be kept up without any manual interference whatever for a period of from 14 to 20 hours. This was certainly an important discovery and even if his patent be not pioneer in the strict sense of the term, it is such a decided step in advance of anything which preceded it that defendants' experts, Warner and Kellogg, are constrained to admit, not only that Brush was the first to invent the principle of substitution in his double carbon lamp, but that the Western Electric company could not successfully compete with the companies using his patent in furnishing all night electric lighting plants unless it could provide double carbon lamps to its customers. Such being the undisputed facts we think that complainant is entitled to the favorable consideration of the court, and his patent to a liberal construction—a construction, which so far as consonant with the language the patentee has himself chosen, will protect him in what he has actually invented.

None of the devices set up in the answer contain the principle of the Brush patent; none of them are even worthy of being considered as anticipations except the American patents to Day of 1874, Nos. 147,827 and 156,015 and the French patent to Denayrouse of 1877, No. 3,170. The Day patents upon which defendants chiefly rely as an anticipation of the Brush patent as construed by the complainant, exhibit a single carbon lamp, having two carbons instead of one, attached to each carbon holder, so that in the operation of the lamp both branches of the carbon holder are raised and lowered *simultaneously*. While the upper and lower carbons are in contact the current is divided between them; but when separated to form the arc, though the separation of both sets occurs at the same instant, owing to the difference in resistance of the carbons, only a single arc is formed. When this arc has burned for a few minutes the arc will shift to the other pair of carbons, remaining until they are so far consumed as to require additional feeding when the arc is shifted back to the first pair, and they are thus caused to burn alternately instead of successively, as in the Brush patent.

This alternation is of course owing to the fact that both sets of carbons are separated *simultaneously* and not in succession as in the Brush patent, in which one is held in reserve until the first pair is wholly consumed. The Day lamp, however, not only lacks the non-coincidence in the separation of the carbons which is the prominent feature of the Brush patent, but in practice it never seems to have been a success. The shifting of the light from one pair of carbons to the other took place every few minutes and was attended

each time by a momentary extinguishment of the light, which occurred so frequently that it was not considered of any commercial value; and during the 16 years it has been in existence but two lamps seem ever to have been constructed in accordance with the patent, one of which was tested in 1879 and proved a failure, and the other of which was made in 1887 for the purpose of being used as an exhibit in this case. Not only was the light fluctuating and unsteady, but the idle pair of carbons so near the pair in operation threw a broad shadow back of them, which was transferred from one side of the lamp to the other as the arc shifted and seriously impaired the commercial value of the lamp.

The French patent of Denayrouse, it is true, contained the principal feature of the Brush patent in the successive combustion of two pairs of carbons, but by means so different that they can by no stretch of construction be regarded as mechanical equivalents. The invention has no application to carbons placed end to end as in the American patents, but to those lying side by side as in the patent of Jablochkoff, who appears to have originated this arrangement. It is in fact a duplication of the Jablochkoff candle with the addition of "an electric key for making and breaking contact with the electric current for each such candle. This key is worked by one arm of a lever, the other arm of which has a stud pressed by a spring against the candle which is burning near its lower end. When this candle is burned nearly down so that the stud of the lever is no longer supported by the solid matter of the candle or carbon, the lever and key are moved by the spring, and contact is thus broken with the circuit for the nearly consumed candle and is made with the circuit for a fresh candle, which is thereby kindled, and thus successively as candle after candle becomes consumed, fresh candles are kindled automatically to take their place." But as this patent is not seriously claimed as an anticipation, no further reference to it will be made. The main questions in this case turn upon the proper construction of the Brush patent. While the claims are undoubtedly broad, they ought not to be interpreted as for a function or result, since there is nothing novel in substituting one pair of carbons for another and thus securing a successive combustion of two or more pairs. It was done long before the Brush patent and may still be done by manual interference, by replacing one set of carbons with another, or by any mechanism which does not involve the dissimultaneous and dissimultaneously separating and feeding movement. What the claims purport to cover are briefly all forms of mechanism constructed to separate the two or more pairs or sets of carbons dissimultaneously (a word coined for the occasion, but readily understood) or successively in order that the light may be established between the members of but one pair or set at a time, while members of the remaining pair are maintained in a separate relation. It is claimed by the defendant, however, that the words "dissimultaneously or successively" contained in the first six claims of the patent refer only to the exact instant, the very *punctum temporis*, of the separation of the carbons; and that as the Scribner patent under which the defendants are operating, provides for the initial simultaneous separation of the carbons, there is no infringement though the light is formed between but one pair, the other being held in reserve to await their consumption. If this contention be correct, then it necessarily follows that Brush, who is acknowledged to be the actual inventor of the double carbon, and whom defendants' expert, Mr. Lockwood, frankly admits (p. 243) to be justly regarded as having done more than any one else to make electric arc lighting on a large scale a practical success, secured by his patent the mere shade of an idea—a wholly immaterial and useless feature, abandoning to the world all that was really valuable in his invention. In determining the proper construction of his claims, two considerations ought to be kept prominently in view: 1st, the declared object of the inventor; 2d, the state of the art.

1. That he intended to secure for himself all he now claims is evident upon the most cursory reading of his patent. In the introduction to his specifications he says that his invention consists "First, in a lamp having two or more sets of carbons adapted, by any suitable means, to burn successively, that is, one set after another. Second, in a lamp having two or more sets of carbons, each set adapted to move independently in burning and feeding; third, in a lamp having two or more sets of carbons, adapted each to have independent movements and each operated and influenced by the same electric current. Fourth, in a lamp having two or more sets of carbons, adapted each to have independent movements, and each operated and influenced by the same electric current, said carbons, by any suitable means, being adapted to being separated dissumultaneously, whereby the voltaic arc between a single set of carbons is produced,"—this last clause apparently for the very purpose of removing any doubt as to the object of the non-coincident separations of the carbons. Again he says, "I do not in any degree limit myself to any specific method or mechanism for lifting, moving or separating the carbon points or their holders, so long as the peculiar *functions and results* hereinafter to be specified shall be accomplished. * * * This function of dissimultaneous action upon the carbons or their holders, whereby one set of carbons shall be separated in advance of the other, constitutes the principal and most important feature of my present invention." These peculiar *functions and results* are subsequently described as follows: "One pair is separated before the other, it matters not how little nor how short a time before. This separation breaks the current at that point, and the electric current is now passing through the unseparated pair of carbons, A^1, and now when the lifter, continuing to rise, separates these points the voltaic arc will be established between them and the light thus produced." "It will be apparent by the foregoing that it is impossible that both pair of carbons, A A^1 should burn at once. This function, so far as I am aware, has never been accomplished by any previous invention, and by thus being able to burn independently and one at a time two or more carbons in a single lamp, it is evident that a light may be constantly maintained for a prolonged period without replacing the carbons or other manual interference." This function is again restated in the second and third claims. It would seem that no language could make the object of the inventor clearer than that which he has chosen.

2. A reference to the state of the art, as already shown, demonstrates that Brush was a pioneer in this branch of electrical construction. As an experienced electrician it could hardly have escaped his attention that it is practically impossible with the most delicate adjustment of mechanism to keep up with the same current of electricity, two distinct voltaic arcs for any length of time, owing to the inevitably different resistance of the two sets of carbons. If there had been any doubt upon that point, a reference to the Day patents would have solved it. These patents exhibit two pairs of carbons separated apparently simultaneously, but as the patentee states, "The current selects the route offering the least resistance, and, therefore, follows that pair of carbons in closest impact. When the points are separated, it continues to follow the same pair until the distance between them, resulting from waste, is too great, when the current weakens or breaks. * * * The current chooses another pair of carbons, the magnets come into play, and the light is re-established." Indeed, it is quite apparent from all the experiments connected with the arc lighting that the establishment of the arc between one pair of carbons, instead of both, was not necessarily due to the initial non-coincidence in the separation of the carbons, but also to the different powers of resistance of different carbons of low resistance, which seems inevitable, however delicately the mechanism be made or adjusted. In this view it is difficult to see what object Brush could have had in patenting this feature, and we think, therefore, that the word "dissimultaneous" used in his claims should be construed as referring to that separation which results in the production of a single arc.

It is argued, however, by the defendants that while the claims originally presented by Brush were broad enough to cover the feature of the successive burning of the two pairs of carbons, that these claims having been rejected as functional, he subsequently accepted narrower claims, and that, under the familiar principle that a patentee, who has once acquiesced in the rejection of a claim cannot thereafter claim it by construction, applies in this case. If the premises be true, the conclusion is undoubtedly correct. The specifications were originally filed May 15, 1879, and the first three claims were rejected as "too broad or functional," but no objection was made to the fourth. These claims were again presented with a very slight and immaterial change, and were again rejected July 8th, as "not materially changed." This called forth a protest from the patentee, who reformed his claims, but says in his letter that "these claims, being fully as broad as any yet presented, we anticipate the same objection and will therefore endeavor to show wherein the examiner has erred." He then enlarges upon the importance of the invention, denies that the claims are too broad or functional, states that his invention is a principle or method of moving the carbons in a double carbon lamp, and that "to prolong the time that any electric lamp will continue its light without any manual interference or attention, is a vitally important matter," and urges the allowance of the claims. The new claims were presented July 14th and 16th apparently in person and the patent was allowed on the following day. On comparing the claims as originally presented with those finally allowed, we find the changes to be of little consequence. The first claim was changed only by erasing the words "Whereby the voltaic arc is established between the members of but a single pair, to-wit: the pair last separated," but as these words are substantially contained in the second and third claims, the change was not an abandonment of this feature. Certainly the first claim is no narrower than it was before. In the second original claim the words "Each pair or set adapted to have independent separating and feeding movements," are erased, and the words "In combination with mechanism constructed to separate said pairs dissimultaneously or successively" substituted, but with words added showing the object to be "to establish the electric light between the members of but one pair." In the third claim the word "dissimultaneous" is combined both with "separating" and "feeding" movements indicating very clearly the object of the patentee. But it is quite unnecessary to analyze these claims at length. Taken in connection with the correspondence they show that the examiner yielded to the views of the patentee, and allowed the claims in such terms as to express his theory of the invention.

In the view we have taken of the proper construction of this patent the question of infringement presents no difficulty. The defendant company admits that it used in Toledo in the course of its business for the purpose of commercial lighting a number of double carbon lamps similar to the complainant's exhibit, "defendant's lamp," but insists that such exhibit has been injured or changed by the twisting of the lifting lever and the bending of the clutch lever, so that it is in an abnormal condition. This exhibit shows a complicated piece of mechanism, by means of which the electric current entering the lamp is divided—a portion being used to energize two magnets, AA, the object of which is, through a system of levers, to raise the two carbon rods. When the arc is established between one pair of these carbons, the other is lifted, and held in reserve by a retaining magnet until the first pair is consumed. In this exhibit there is a perceptible dissimultaneous initial separation of the two pairs of carbons, and hence an infringement of complainant's lamp, even according to the narrow interpretation put upon it by the defendants; but it is insisted that this is an accident in the construction or use of this particular lamp. The testimony of Mr. Nolen, however, a witness for the complainant, shows that in February, 1887, he examined a lamp at defendant's station in Toledo similar to complainant's exhibit, "defendant's lamp," and that the mechanism was such that one of the carbons was raised a little before the other, and that he noticed about eighteen other similar lamps in operation in Toledo. Mr. Adams, another witness, swears that he visited Toledo the following year, and saw these lamps, and that all he observed were burning on the same side; that the next morning he looked at the same lamps and always found the burned out pair of carbons upon one side, and the other only partially consumed, and that upon manual manipulation of some of these lamps, one or two separated their carbons with a visible want of coincidence. This is certainly strong evidence to indicate a purpose on the part of the designer or the manufacturer of these lamps, that the separation of the carbons should be simultaneous. This testimony, however, is denied by defendant's witness, Warner, who examined the same lamps, and found but two in which the separation did not take place simultaneously, which he judged to be due to rough handling by those having charge of them. We do not care, however, to discuss this testimony at length, or to dispose of this case upon the theory that defendants have made use of a few lamps which in practical operation, may have separated their carbons dissimultaneously, and thus have infringed the Brush patent upon defendants' own interpretation of it.

The Scribner lamp which defendants are using undoubtedly contemplates an initial simultaneous or coincident separation of the two pairs of carbons, and in this particular differs from the Brush patent. They are alike, however, in the vital feature that the final or arc-forming separation is dissimultaneous, and in the total consumption of one pair of carbons before the other. In the Brush patent the order of combustion is predetermined by the initial non-coincidence of the separation; in the Scribner patent it is a matter of chance depending upon the relative resisting power of the two carbons or of the retaining magnets which is at first consumed; in other words, the non-coincidence is a function of both patents, but in one it is a matter of calculation, and in the other a matter of accident. Undoubtedly if the Scribner patent had preceded that of Brush, the latter would have to be limited to the initial non-coincidence of separation; but as it precedes the other, we think it entitled to a liberal interpretation. If we are correct in this view, then as the Scribner patent contemplates a dissimultaneous arc-forming separation by mechanism, certainly not radically different from that of Brush, we are constrained to hold it an infringement. It is unnecessary to go into the details of the Scribner device, so long as by mechanism it accomplishes automatically the function of the Brush patent. We think the language of the Supreme Court in the case of the Morley Sewing Machine Co. vs. Lancaster, is applicable to this patent: "He was not a mere improver upon a prior machine which was capable of accomplishing the same general result, in which case his claim would properly receive a narrower interpretation. This principle is well settled in the patent law both in this country and in England. Where an invention is one of a primary character, and mechanical functions performed by the machine are, as a whole, entirely new, all subsequent machines which employ substantially the same means to accomplish the same results are infringements, although the subsequent machines may contain improvements in separate mechanisms which go to make up the machine."

We should have felt fully justified in disposing of this case by a simple reference to the opinion of Judge Gresham in the Brush Electric company vs. The Ft. Wayne Electric Light Co., in which the same construction was placed upon the Brush patent, but in view of the importance of the questions involved, and of the elaborate preparation of counsel, we have deemed it proper to give it an independent consideration.

We are clearly of opinion that complainant is entitled to relief in this case, and a decree will, therefore, be entered for an injunction, and the usual reference to a master to assess and report its damages.

The expense involved in the transfer of the telephone lines at Omaha, Neb., in order to avoid disturbance from the electric railway circuits will probably result in extended and costly litigation. The telephone company is compelled to introduce complete metallic circuits. About $10,000 have been expended in this manner already, and the bills for repairs have always been presented to the motor company. Now Farnam and Harney streets are to be equipped and additional expense must be incurred. The matter is to be formally brought to the attention of the courts forthwith.

CORRESPONDENCE.

New York Notes.

NEW YORK, Aug 15.—The electric light is slowly gaining ground even in the city of New York, although its struggle for existence against the prejudices and marked opposition of the Gas Commission is a fierce one. Electric light companies, in order to serve the public, are compelled to furnish electricity for street lighting at a loss. East River park after much discussion will be lighted by electricity, and the necessary poles are being placed in position. Fourteen electric lamps are deemed sufficient to light all parts of the park, and will be located mostly on the water front plaza. It will not be necessary to advertise for bids as the amount is under $1,000, by which a saving of time and trouble is gained. The Harlem Lighting company, whose plant is situated near the park, will undoubtedly furnish the electricity.

From the communication of the Steam Heating company to Commissioner Gilroy in answer to his letter of arraignment, it would seem that the company has an ironclad franchise, by virtue of which it will extend its system under the protest of the Department of Public Works. It claims that "the power of the municipal authorities over the mains in connection with the New York Steam Heating company terminated when the resolution was adopted by the common council, and their consent to lay pipes and mains cannot, therefore be recalled. The whole authority has passed from the municipal authorities, and is subject to only such regulations as may be prescribed by the state through the legislature, from whom the company has obtained its corporate existence and powers."

This communication of thirty-four pages rebukes the commissioner for getting in the way and interfering in a matter in which no department of city government has the right to interfere. It blames him for not granting the permits to open the streets, saying: "In but one instance has this company ever made an opening in the streets of this city without a permit from your department, and this was through misapprehension. Recently you have refused these permits and at the same time you insist upon 'an unequivocal statement and explanation as to the neglect of the steam company to properly restore and repair the pavements in certain places.' This is pure and simple child's play. If there are any pavements imperfect, the fault is wholly yours in refusing to grant us necessary permits, and until you remove this fault, the blame must rest with you." The commissioner confesses his inability to cope with the question, and says, "That there is but one department that can take summary action with these people, and for some reason or other that department refuses to do so. The Health Department could effectually squelch this nuisance and put a stop to all these abuses and high-handed outrages. This is the only way I can see through the difficulty. I receive piles of letters every day complaining of foul odors and steam leaks. Yet I am powerless to act. I send all complaints to the Board of Health."

The death of the Hon. Samuel B. H. Vance, president of the Mitchell Vance company, occurred last Sunday at his summer home on Long Island. Flags were displayed at half mast on the city hall in recognition of the death of an ex-president of the board of aldermen and mayor of the city.

Mr. Vance was born in the Keystone State 76 years ago, but for more than half a century he had been a resident and actively identified with the affairs of New York. He engaged in his first important business enterprise in 1854, when he became a member of the firm of Mitchell, Vance & Co., which succeeded Hawart & Daily, who carried on an establishment for the manufacture of gas fixtures on the west side of Broadway, near Prince street. In 1873 the co-partnership was dissolved and the company incorporated, Mr. Vance assuming the position of vice-president. Later he became president. In his younger days Mr. Vance saw service in the war with Mexico as a captain of volunteers. He was for several terms a member of the board of education as school trustee of the fifteenth ward. Elected to the board of aldermen in 1872 as alderman at large, he was chosen president of the board January 7, 1873, and became mayor in December, 1874. Mr. Vance was a member of the Union League club and a trustee of the Roosevelt hospital.

Judge Beach of the Supreme court has denied the application of the North American Underground Telegraph & Electric company for an injunction restraining the Consolidated Telegraph & Electrical Subway company, and the New York Underground Telegraph company from using any subway system other than the Johnstone system. The complaint alleges that the plaintiff and the Consolidated company entered into a contract on March 8, 1888. This contract, says Judge Beach, gave the defendant the right to "adopt, use, and lay, so far as may be desirable and practicable," the Johnstone system. The judge holds that there is no stipulation in the agreement that the defendants shall exclusively use the plaintiff's system, but on the contrary the wording of the instrument seemsrather to give the defendants a right to limit the extent of the use according to their judgment upon the point of desirability and practicability. The right to an enforcement of such a covenant, even if in the contract, would be extremely doubtful in view of the powers of the Board of Electrical Control in regard to subway construction. The injunction would probably seriously retard and interfere with a public work prosecuted by the Board of Electrical Control under authority of the state. W. H.T.

Columbus, O.

COLUMBUS, Aug. 14.—The new Sprague electric railway in this city is not yet completed. Cars were to be running August 1, but generators and motors have just arrived. It is expected that cars will run by September 1st.

The Columbus Edison Electric Light company is putting in natural gas under its boilers. The Murphy smokeless furnace is used at present. It is also laying a new underground feeder to furnish light and power to the new buildings of the M. C. Lilley company. Current for 1,000 16-candle-power lamps will be supplied.

The Chittenden hotel of this city is being remodeled and enlarged, and will have an isolated plant of 600 incandescent lights.

A. W. Field, general manager of the Columbus Edison Electric Light company, is in New York this week. B.

Kansas City, Mo

KANSAS CITY, Aug. 14.—The West Side road in Kansas City, Kan., is at last started, a large force of men having been put on to the grade work last week. The contract has been let, $40,000 worth of steel rails have been purchased outright, and they will be on the ground within ten days. The route of the proposed road begins at Fifth street and Minnesota avenue, runs north on Fifth to State avenue, east on State to Third street, north on Third street to Greeley avenue, west on Greeley to Fourth street, north on Fourth to Haskell avenue, west on Haskell to Seventh street, south on Seventh street to Quindaro boulevard, west on Quindaro boulevard to Fifteenth street, and north on Fifteenth to Brown Park. Work was begun last week at Seventh street and Quindaro boulevard and the force employed will be largely increased at once. The fact that this company has gone out on Fifteenth street to Brown Park indicates that the Metropolitan Street Railway company has a voice in the councils of the West Side company's directory. The great Metropolitan system, whose arteries extend into every portion of the two Kansas Cities, has not one single park, and the route of the West Side road indicates without doubt the intention of the Metropolitan company to have a park larger than any in the two cities. The West Side Electric Railway company was originally chartered by James D. Husted and others, who, a few months ago, transferred it to a new organization headed by E. D. Brown. Gen. D. R. Cornell has been identified, to some extent, with the financial resources of the company, having negotiated the bonds on the road. D. W. Troup, a prominent capitalist of Kansas City, Kan., is vice-president.

One of the most important features of the Kaw river water power situation was developed last week when, the Argentine River Improvement company sold its right to drain the Kaw to the Inter-state Electric & Water Power company, of Kansas City, Kan. The power company is an organization of eighteen months' existence. The latter company was recently incorporated by local and Eastern capitalists, and has purchased a large tract of land near Muncie. The significance of this latest deal is wrapped up considerably in the Argentine company's charter under the state of Kansas. This company was granted the exclusive privilege to dam the Kaw, from its mouth to the city of Lawrence. The new company springing up found itself confronted with the fact that, although possessed of $1,000,000 capital, it could not, under any circumstances, dam the Kaw until a settlement could be made with the Argentine company.

A meeting of the local committee of the Old Time Telegraphers' association was held in the office of J. D. Cruise to perfect arrangements for the convention, Sept. 15 and 16, in this city. A committee was appointed to wait upon the several G. A. R. posts of the city and notify them of the approaching convention.

A large number of citizens along the Riverview branch of the elevated road advance a proposition that may result in the "L" road being turned into an electric line. No formal proposition has been made, but the company has been asked if it will consider a proposition, in the shape of a land and cash bonus, to run cars through from Chelsea park via the Riverview line to Eighth and Delaware streets. The company has not replied but will do so at an early date. Col. D. M. Edgerton, receiver, and Vice-President D. D. Hoag are now in New York City. While it is extensively rumored that their visit is for the purpose of determining upon this question, officers of the company here deny the report and state that the company is not considering any proposition on the subject. From Manager Stone it was learned that the company has figured on the possibility of using electric power, and has determined that $75,000 would effect the change of systems. He said it was known definitely that the road could be operated under the electric system much more cheaply, but he could not affirm a report to the effect that the change would be made. The Riverview citizens have figured extensively in the premises and have information at hand showing that the road bed will not have to be changed at all in order to undertake the new system. The worst grade is in the tunnel on Eighth street, where an 8.6 per cent. grade prevails. Practical demonstration, however, has been made to the effect that a car can be propelled over a 12 per cent. grade, so there are no insurmountable difficulties in the way of a change.

Henry Hafner, at last week's council meeting in Kansas City, Kan., petitioned for a franchise granting him the right to construct a single and double track electric street railway in that city. The route is similar to the one asked for by E. S. W. Drought, E. W. Towner and others last fall. It commences at Seventh street and Quindaro boulevard, runs south on Seventh to Walker avenue, to Eighth street, to State avenue, east to Fifth street, south to Ohio avenue, west to Seventh street, along Seventh street, Euclid and Cornell avenues and Seventh street to the viaduct; over the viaduct to Kansas avenue, down Kansas avenue to Packard street, north to Scott avenue, east on Scott street and over private property to Fourth street, north to Berger avenue, east on Berger avenue to Adams street extended. Hafner also agrees to pay the city $500 per annum for the use of the viaduct, and have the road in operation one year after the granting of the franchise. The whole matter was reported to the franchise committee. P.

Des Moines, Ia.

DES MOINES, August 14.—A new enterprise which is attracting much attention and favorable comment is the Des Moines Water Power company, of which Dr. E. T. Likes is president and C. K. Mead, formerly local manager of the Western Union Telephone company, is secretary and manager. It was organized last fall for the purpose of utilizing the power between the two banks of the Des Moines river, in the production of electricity for lighting, power and heating purposes. The company has a franchise permitting it to run its wires through any of the streets and alleys of the city and it is the intention of the company to place them all underground, the first application of the underground system in Iowa. Work was commenced last December upon the dam, which is now nearly completed. It is a substantial structure 460 feet in length, 28 feet wide, 5½ feet in width in the center and is made of cement rock. A power house will be located on each side of the river and five water wheels placed in position in each plant. They are special 66-inch wheels, weighing 10,000 pounds each which furnish 100-horse power, or 1,000 horse power in all. The company will build a large power building, space in which will be rented to small manufacturers desiring to use power furnished by the company. The new company promises also to give the city another electric street railway system. The principal stockholders in the power company now own and operate the Belt motor line and have the exclusive franchise to the streets of North Des Moines and a route into the city. It is reported that on the completion of the plant these lines will be operated by electricity.

The electric light plant in process of construction at Vinton was partially destroyed by fire last week. The loss falls upon contractor Smith and is quite heavy.

The Dubuque Street Railway company has been granted an electric light and power franchise by the city council.

The Keokuk street car companies are engaged in the same kind of a warfare as has been witnessed in other Iowa cities since electricity came into such common use. The horse car line is endeavoring to stop the progress of the electric system and contests over the occupancy of streets are of frequent occurrence. The electric company has the council and citizens with it, however, and is increasing its system rapidly.

One hundred 2,000-candle-power arc lights are to be placed upon the streets of Dubuque under a contract made by the council. The contract price is $75 per year per light.

Burlington is one of the last of the larger cities in Iowa

to grant a franchise to an electric railway company, but now indications are that the popular motive power will be in use in that city in a very short time. The city council granted a franchise to a company composed very largely of local capitalists some time ago, and the contract for the construction of about fifteen miles of road has been let. The electrical equipment has been awarded the Westinghouse Electrical & Manufacturing company. The first order for rolling stock has been placed and calls for twelve cars of the latest and best pattern. F. M. C.

Nashville, Tenn.

NASHVILLE Aug. 14.—It is boldly claimed by those interested that in point of the number, extent and importance of its electrical industries, Nashville is the fourth or fifth city in the United States, and that in the matter of its electric street car system it leads any other city in America. Detailed statistics to prove these claims will be made public as soon as the industrial census of the city, which is now being compiled by the government, is completed. The first wire strung in the city was the celebrated "O'Reilly's Line" of telegraph about forty years ago. The telephone came next, then the electric light, electric time, street cars, stationary motors in rapid succession. These, including the city wires for fire alarm, police call etc, have encumbered the streets with an unsightly mass of poles and wires that call for municipal control. Up to the present time the company that first entered a street strung its wires to suit its own convenience without regard to the rights or convenience of the companies that might follow, but recently the city has appointed an electrician to look after the wiring of streets and houses and this officer has made a long report to the board of public works and the council, pointing out the dangers and annoyances of a lack of system and recommending the enactment of certain ordinances giving the city power to control and regulate the entire matter of wiring he streets and houses.

A large force is still at work extending the tracks of the United Electric company, and as soon as four more new cars arrive this company will run through cars from the extreme east to the extreme west end of the city. The route for the through north and south line is not yet agreed upon.

Work is also progressing rapidly on the new lines of street roads.

The Capitol Electric company has a number of stationary motors in operation running fans and elevators They have proved so economical that the Presbyterian Publishing House has arranged with the company to put in a large motor to run its printing presses. Some novelties, among others a boot-blacking apparatus, are to be introduced soon. B.

Louisville, Ky.

LOUISVILLE, Aug. 14.—The poles for stringing the wires on the Fourth street electric line to the Jockey Club grounds are nearly all in position, and cars will be running within two months. The cars will probably connect at the Jockey Club grounds with a dummy line to Jacob Park which will run west to Seventh street and then out the Seventh street road to the park.

Poles are being placed along Market street the entire length and on Eighteenth and Shelby streets. The Market and Shelby electric line will extend from the south end of Shelby street to Market and then down Market to the Fountain Ferry road, some six or seven miles.

The Market and Eighteenth street line will be changed to the Market street and Parkland suburb line, the cars extending down Dumesnil, instead of stopping on Eighteenth street. The Parkland residents are delighted at the prospect of rapid transit throughout the day, as they now have to depend on steam cars running hourly before 10 o'clock in the morning and after 3 o'clock in the afternoon. The Second street line will also be equipped with electricity and all cars will run out as far as the House of Refuge. The Nineteenth and Bank street line will also be equipped at once, and after these lines the belt line, taking in Main, Fifth, Brook, Oak and Seventh streets. All the machinery and cars for these lines will be received within sixty days and the lines will be operated as soon as the tracks can be properly arranged, and the wires strung.

The line to Jacob Park from the Jockey Club connecting with Fourth street, according to Superintendent Hardin H. Littell, will be completed in ninety days, as little trouble is being experienced in getting the right of way. The necessary equipments have been ordered.

C. W. Tucker of this city, has brought suit against the Louisville Electric Light company and the Brush Electric Light company for $75,000. On the night of September 15, 1889, while the Bamberger-Bloom building was burning, he received an electric shock which he claims resulted in paralyzing his whole right side.

Last week, at Paducah, a telephone wire broke and fell across a trolley wire on the electric line, resulting in the burning out of the telephone system.

At Frankfort, Ky., the street car company which has been granted the right to use the streets, has contracted with a Nashville company to put in an electric line. The Thomson-Houston system will probably be used The company will begin work within ninety days and have the cars running before spring.

At Lexington one-half the electric railway system of the city will be in operation by the 15th inst., and the remainder by September 1. That portion to be first operated will include the lines that lead to the Agricultural & Merchandise Fair association grounds.

Catlettsburg, Ky., is to have its electric light plant enlarged and Flemingsburg is to have electric lights as soon as the plant can be put in. J. W. L.

Lincoln, Neb.

LINCOLN, Neb., August 14 —The line of electric street railway to be built north to the Episcopal college, will start from some central point in the city and run north on Twelfth street to the Episcopal college and from the college run one half mile east. The length of the line will be about five miles, about two miles of which is now being completed. The company was incorporated one year ago as the North Lincoln Street Railway, but amended articles will shortly be filed and a new name adopted, "The Lincoln City Electric Street Railway company." The electric equipment to be used is the Westinghouse overhead system. The order for the electric equipment was placed with the Westinghouse company some time ago and work on it has been in progress for about four weeks. The contract calls for the completion of the equipment and operation of the road by September 1.

The power house will be located at the knitting mills at Yolande place. With a little enlargement of the engine house there will be sufficient room to accommodate the plant. Here will be stationed a 100-horse power Corliss engine, and an 80-horse power dynamo. These have already been ordered with all other necessary apparatus for the plant. The contracts have also been let for the ties and rails for the balance of the track. The cars will come from Minneapolis, Messrs. Brace and Bush of the company are confident that the work will be completed by September 1 and trains running The distance from the site of the Episcopal college to O street is a little more than three miles, but with the electric motors this space will be covered in about fifteen minutes, so that a fine section of suburb will be close and convenient. The incorporators of this company are D. L. Brace, G. A. Bush, George E. Bigelow, C. T. Brown and L. C. Humphrey. The fact that they have at last assured an electric road, and the first one for Lincoln, will doubtless be something for which the people will give them full credit. F.

Pittsburg.

PITTSBURG, Pa., Aug. 16.—W. Y. Brady of this city has just finished an invention which he considers of much importance. He calls it "the adjustable life-saving guards for street cars," and it consists of a series of pliable bars covered with leather and resting on iron shoes which, when lowered, will run close to the ground and receive any impediment in the path of the car. Mr. Brady thinks his device is worthy the attention of all rapid transit people. Of course, he does not claim it would prevent accident; he only sets forth that its use would render accident less likely to terminate seriously.

Street railway projects are legion in and around Pittsburg at the present time. One of the latest schemes is an electric railway to parallel the Pennsylvania railroad from East Liberty to Braddock. It is not to be supposed that the Pennsylvania railroad will stand supinely by and allow this proposed railway to become a reality, hence the prospects for war are first-class. The public would probably be well satisfied to have the new line, regardless of the fact that the railroad people are giving fair accommodations between Braddock and Liberty.

Reynoldton, Pa., a close neighbor of McKeesport, Western Pennsylvania's biggest borough, will soon be nightly brightened by electricity. The Enterprise Light, Power and Heat company has been formed at McKeesport and will set about the erection of a central station building immediately. Reynoldton is a big town, and the capitalists who are interested in the new company have their wits about them.

The Standard Underground cable people of this city say they were never so busy as just at this moment. They are shipping a big lot of goods to Minneapolis now, and the metropolis has called upon them for a large quantity of wire. They hope to get into their new plant at Brinton in the course of a few months, as their present facilities are inadequate.

The Troy Hill Electric Railway company of Allegheny, wants the city authorities to give it the right to build an electric railway line to tap the populous Troy Hill district. The city will probably look with favor upon the application. At present the residents of Troy Hill are not blessed with rapid transit facilities.

Washington, Pa., will have a new electric street railway in the near future. The Washington Electric Street Railway company, which has been owned by outsiders until recently, is now in possession of local people. The company's capital stock is $60,000.

For theater lighting electricity is "the thing." Mr. Charles L. Davis, widely known as "Alvin Joslin," appreciates this fact. Mr. Davis is interested in a new theater at Pittsburg, and he has contracted for a first-class electric lighting outfit to be placed in his establishment.

The power house of the recently organized Birmingham Traction company, a corporation which has decided to adopt the electric motor system on its street car lines, is to be one of the finest buildings of the kind in this part of the country.

The building is to be erected at the corner of Carson and Thirtieth streets, South side. It will be of brick, with stone trimmings. The system to be adopted by the company has not yet been decided upon, although it is certain that the overhead wire method will be used. The boiler house, directly back of the power house, will be 116 by 50 feet, and back of that will be located a machine shop where the company intends to do its own repairing, covering 100 square feet of ground. On the left of the power house, the company is erecting a mammoth car shed.

The Hon. C. W. Robison, a well-known local politician, told a story a few days ago well worth repeating, inasmuch as it illustrates how much the value of street railway charters has risen lately. Several years ago Mr. Robison secured a charter for a cross town street railroad in Allegheny City. He held the charter, but did nothing further to develop it, nor did he ask councils for the right of way of the streets which the charter intimated would be traversed by the contemplated line. Some time ago, however, the Pleasant Valley Electric Railway company, having extended most of its lines, thought it would be a good thing if Mr. Robison's charter could be obtained, and overtures were at once made to that gentleman with the view of purchasing it from him. Mr. Robison, who had almost forgotten about his charter, was glad to find a buyer and when he was offered $5,000 for it he gave it up with alacrity. How great was his surprise, however, when the Pittsburg and Manchester company came to him a few days later and offered him not $5,000 but $50,000 for the charter. Of course Mr. Robison was sorry he had sold so quickly but it could not be helped. Still it made him think that his charter might have brought a good deal more money than he got for it. His surprise, however, became much greater when a few days ago the Pleasant Valley people put an appraised value of $200,000 on that charter.

E. H. H.

Cleveland, O.

CLEVELAND, O., Aug. 14.—S. D. Nesmith, manager of he Cleveland office of the Edison United Electric company, has placed a search lamp on the steamer Progress, plying between Ashtabula, O., and Escanaba, Mich. The search lamp has been found quite serviceable in detecting shoals.

The Cleveland Construction company has been re organized, with C. W. Foote of the Sprague company, H. H. Hosford of the Western Consolidated Dynamo & Motor company and Christy Bros. of Akron, O., as active members.

The electric road project of Sandusky has been abandoned.

There is a scheme on foot in Cincinnati, to move canal boats by the overhead trolley system.

H. B. Spiegle has organized the Euclid Avenue Electrical company.

The electric road up Hamilton Pike to College Hill and Mt. Healthy, suburbs of Cincinnati, will be undertaken as soon as the right of way is settled.

The Garden street or Central avenue electric line will be in operation by November 1.

The Short palace cars have made their appearance on the streets.

The trailers on "Tom Johnson's" lines are being provided with wire bars to prevent persons from getting on the wrong side. R.

THE ELECTRIC LIGHT.

The Selma, Ala., Electric Light & Gas company contemplates the introduction of the incandescent system.

The Sedalia, Mo., Electric Light and Power company has increased its capital stock from $80,000 to $120,000.

J. A. Hart and others, Chattanooga, Tenn., have incorporated the Farrell Electric Light, Heat & Steam company.

The Brunswick, Ga., Light & Water company has put in a new 125-horse power boiler at its electric light works.

The Central Electric company, now organizing at Lexington, Ky., will operate the electric light plant at that place.

The erection of an electric light plant at Mammoth Springs, Ark., is projected. A company has already been started.

The Dallas, Tex., Electric Light company contemplates changing its lighting system to the Wood arc light, putting in new dynamos, etc.

W. J. Stowers, M. D. Shelby, W. D. DeLong and others have received a charter to erect an electric light plant at Merrillton, Ark.

C. A. Waller, A. H. Benners, Charles Stollenweick and others have organized a stock company to erect an electric light plant at Greensboro, Ala.

It is proposed by the city of Toronto to introduce 1,000 arc lamps for street illumination. The saving in this department due to this change, would be about $53,000 per year it is estimated.

A special election was held in Slater, Mo., last week for the purpose of authorizing the city council to erect or purchase an electric light plant at a cost of $7,750 and issue bonds therefor. The proposition was carried by a vote of 278 to 32.

The Media, Pa., Electric Light, Heat & Power company has a fifteen hundred Westinghouse alternate current plant and is now ordering an additional five hundred-light machine, with a view to keeping up with the demands of its customers.

An ordinance has been introduced in the St. Louis city council, granting to the Consumers' Gas & Electric Light Supply company the right to build, operate and maintain gas plants and electric light plants, and lay its pipes and wires along and under the streets.

The Calumet Gas company of South Chicago, is enlarging its works to an extent that it will increase its capacity threefold. In connection with the gas works two brick buildings, one 75 by 100 and one 40 by 130 feet, are being built for an electric light plant. Both arc and incandescent lamps will be furnished.

For some time there has been quite a fight going on in Boonville, Mo., between the gas people and those who favored electric light, and last week a victory was scored for the electric light people. The council has ordered the gas company to discontinue lighting the streets and instead of gas lamps, twenty arc lights are now burning.

The Allentown Electric Light and Power company, Allentown, Pa., which for some time has been using the Westinghouse alternate current system of incandescent lighting, has just placed an order with the Westinghouse company for another machine, it being found necessary to increase the capacity of the plant to 2,000 lights.

Many of the occupations which had formerly to be suspended when the shades of night fell can now be carried on effectually by the use of the electric light. Not long ago a large horse sale was conducted at night by the electric light at a New York horse market. The points of the animals were seen as distinctly as in the daytime, and the purchasers appreciated the cool evening breezes which blew through the building.

When the spirit of progress strikes a town it is not long content without an electric light plant. Electric illumination is deemed a necessity wherever commercial activity is found. The South, as everybody knows, is developing rapidly at the present time and consequently in that region there is large demand for electric lighting apparatus. The Westinghouse Electric Manufacturing company has recently closed contracts for plants in three Georgia towns, Valcosta, Washington and Waycross.

The electric light is being turned to very artistic use by a prominent wall paper manufacturer of New York. The dark, clear-cut shadows caused by the play of the electric light among the foliage of trees have often been remarked, and the gentleman in question has been for some time making, by means of photography, a series of records of these beautiful effects, which he intends to use in connection with his business. The collection is a valuable one, and some of the designs which have already been made from it are of exceptional merit.

A St. Louis paper says: "At the meeting of the Electric Lighting committee of the Board of Public Improvements yesterday, it was decided to recommend to the board that the resignation of E. V. Matlack, Inspector of City Lighting, be asked for. That recommendation will be made tomorrow. There is excellent authority for the assertion that Andrew O'Reilly, an electrical engineer, has been chosen as Matlack's successor. The present inspector has incurred the displeasure of the electric lighting companies and especially of their electrical expert representatives, and to this faction has been recently added the influence of some of the capitalists who are equipping street railroads with electric motors. They claim that he has been unnecessarily exacting in the matter of the location of poles and in other details. There is good ground for the statement that the Board of Public Improvements will to-morrow adopt the recommendation of its committee."

The Consumers' Gas company of Toronto, Canada, is fighting the introduction of incandescent electric lights. It announces that its former customers will be charged rental for motors if they put in electric light. This will hardly pay the gas company. A Canadian journal remarks: "A move of this kind might have succeeded in the early days of electric lighting, when the service was more or less liable to interruption, but now that it is practically continuous, and reserve machinery at hand to meet all conceivable emergencies, the position is different. Electric lighting is an infant industry just now, but a pretty healthy infant, and promising so rapidly to assume the proportions of a giant, that an attempt to crush the life out of it is not at all likely to succeed. Our friends of the Gas company should keep cool. There is plenty of room for them yet, and the biggest vacuity they have to fill is the room for improvement in the quality of their gas."

THE ELECTRIC MOTOR.

The Electric Street Railway company of West Bay City intends to extend its line on Midland street at once.

The General Electric company of Seattle, Wash., will enlarge its plant so as to furnish power as well as light.

Electric street cars are running at Hannibal, Mo. The regular operation of the line is meeting with much success.

The Covington (Ky.) Street Railroad company is considering the advisability of equipping its lines with electrical apparatus.

The Citizens' Railway company has purchased the Waco (Tex.) Street railway and is converting it into an electric railroad.

A syndicate has been negotiating for the purchase of the street railway lines of Raleigh, N. C., with a view of converting them into electric roads.

The West Lynchburg (Va.) Land company has awarded the contract for converting its street railway into an electric line to the American Development company.

Woodbridge & Turner have just commenced an extension of the electric railway at Chattanooga, Tenn., on East Ninth street. This new construction will extend one and a quarter miles.

The Moberly, Mo., city council has granted a 20 years' franchise to the Western Engineering company of Kansas City to construct and operate an electric street railway in Moberly, the work of construction to be begun in four months.

The initial steps have been taken to transfer the Transcontinental street car line of Portland, Ore., into an electric system. The system already includes 17 miles of track and numerous extensions are contemplated for an early day.

The Springfield, Mo., Electric Railway company has filed articles of incorporation with a capital of $100,000. The company proposes to put in twelve miles of electric railway here within the next three months. The Metropolitan is now putting in twenty miles also.

The entire property and franchise of the Hastings (Neb.) Improvement company has been sold for $50,000 to S. W. Hayden, a Hartford capitalist. Mr. Hayden, it is stated, will take immediate steps toward changing the most frequented lines from horse cars to the electric motor system. Important extensions of the lines will also be made, notably to the asylum and the Academy of the Visitation.

The street railway at Bridgeport, Conn., has been purchased by Arthur Leutchford, John N. Beckley, M. H. Briggs, William S. Kimball, C. M. Everest, A. G. Yates, A. E. Perkins, Frederick Cook, A. N. Perrin, of Rochester, N. Y.; S. H. Hubbard and C. A. Hotchkiss, Bridgeport; H. Sellers McKee, Pittsburg; M. A. Verner, Buffalo. The new owners of the line are interested in the development of the electric system and their new acquisition will undoubtedly be converted into an electric road.

The fight between the street railway companies in Milwaukee is becoming more interesting as well as complicated. After listening to arguments on behalf of the rival companies Mayor Peck signed the ordinance giving the Milwaukee & Whitefish Bay company a franchise on the disputed streets. Then the Cream City company promptly served the new company with an injunction restraining it from beginning work. The Milwaukee & Whitefish Bay company enjoined the Cream City company from continuing work.

The projectors of the Pennock primary battery have at last attracted attention on the other side of the pond and the London electricians are laughing at the claims they make for their device. Here is an extract from the *Electrical Review*: "The Chicago *Illustrated Century* devotes an article to seriously advocating the Pennock primary battery as a source of motive power for tramways. The inventor calculates that a ten-mile track with 15 cars on the overhead wire system costs $215,000, the storage battery method $200,000, cable $885,000, and the Pennock plan only a fifth of the electrical and one-twentieth of the mechanical systems mentioned. Our contemporary gravely states that Mr. Pennock, by his primary batteries, can do away with the necessity of accumulators, dynamos, overhead wires, etc., and yet run the cars at a mere fraction of their usual cost. Moreover, the speed and power attained is claimed to be far greater than with the steam engine, as will shortly be shown by a train to be run between Chicago and New York by the inventor himself. The Chicago *Illustrated Century* is just 100 years behind the times, and Mr. Pennock will have to add another century to his age before that train with primary batteries knocks out steam."

W. D. Robinson of Detroit, has caused a considerable stir in business circles of that city by the introduction in the council of petitions for a franchise for a very comprehensive system of rapid transit street railways. Mr. Robinson, and the gentlemen whom he represents, ask for the privilege of laying nine north and south lines of track and six cross town routes, extending across and completely encircling the city. The company, the personnel of which Mr. Robinson says will be disclosed when the franchise is granted, offers to deposit a certified check for $50,000 guaranteeing the following conditions: For a franchise of thirty years' duration they will put in any system the council may select, electricity or a continuous cable charge but one fare of three cents for any single trip not to exceed twenty miles; will pay a tax of one per cent. on their gross earnings in addition to paying municipal taxes upon all their real and personal property, the same as an individual, and will do all the paving within the limits of their tracks. In case a franchise is given the company will lay six miles of track within six months and twenty miles yearly until the whole fifty miles is constructed. Mr. Robinson denied that the Detroit City Railway company was in any manner interested in the franchise, but stated that it was the proposition of a number of Detroit and New York capitalists.

The employes of the Electric Railway company, Wichita, Kan., worked by electric light Saturday night, Aug. 9, and until 4 o'clock Sunday morning. The rush to have eight miles completed did not call for such diligent work, but the men concluded that they would not object to making one day in a night. The total mileage of the company is 9¼ miles, or more than the amount called for by the franchise up to this time. The company has been at work exactly four months, and the showing is a good one. The management has not only handled track construction, but also given attention to securing central station machinery and done considerable work in that department. The boilers are set in the new station, and some of the electrical machinery has arrived. A message to the president, J. O. Davidson, announces that eight of the car motors have been shipped from Boston. The cars equipped with motors on hand at present are not able to cover the mileage of the entire system. Taking in the tracks not removed, belonging to the lines before the consolidation, there are about 15 miles of track. The South Main line is about two miles long, but the connecting link on Main and Douglas has not been put in, and may not be for two or three days, as there are no cars to give the service. A car will make an occasional trip along the South Main line, to comply with the franchise and give no chance for any trouble.

THE TELEGRAPH.

Atlanta, Ga., has decided to bury its telephone wires and the city has given the local company until 1893 in which to comply with the order.

Telegraph service in the southern part of New York and Northern Pennsylvania was interrupted by electrical storms last week. Several houses were struck, and much damage done by lightning.

Operators employed by the Associated Press association are under instructions to learn to manipulate the keys of a type writer. The association has purchased a machine for each operator in its service, and there will soon be a double click at the receiving end of the line as messages are flashed over the wire.

A dispatch from St. Louis says: "The local management of the Western Union Telegraph company has compelled all its operators to sign an agreement not to speculate in grain or provisions, or place their money on sporting events. The company takes the position that speculation by operators on information obtained while working the wires is demoralizing to them and tends to unsettle the confidence of patrons in the security of the telegraph as a medium of confidential exchange between business-men."

Telegraph operators have many stirring experiences, especially those stationed at out-of-the-way railroad offices. One of the most sensational that has been related in some time though was that of Miss Ida Wakely, the night telegraph operator on the New York, Chicago and St. Louis road at Swanville, Pa. A few nights since a vicious looking tramp tried to open the door to the little station, and failing, appeared at the window and demanded admission. He was refused, and, procuring a large lump of coal, broke the window open. As he tried to enter the brave young lady drew a revolver on him and held him at bay while she quietly, with her other hand, called the operator at the next station and informed him of her situation. A train happened to be sidetracked at the station, and the engine was uncoupled, and, with the crew on board, started to the relief of the young woman. The tramp had drawn a knife and was still making ugly threats and was trying to induce the young woman to hand out the contents of the safe when the engine rounded a curve. The flash of the headlight frightened the would-be burglar away and he made his escape.

Miscellaneous Notes.

The California Electrical society is securing subscriptions for a library.

The Down Electric company, capital stock $10,000, has been formed at Chicago by J. A. Wenter, H. P. Williams and John M. Glen, to do general electrical construction work.

A company has been formed at Detroit, Mich., with a capital stock of $200,000, to manufacture batteries under patents granted recently to M. W. and M. F. Parish of Detroit. The officers of the company are Robert Mc-

Kinstry, president; Jas. A. Randall, vice president; A. A. Boutell, secretary, and M. L. Williams, treasurer.

The Eastern Kansas Telephone company of Garnett, Kan., has been incorporated with a capital stock of $10,000; directors, C. W. Chandler of Paola; M. L. White of Garnett; J. B. Rhodes of Colony; C. W. Singleton of Greeley; W. L. Cabot of Westphalia.

Personal Mention.

Henry H. Turner of the Gundlach Optical company, Rochester, N. Y., visited Chicago last week.

Business Mention.

H. A. Rogers, of 19 John street, New York City, is doing a good business in manufacturers', machinists' and electrical supplies of all kinds.

Chas. F. Gregory of Chicago, is now at the Cape May convention representing the Sperry company, and has a sample of the new triple carbon lamp on exhibition.

The Okonite company continues to report large orders. Now that its new factory at Passaic is completed it is doing a bigger business than ever, and the outlook for the future is most encouraging.

The Interior Conduit & Insulation company of New York, has just issued a new book of testimonials which it will be glad to furnish to all who will give them a call at the Convention at Cape May.

The Northwest Thomson-Houston company of St. Paul, Minn., is issuing a monthly which is entitled the *Electrical Northwest*. It is a handsome publication and it prints a considerable amount of well-selected electrical matter.

The New York Insulated Wire company has issued a pamphlet describing the wires and cables manufactured in its establishment. Formulæ, tables, and much other information valuable to the trade, is also contained in this unpretentious little document.

The Western Electric company of Chicago has just issued a new general catalogue. It is a volume of over 200 pages, and is profusely illustrated. The catalogue contains a general description of the immense amount of electrical apparatus manufactured by the company.

The new catalogue just out of the Connecticut Motor company contains, besides descriptions of its well-known motor, a set of equations by Albion T. Snell, which give "approximately the safe average output of dynamos and motors for continuous running." These equations will be valuable to those who have no technical electrical training.

The Abendroth & Root Manufacturing company, 28 Cliff street, New York City, find a good demand for its new water tube sectional safety boilers and its spiral riveted pipe. The new form of Root boiler is well adapted, and very popular for electric lighting and power stations, being a rapid steam generator, economical in the use of fuel and easily managed.

The Western Light & Power company of Chicago had considerable trouble with the bearings of an engine, which seemed to run hot all the time. After using the Magnolia metal, W. M. Talcott, the general manager of the company, wrote: "We have had the most excellent results from the use of your Magnolia metal, and could not ask for better service."

Managers and superintendents of electric light and power stations seem to have taken a decided fancy to the Davidson steam pump, manufactured by M. T. Davidson, 43-53 Keap street, Brooklyn, N. Y. The number of them in use for such service is rapidly increasing. The Davidson pump has many admirers too, among general manufacturers and mining men.

The Westinghouse alternate current incandescent system is being employed for central station lighting in every state and territory of the union with the exception of the state of Nevada and the territory of Arizona. In the state of Texas twenty lighting companies have seen fit to adopt the Westinghouse system. In Pennsylvania the Westinghouse stations number very nearly forty.

The Hazelton Tripod Boiler company, Chicago, has issued a neat catalogue containing a description of the apparatus. A large number of letters from well-known companies using the Hazelton boiler are presented. These testimonials corroborate the favorable statements made for the boiler, and show the favor in which it is held by those who have had practical experience with it.

At the World's Exposition in Paris in 1889, a prize medal was awarded to Messrs. Giles Bros. of Chicago, for their anti-magnetic shield for watches. A number of tests were made regarding the efficacy of these shields, and the most satisfactory results were obtained therefrom, and it was proved to be one of the best and most practical solutions of the trouble which electricians have with their watches.

The Weston Electrical company, of Newark, N. J., is putting the finishing touches on its new factory, and the four principal floors with their splendid array of fine tools make an imposing appearance. Superintendent Britton is delighted with his new charge, and promises the most accurate and finest finished ammeters and voltmeters in the world. He moreover says orders will be filled promptly hereafter, and no lay over as has often been the case in the past.

The Chalmers-Spence company, miners and manufacturers of asbestos, find its new offices and salesrooms, 59-61 Liberty street, New York, very commodious, and has now ample facilities to transact its rapidly growing business. The demand for its famous fire felt, and other asbestos pipe and boiler coverings continues at high water mark, as well as for its popular asbestos packings, sheathings and cements. The electrical fraternity are not one whit behind the other great industries in the appreciation of these standard goods.

The Electric Mutual Insurance company of Boston, Mass., writes: Will take the whole risk on stations at fair rates, and return the profits at the expiration of the policy. "It belongs to no boards," it writes. "It makes its own rates. All of its directors are prominent electric light men. It is the electrical industries' own company. It also insures lamps, converters, meters, etc., outside of the station."

The following announcement is made by the Edison Lamp company of Harrison, N. J., Francis R. Upton, general manager: "By an arrangement made with the Edison General Electric company, whose principal office is in the Edison building, Broad street, in the City of New York, the business heretofore conducted by us, will be done by and in the name of the Edison General Electric company. All future purchases for the works will be ordered and paid for by the Edison General Electric company."

Queen & Co. of Philadelphia report a steady and increasing demand for their specialties in test instruments. Their improved portable testing sets are meeting well deserved favor as new features of great value to electricians have been introduced. These sets are being made in large quantities to fill orders already received. The new Magnetic Vane ammeters and voltmeters as brought out by the same firm are much sought after, and are now in use by the Edison, Brush and Mather companies. Meters of special size and range will be made if desired. A large collection of instruments has been placed on exhibition at Cape May during the convention, by the firm.

The Electrician Time company, which was recently incorporated in Chicago by several of the leading electrical people, has opened offices in the Stock Exchange building, corner Monroe and Dearborn streets. The business of this corporation is to supply electricians and others with watches protected from magnetism by the Giles' anti-magnetic shield. They also furnish other reliable goods, such as jewelry, diamonds, silverware, etc., on time, when desired, or for cash. Mr. Bryson, the manager, was for a number of years connected with the firm of Giles Bro & Co. L. W. Collins, for the past year manager of the Chicago Electric club, has also associated himself with the company, and his large acquaintance among electrical people, gained during his service with the club, will make him a valuable addition to the staff. This company has recently issued a handsome two-page circular stating the object of its business, and accompanying it are a number of testimonials from some of the leading electrical and railroad people, testifying to the merits of the anti-magnetic shield. The circular is embellished with cuts of the new styles of watches and altogether presents a neat and attractive appearance.

Electrical Patents.

Issued Aug 12, 1890.

433,948. Electric Conductor Terminal. Charles A. Lieb, New York, N. Y.

433,981. Telephone. Edward Davis, Cambridge, Mass.

Claims one and two follow:

"1. In an electric telephone, the combination, with a resistance material, such as powdered carbon, a diaphragm in contact with the same, an electro magnet arranged in proximity to said diaphragm, so as to act upon it, an electric circuit containing a battery, the resistance-varying material, and the primary of an induction coil, of a main line, including the electro-magnet, the secondary of the induction coil, and a telephone receiver, said electro magnet diaphragm and resistance material being so arranged relatively that a current in the main line will produce a current of opposite polarity in the primary circuit of the induction coil.

"2. In an electric telephone with a mass of semi-conducting material, two conducting diaphragms confining said material, an electro-magnet arranged in proximity to one of the diaphragms, a circuit containing a battery, the semi-conducting material and the primary of an induction coil, of a main line, including the electro-magnet, the secondary of the induction coil, and a telephone receiver, the diaphragm opposite the one acted upon by the electro magnet, being arranged to receive and be acted upon by vibrations of the air."

434,007. Machine for Covering Insulated Conducting Wire with Lead. Lewis W. Tracy, New York, N. Y.

434,008. Machine for Covering Insulated Conducting Wire with Lead. Lewis W. Tracy, New York, N. Y.

434,011. Vertically-Adjustable Dynamo Support. Thos. Wrigley, Oak Park, Ill.

The last claim is given:

"2. A dynamo supporting device consisting of a lower or stationary frame provided with a series of vertically-screw-tapped boxes, of jack-screws engaging these boxes, of an upper frame having boxes engaging the upper ends of the jack screws, of sprocket wheels mounted upon the several jack-screws and being spanned by an endless link-belt, of a worm-wheel mounted upon one of the jack-screws, and of a worm engaging the worm-wheel, and being operated by a hand crank."

434,017. Method of Welding Metals by Electricity. Herbert E. Fowler, New Haven, Conn.

Claim three is as follows:

"The method of welding metals by the aid of electricity, which consists in holding the parts to be welded in contact and causing an electric current to traverse the joint, then cutting off the electric current and applying external heat and pressure and working the joint by rollers or hammers to complete the weld."

434,024. Electro-Therapeutic Appliance. Gustav Monrath and William M. Gibbons, Chicago, Ill.

434,030. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

434,032. Ammeter and Voltmeter. Gustav Pfannkuche, New York, N. Y.

434,034. Support for Car Motors. Sidney H. Short, Cleveland, O.

434,036. Trolley for Electric Railways. Joseph H. Wehrle, Newark, N. J.

434,038. Automatic Electric Lamp Hanger and Switch. Oscar B. White, Cleveland, O.

434,063. Brake Mechanism for Electric Street Cars. Joshua Illingworth and Amos M. Baker, Cleveland, Ohio.

434,076. Underground Electric Conduit. Franz G. C. Zopke, Berlin, Germany.

434,087. Electric Rail Connector. Charles A. Lieb, New York, N. Y.

434,093. Secondary Battery. Paul Schoop, Zurich, Switzerland.

434,095. Rotating Part of Dynamos and Motors. Elmer A. Sperry, Chicago, Ill.

434,097. Power Gearing for Vehicles. Elmer A. Sperry, Chicago, Ill.

434,098. Power Gearing for Vehicles. Elmer A. Sperry, Chicago, Ill.

434,133. Method of and Apparatus for Burning Holes in Metal. William P. Kookogey, Brooklyn, N. Y.

434,144. Electric Insulator. John K. Dunbar, Austin, Tex.

434,147. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

434,148. Electrically-Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa.

434,149. Cut-Out and Connection for Electrical Apparatus. Charles J. Klein, New York, N. Y.

434,151. Switch for Electric Circuits. Philip Lange, Pittsburg, and Oliver B. Shallenberger, Rochester, Pa.

434,152. Switch for Electric Circuits. Philip Lange, Pittsburg, Pa.

434,153. Incandescent Lamp Socket. Philip Lange, Pittsburg, Pa.

434,154. Electric Indicator. Philip Lange, Pittsburg, Pa.

434,159. Incandescent Electric Lamp. Albert L. Reinmann, Allegheny, Pa.

434,162. System of Electrical Distribution. Oliver B. Shallenberger, Rochester, and Henry M. Byllesby, Pittsburg, Pa.

434,163. Protector for Electric Machines. Lewis B. Stillwell, Pittsburg, Pa.

434,164. Core for Electrical Apparatus. Charles A. Terry, Pittsburg, Pa.

434,165. Subway for Electric Conductors. Geo. Westinghouse, Jr., Pittsburg, Pa.

434,166. Electric Arc Interrupter. Alexander Wurts, Pittsburg, Pa.

434,167. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

434,168. Safety Fuse for Electric Circuits. Alexander Wurts, Pittsburg, Pa.

434,169. Electric Safety Fuse Box. Alexander Wurts, Pittsburg, Pa.

434,170. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

434,175. Electric Arc Lamp. Wm. E. Cady, Corry, Pa.

434,180. Electric Motor. Theodore M. Foote, Boston, Mass.

434,181. Device for the Adjustment and Testing of Electric Cars. Theodore M. Foote, Boston, Mass.

434,199. Connector for Secondary Batteries. James K. Pumpelly, Chicago, Ill.

434,206. Armature for Dynamos. Albert Schmid, Allegheny, Pa.

434,224. Secondary Battery. Henry Woodward, Toronto, Canada.

434,261. Printing Telegraph. Theodore M. Foote, Boston, Mass.

434,264. Spring Motor for Cars. Albert F. George, Kansas City, Mo.

434,275. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

434,276. Current Collecting Device for Electric Cars. Rudolph M. Hunter, Philadelphia, Pa.

434,301. Method of Making Electrodes for Secondary Batteries. Paul Schoop, Zurich, Switzerland.

434,363. System of Transportation by Electricity in Mines. Elmer A. Sperry, Chicago, Ill.

434,371. Lightning Arrester. Alexander Wurts, Pittsburg, Pa.

434,376. Secondary Battery. George W. Cochran, New York, N. Y.

434,382. Electro-Magnetic Clutch. Stanley C. C. Currie, Philadelphia, Pa.

434,389. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

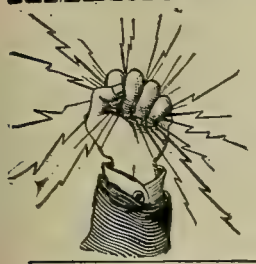
434,390. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

434,391. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

434,410. Closed Conduit for Electric Conductors. Chas. J. Van Depoele, Lynn, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

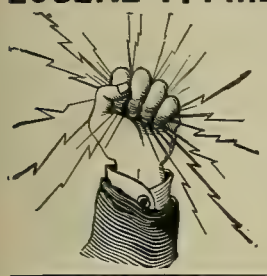
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

---

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

NOTICE

—TO—

Eletcric Light Contractors.

Office of the Clerk of the Village of Cambridge, Ohio.

Sealed proposals will be received at this office until Saturday, September 20th, 1890, at 12 o'clock M., for lighting the streets of said village with Electricity for a term of five years, according to specifications on file in this ofice. The right to reject any or all bids is reserved. Proposals must be sealed and endorsed Bids for Lighting the Streets of Cambridge, Ohio.

JOHN S. BLACK,

Village Clerk.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

WANTED.

Salesman at once for Electrical Supplies. Only first-class men need apply.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO., ST. PAUL, MINN.

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

THE TURNER BRASS WORKS
4 LASALLE AVE
MAKE ANYTHING IN BRASS.
CHICAGO.

WANTED.

At once, experienced armature winders. Best of reference required.

COLUMBIA ELECTRIC CO.,

207 E. Fourth St., ST. PAUL, MINN.

THE SUNBEAM

MAINTAINS ITS RATED CANDLE POWER.

SEND FOR PRICE LIST.

SUNBEAM INCANDESCENT LAMP CO.,

Corner Randolph and Canal Sts., CHICAGO, ILL.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

OKONITE TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

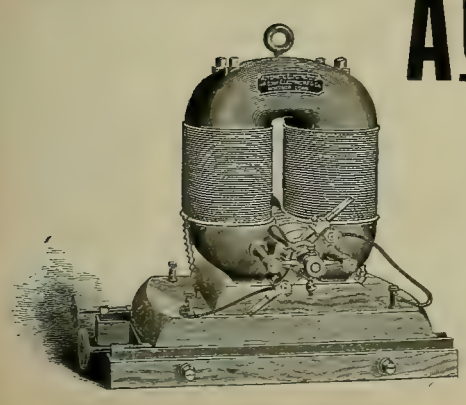
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: *NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.*

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 48c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FRANK T. BROWN, Late

PRINCIPAL EXAMINER ELECTRICITY,

U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental

MACHINERY.

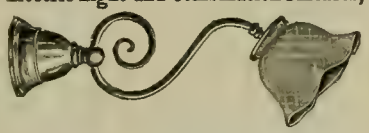
Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

Binders

FOR THE Western Electrician

$1.00.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

—— Electric Light and Street Railway Goods a Specialty. ——

SEND FOR CATALOGUE AND SPECIAL PRICES.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

PURDUE SCHOOL OF ELECTRICITY.

New laboratory, fitted with best appliances, dynamos, storage batteries, and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue.

PURDUE UNIVERSITY, La Fayette, Ind.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

THE ELECTRICIANS TIME CO. of CHICAGO,

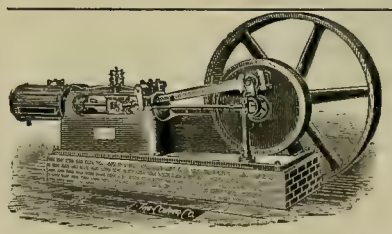
167 Dearborn Street.

WATCHES, DIAMONDS.

PRESENTATION GOODS.

All grades of watches from $10 to $500, protected against magnetism by the **PATENT ANTI-MAGNETIC SHIELD.**

—CORRESPONDENCE SOLICITED.



RICE AUTOMATIC ENGINES.

Simple, Compound, Compound-Condensing.

BOILERS,

HANCOCK INSPIRATORS, FEED WATER HEATERS, Etc.

We make a Specialty of Erecting Complete **Steam Plants.**

SMITH-VAILE STEAM PUMPS for every purpose.

FAIRBANKS, MORSE & CO.,

ST. LOUIS. **CHICAGO.** KANSAS CITY.
DENVER. OMAHA. ST. PAUL.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

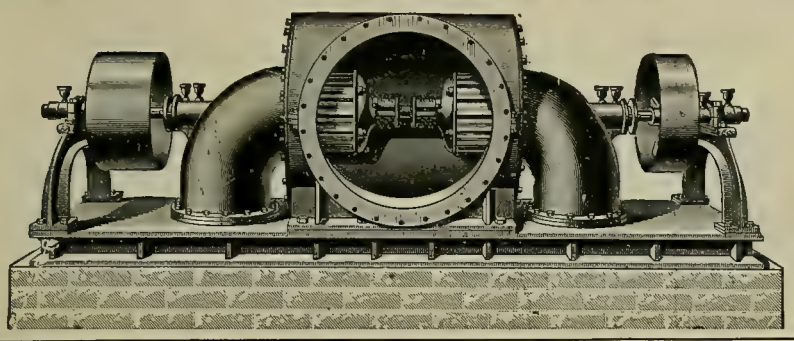
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its diameter, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use. we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ENGINES

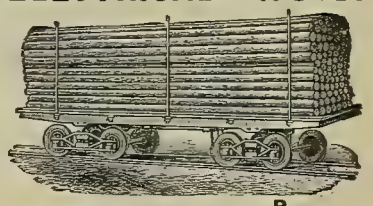
CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

ELECTRICAL WOOD.



Telegraph / Telephone / Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,
Room 410, Com'l Bld'g, St. Louis, Mo.

WILLIAM S. BATES,
PATENT LAWYER,
204 Dearborn Street, CHICAGO.
17 YEARS EXPERIENCE IN THE PATENT OFFICE AND THE COURTS.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,
Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

COLUMBIA
Incandescent Lamp Co.,
1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

WESTERN ELECTRIC CO,

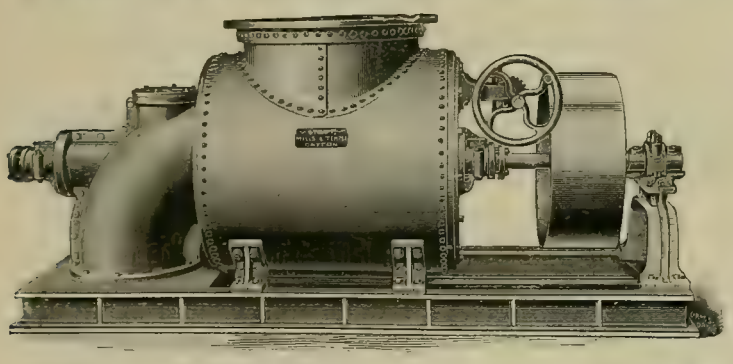
WE ARE THE EXCLUSIVE WESTERN AGENTS FOR THE SALE OF

A. G. DAY'S KERITE WIRES FOR TELEGRAPH, TELEPHONE, AND ELECTRIC LIGHT USE.

PRICES ON APPLICATION.

CHICAGO. NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its h'gh efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for New CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—The Armington & Sims Engine, Steel Boilers, Ireson Link Belt, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, Etc.

SEND FOR LATEST CATALOGUE.

LEVER UP—SHOWS OIL DROPPING.

LEVER DOWN—SHOWS OIL STOPPED.

POWELL'S PATENT IMPROVED SIGNAL OILERS

for DYNAMOS and HIGH SPEED ENGINES.

AUTOMATIC, UNIQUE STYLE, DURABLE, EFFICIENT. | EVERY OILER GUARANTEED.

Send for Special Circular and Price List. Address

THE WM. POWELL CO. CINCINNATI, O.

ADVANTAGES OF THE EVANS SYSTEM OF DRIVING DYNAMOS.

ECONOMY IN ROOM.

No loss of room by reason of long lines of belting. All the space is made available. More than double the number of dynamos can be put in the same space than by ordinary belting. In the erection of new stations, or the increase of old, an immense saving is realized.

EFFICIENCY.

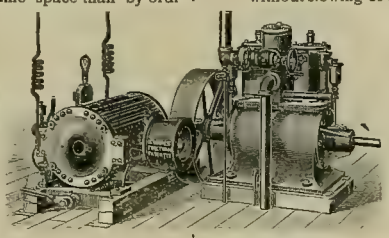
There is no slip. Consequently there is less loss of power in transmission, and a steady light is obtained. There is also less pressure on the bearings than by ordinary belting for the same amount of power.

SAVING IN BELTS.

Belts cost less than one-tenth of ordinary belts, and last over twice as long. The saving in belts alone nearly pays the royalty.

SIMPLICITY AND COMPACTNESS.

The dynamo pulley is placed in immediate contact with the driving pulley. No expensive clutches or complicated belt holders are necessary. The Evans Friction is a perfect clutch in itself.



PERFECT CONTROL.

Each and every dynamo can be stopped or started independently of every other without slowing or stopping the engine or other motive power.

FOR POWER GENERATORS.

Where the load is intermittent and subject to sudden changes, as in street railway work, the Evans Friction adapts itself promptly and effectively to the work without the "flop" or unsteady motion of ordinary belting.

CLEANLINESS.

The Evans System does away with long flying belts which carry a large amount of dust, and not only is the room cleaner but the bearings are freer from grit.

For SIMPLICITY, COMPACTNESS, ECONOMY, EFFICIENCY and CLEANLINESS, the EVANS SYSTEM surpasses anything yet devised for driving dynamos.

This Ad. will be changed Sept. 13.

Send for Catalogue "D" to ***The EVANS FRICTION CONE CO., 85 Water St., Boston.***

BERNSTEIN ELECTRIC CO.

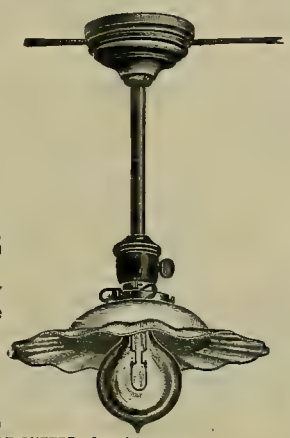
INCANDESCENT LAMPS

—FOR—

ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

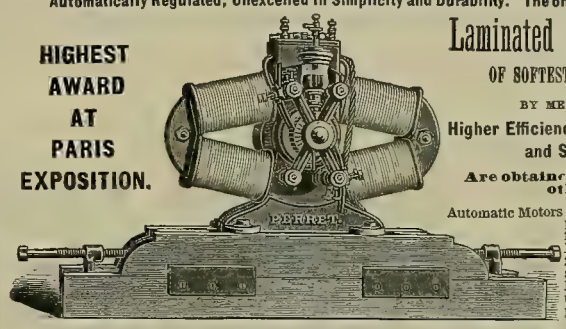
79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets

OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

INTERIOR CONDUIT AND INSULATION CO.

GENERAL OFFICES. 16 & 18 BROAD STREET

NEW YORK May 29/90

FACTORY. 154-156 WEST 27TH ST

Thomas A. Edison Esq
My Dr Edison

Are you to rewire your House today What system of wiring would you employ?

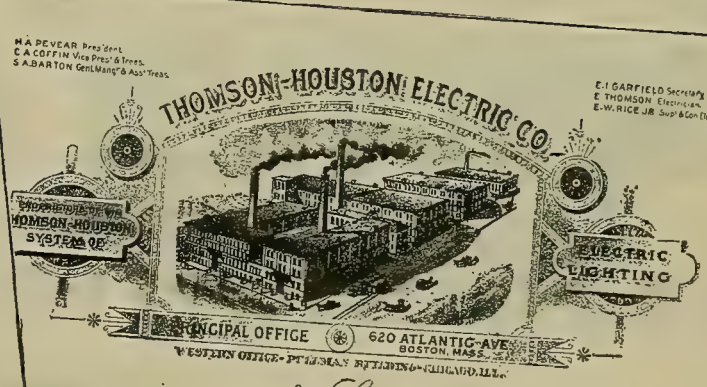
Yours Truly

Edw. H. Johnson

The Asphaltic paper tubes of the "Interior" Conduit Co

Thomas A. Edison

Orange N.J. May 30/90 -



Lynn, Mass. June 6, 1890. 189

Interior Conduit and Insulation Co.,

154 West 27th St., New York, N. Y.

Mr. Edw. H. Johnson,

Dear Sir:-

In reply to your letter of May 29th inquiring in relation to the system employed for introducing the wiring into my house, I take pleasure in saying that I consider the system the most perfect ever devised for interior wiring, and that it has been worked out practically in a very successful manner by your Company. The features of flexibility and security together with ease of repair are not the least of the points in its favor.

Yours very truly,

Elihu Thomson

THE BUTLER HARD RUBBER CO.

33 Mercer Street, NEW YORK,

MANUFACTURERS OF

HARD RUBBER GOODS

Of every description, including the celebrated ***HARD RUBBER BATTERY CELLS,*** manufactured under ***Kiel's Patents*** for ***Primary and Storage Batteries.*** The cheapest and best Cells in the market. Also ***Sheet, Rod and Tubing*** (Kiel's Patent) for electrical purposes, at reduced prices. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes, constantly on hand.

HARD RUBBER SPECIALTIES OF ALL KINDS MADE TO ORDER. SEND FOR PRICES AND ESTIMATES.

For Sale by CENTRAL ELECTRIC CO., Chicago, Ill.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD W LKINS

TRADING AS

PARTRICK & CARTER,

Manufacturers of and Dealers In Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

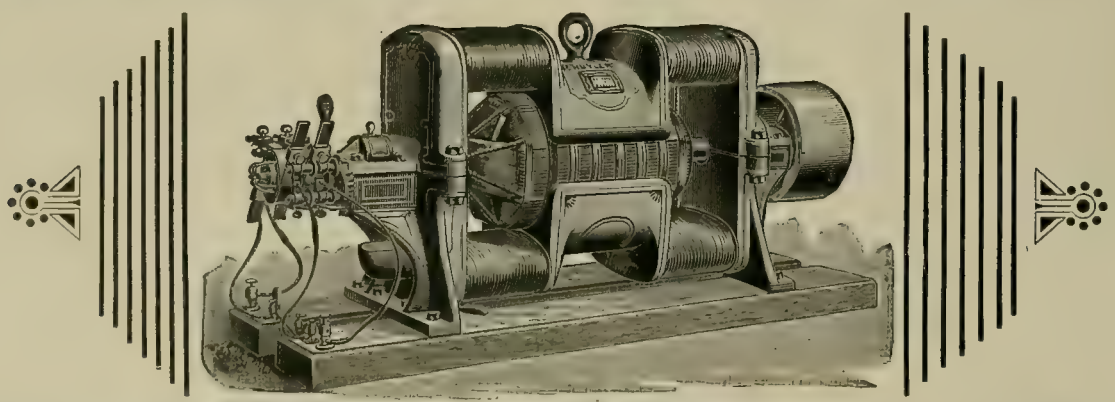
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



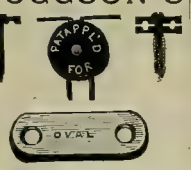
Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
— DOUBLE —
WINDOW SPRING
THE BEST.

THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S



Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

OKONITE
TRADE MARK.
WIRES, CABLES, TAPE and CORD
FOR PROMPT SHIPMENT.

HOGGSON'S
IMPROVED
Door Spring.

Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
—FOR—
ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT
IS MADE ONLY BY THE
Page Belting Company, Concord, N. H.
BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

WANTED.

A second-hand 2-horse power 210 volt incandescent motor. Address

"MOTOR,"
Care of WESTERN ELECTRICIAN.

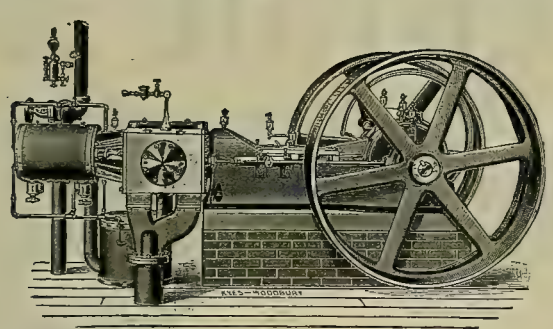
WANTED.

Man to take charge of Detail Department of Electrical Factory. Must be a good mechanic, and have had experience in managing men.

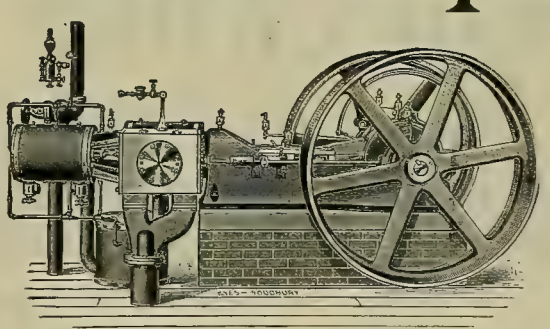
Applications should state experience and salary expected. Address MECHANIC,
Care of WESTERN ELECTRICIAN.

GEORGE P. BARTON,
LAW OFFICE,
225 DEARBORN STREET,
CHICAGO, ILL.
Patent and Trademark Cases.

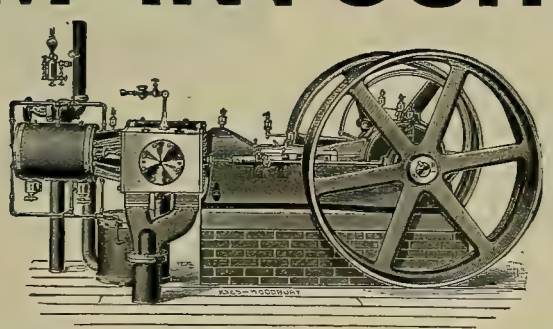
None so Good, None to Equal.



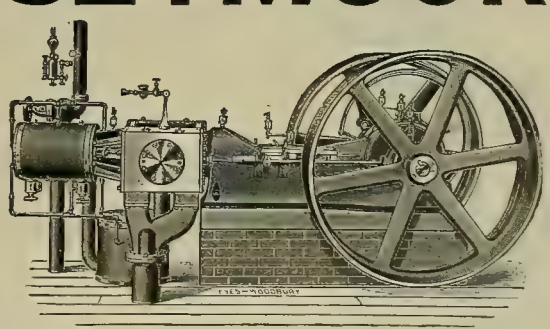
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

LEWISOHN BROS.,

81 and 83 Fulton St, NEW YORK.

SOLE AGENTS
Tamarack Osceola Copper Manufacturing Company,
DOLLAR BAY, MICH.

BARE COPPER WIRE

Guaranteed made from Best Lake Superior Copper.

HARD DRAWN WIRE

For Telephone and Electric Railway Use a Specialty.

Soft Annealed Wire for Electrical Purposes

C. B. HOLMES, Prest. & Genl. Mgr. G. W. GRIFFIN, Superintendent of Construction. WM. C. NICHOLS, Secretary & Treasurer.

The Hazelton Tripod Boiler

Is the quickest generator of steam,
Needs less repairs than any other, and
Is the most economical boiler in use.

ADDRESS
HAZELTON TRIPOD BOILER CO.,
170 TWENTY SECOND ST., CHICAGO, ILL.

OHIO STATE UNIVERSITY,

COLUMBUS, OHIO.
Civil, Mechanical, Mining and Electrical Engineering. SEND FOR INFORMATION.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

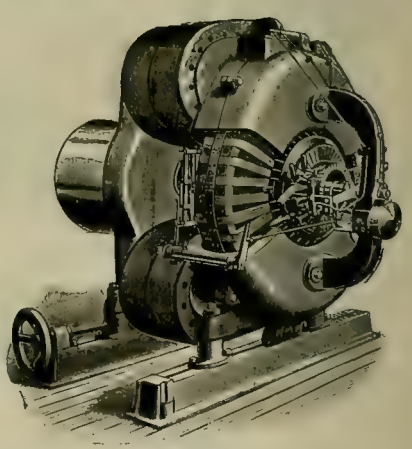
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

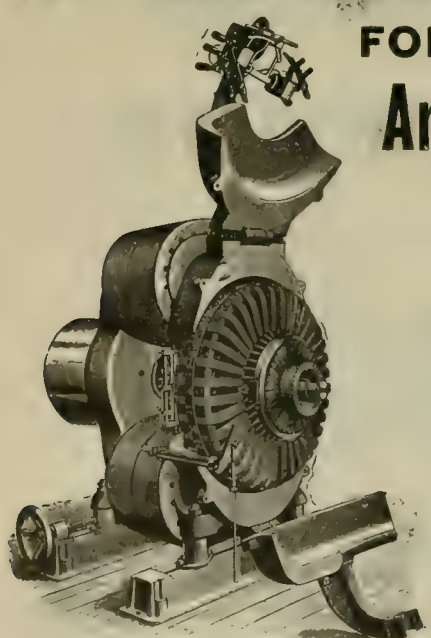
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

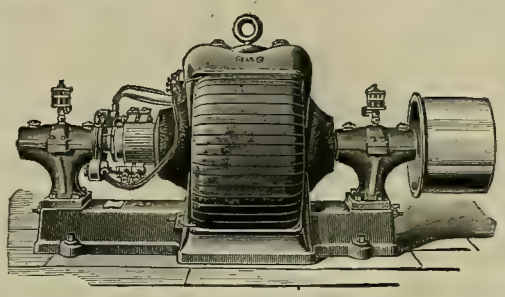
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

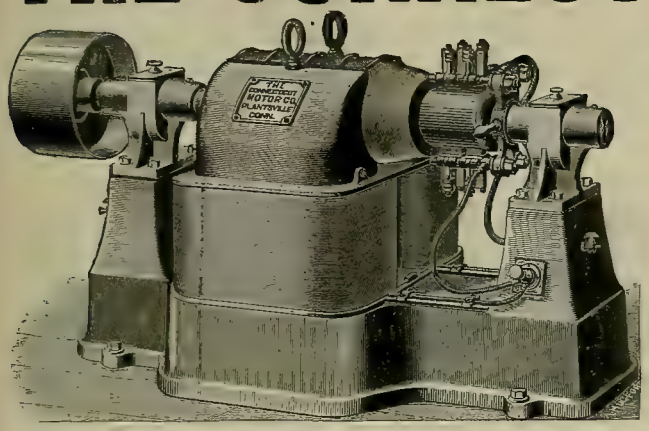
Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 N. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS

EDW. P. ALLIS & CO.,

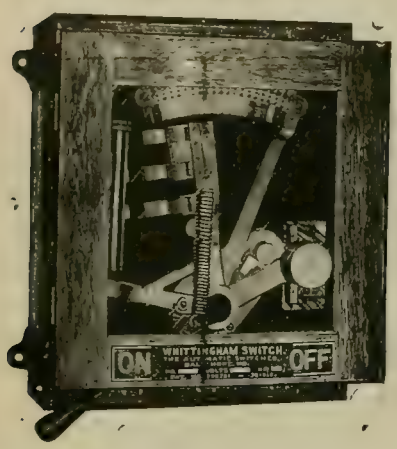
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

WHEN YOU BUY A MOTOR



From ANY Manufacturer or Dealer,

State that you WANT IT SUPPLIED WITH the

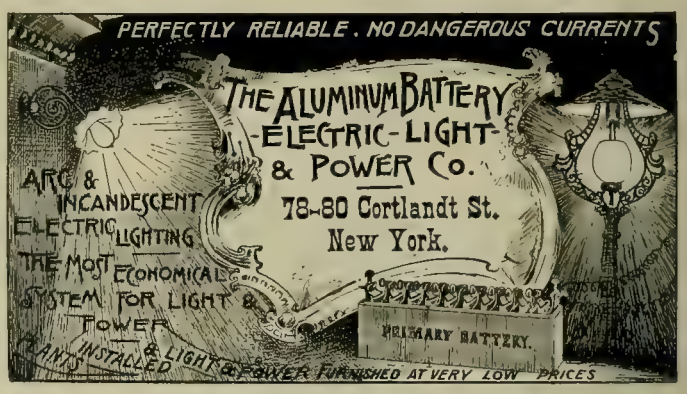
Whittingham Automatic Switch.

Send for Catalogue.

Automatic Switch Co.,

No. 8 Keyser Building,

BALTIMORE, MD.



W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't. J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

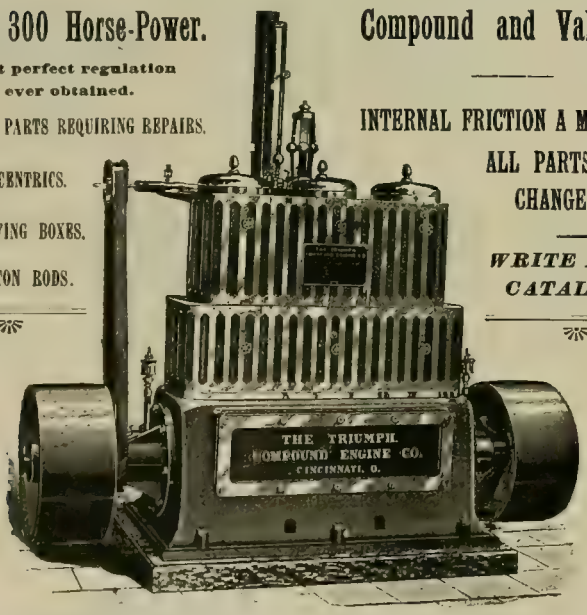
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

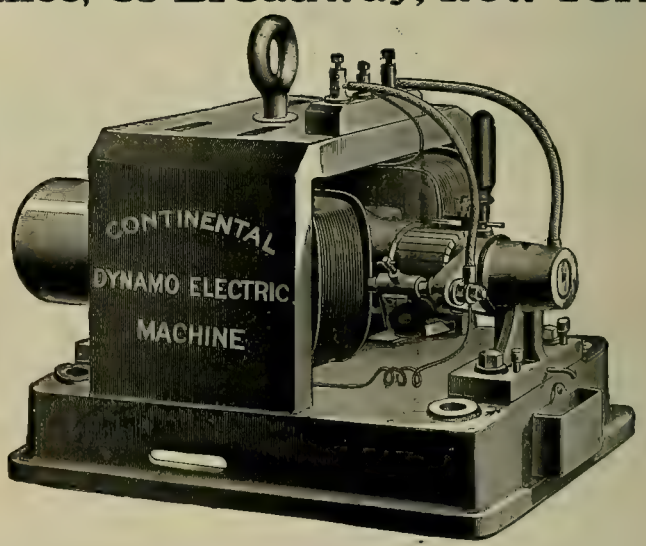
211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Baird, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

ARMATURES COMMUTATORS

REPAIRED and REWOUND

TRUED OR RENEWED

SPECIAL FACILITIES AND AGILITY

DUPLICATES OF ALL KINDS

GENERAL DYNAMO REPAIRING & JOBBING

The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

ANTIQUATED

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"TRIPLE" CARBON LAMP

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

Old Lamps of all Styles, Single or Double, can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

Send for further particulars to the

SPERRY ELECTRIC CO.,

195 to 207 Canal Street, - CHICAGO.

Leverly 1018 CHESTNUT ST., PHILA.

Leverly 1018 CHESTNUT ST., PHILA.

Electric Specialties to Contract.

General Electrical Supplies.

Leverly 1018 CHESTNUT ST., PHILA.

I AM WITH YOU!
"'TIS PITY 'TIS TRUE!"

Leverly 1018 CHESTNUT ST., PHILA.

W-A-T-C-H-E-S.

The World's Exposition in Paris, 1889, awarded a prize medal to The Giles Anti-Magnetic Shield for watches. It has been proven to be the best practical and permanent solution to the trouble electricians have with their watches.

The shield can be applied to any watch, or is furnished in new watches by

GILES BROS., - CHICAGO.

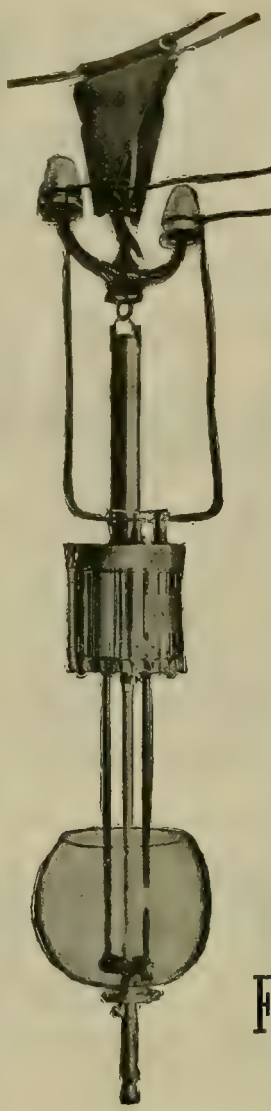
TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,

149 West 18th Street, - - NEW YORK.



THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

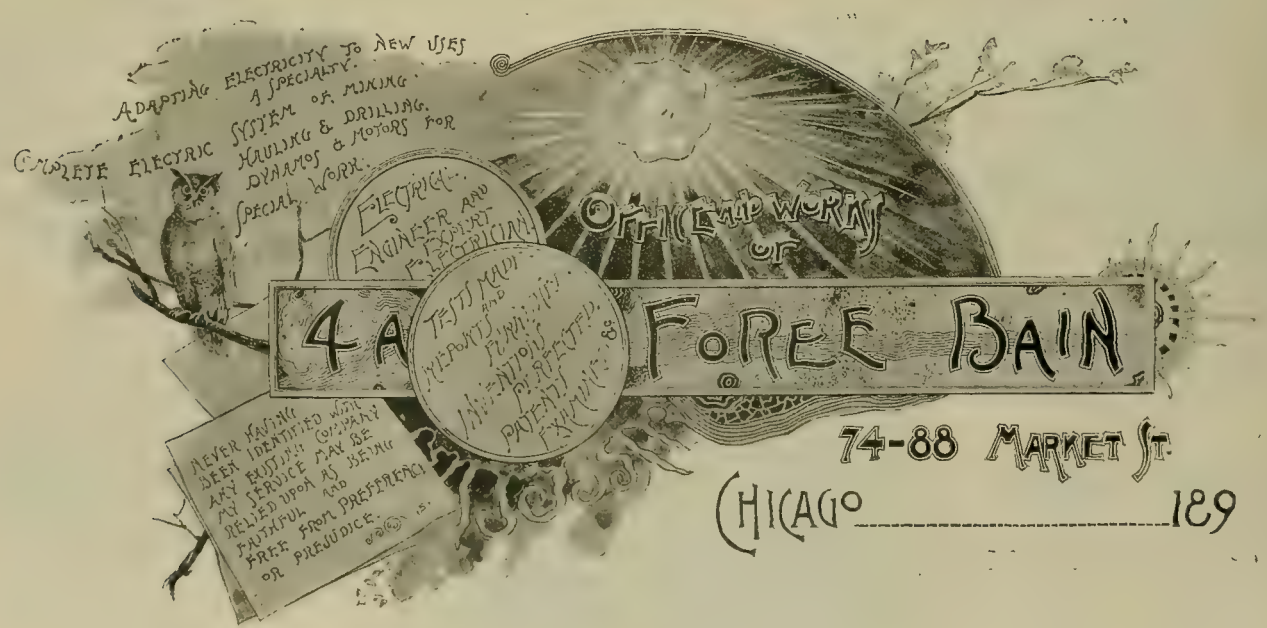
Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.



Electric Light Repairing.

SPECIAL DYNAMOS AND MOTORS,

From 1-200th to 300 H. P. built to order, 2 ozs. to 20 tons in weight, 2 Volts to 5000 Volts in E. M. F.

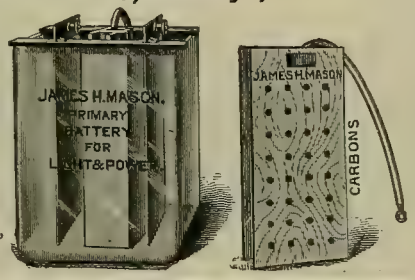
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



BARNES' NEW SENSITIVE DRILL

Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

Over 105 Roads operated under Our System, and that Successfully, both financially and electrically.

EDISON
GENERAL ELECTRIC
COMPANY,

Edison Building, 44 BROAD STREET,
NEW YORK CITY.

STREET ELECTRIC RAILWAYS.

Our Electric system for Street Railways has been found to be the most durable, reliable, economical and convenient.

New roads in course of construction going on in all parts of the country.

Railroad Managers and Others interested in this business are earnestly requested to correspond with us, to *get facts* and *data* showing the advantages and possibilities to be obtained by Electric Traction over any other existing methods.

DISTRICT OFFICES:

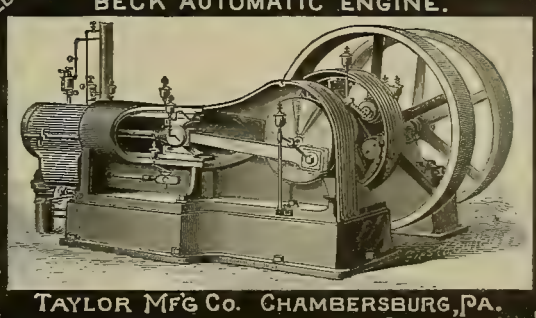
NEW YORK, Edison Building. CHICAGO, Rialto Building.
SAN FRANCISCO, Chronicle Building. NEW ORLEANS, Cotton Exchange.
PORTLAND, ORE., Washington Bldg. DENVER, Masonic Building.
TORONTO, CAN., Bank of Com. Building.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

C., B. & Q. R. R.
—IS THE—
Best Appointed Line
—FOR REACHING THE—
West, Northwest and Southwest.

MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.

ECONOMY UNEXCELLED
REGULATIONS PERFECT
HOT BEARINGS UNKNOWN
PRICES MODERATE



TAYLOR MFG CO. CHAMBERSBURG, PA.
COMPLETE STEAM PLANTS A SPECIALTY

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

o

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

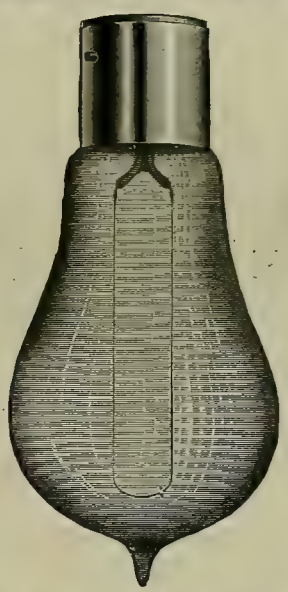
THE KNAPP ELECTRICAL WORKS.

General Western Agents,

—THE—

PERKINS ELECTRIC LAMP CO.

TO FIT ANY SOCKET,
ALL CANDLE POWERS,
ANY VOLTAGE,
ANY EFFICIENCY.



The following are a few of our testimonials:

Your lamps (Perkins) instead of lasting 600 hours have averaged over 1,000 hours without growing black or dim.—CHURCH GREEN ELECTRIC LIGHT CO., Boston, Mass.

The life of the lamps is more than guaranteed, and when burned out they are perfectly white.—H. HEUCK, Heuck's Opera House, Cincinnati, Ohio.

The lamps average their full guarantee, and some have been burning 3,000 hours. — OAKLAND PAPER CO., Manchester, Conn.

We have run all our lamps (Perkins) over 1,200 hours and none of them have given out yet.—Z. CRANE, JR. & BRO., Dalton, Mass.

The light burns up to 16 c. p., is clear, and does not discolor.—J. D. WILTROUT, O. W. Holmes Hospital, Beatrice, Neb.

They (Perkins lamps) have more than met our expectations, as they excel the guarantee by some 2,000 hours.—H. B. CLAFLIN, New York.

GRIMSHAW WHITE CORE
WIRES AND CABLES.

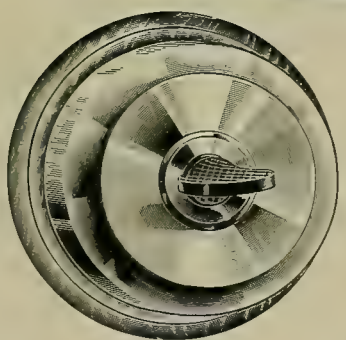
=FOR=

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

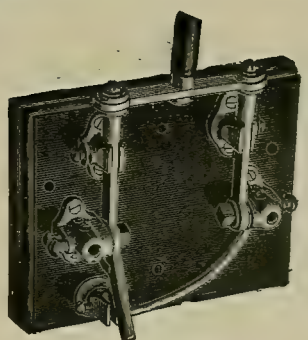
GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

Switch-Board Cables,
Grimshaw White Tape,
Grimshaw Black Tape,
GRIMSHAW SPLICING COMPOUND.

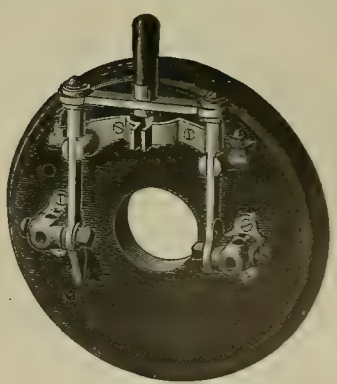
McLennan Switch.



Paiste Switch.



Arc Lamp Wall Switch.



Arc Lamp Ceiling Switch.

GALES COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

THE KNAPP ELECTRICAL WORKS, *54 & 56 Franklin St.,* CHICAGO, ILL.

THE
ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

CAPE MAY VISITORS

Having resolved to inspect their circuits and equip them with modern and improved appliances, are invited to write us for further information or samples of

Important Specialties

mentioned in circulars distributed at the Convention.

☞ Our Stock of Wire, Tools, Construction Material, Instruments, and Specialties was never more complete.

THE BRUSH ELECTRIC CO.,

CLAIMS THE EXCLUSIVE RIGHT TO
MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

The enjoining clause of the Decree of the Court in the case of The Brush Electric company vs. The Fort Wayne Electric Light company is as follows:—

"6. And it is hereby ordered, adjudged and decreed that the said defendants, the Fort "Wayne Electric Light company, Henry G. Olds, Perry A. Randall and Ranald T. McDonald, "together with the officers, successors, or assigns, agents, attorneys and employes of the "defendant corporation, be, and they hereby are, perpetually enjoined and restrained from "making, using, selling or vending any arc electric lamps in which two or more pairs of "carbons are independently adjusted and regulated by one and the same regulating mechan- "ism, and are separated and burned successively, to secure the continuous burning of one "pair of carbons prior to the establishment of the arc between the other pair, substantially "as described in the specification, and claimed in the first claim of said letters patent, No. "219, 208. and also from making, using, selling or vending any electric arc lamps contain- "ing the invention, or inventions, substantially as described in the specification, and claimed "in the second, third, fourth, fifth or sixth claims, or any of said claims in said patent, No. "219, 208, or any imitation, or substantial equivalent thereof constructed substantially as "described in said specification, and as claimed in the said first, second, third, fourth, fifth or "sixth claims, and that an injunction issue forthwith accordingly. And it is further ordered, "adjudged and decreed that the defendants pay the cost herein to be taxed, and that the com- "plainant have execution therefor."

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENCE LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

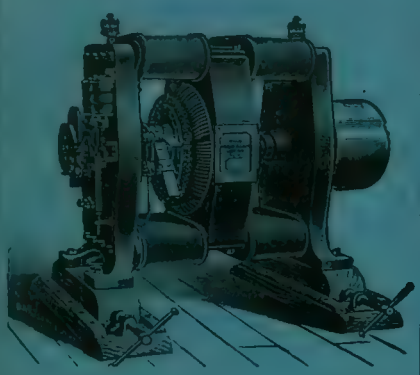
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



WOOD ARC DYNAMO.

MAIN OFFICE:

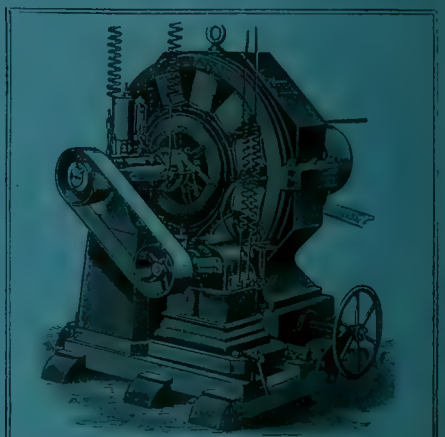
FORT WAYNE, IND.

BRANCH OFFICES:

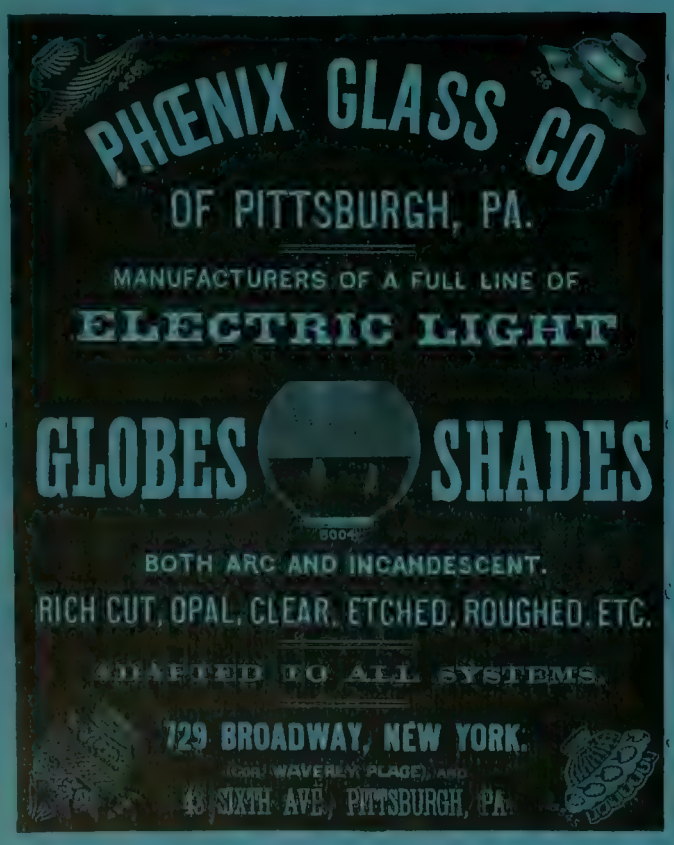
NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.



To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, AUGUST 30, 1890. No. 9.

"AJAX SWITCHES"

FOR CENTRAL STATIONS & POWER CIRCUITS.

SIMPLE. CHEAP. INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS, 74 Cortlandt St., New York.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

To Make YOUR TELEPHONES TALK

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

—INDORSED BY THE—

United States and German Governments.

BEST ANTI-FRICTION METAL

For Dynamo, High-Speed Engine, Steamship, Car, and all Machinery Bearings.

MAGNOLIA ANTI-FRICTION METAL CO.,

Owners and Sole Manufacturers,

London Office: 75 Queen Victoria St.
Chicago Office: 41 Traders' Building.

74 CORTLANDT ST., NEW YORK.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

—MANUFACTURERS OF—

Weather Proof Wire, Annunciator Wire, Gas Fixture Wire,
Insulated Iron Wire, German Silver Wire, Arc Lamp Cords,
Magnet Wire, Office Wire, Tinsel Cords,
Rubber-Covered House Wire, Flexible Brush Holder Cable, Flexible Cords,
Telephone, Telegraph and Electric Light Cables.

PARAGON TAPE.

Please address all communications to the nearest District Office.

EDISON BUILDING, BROAD ST., NEW YORK.

MAIN DISTRICT OFFICES: EASTERN DISTRICT, EDISON BUILDING, NEW YORK. CENTRAL DISTRICT, "THE RIALTO" BUILDING, CHICAGO. MOUNTAIN DISTRICT, MASONIC BUILDING, DENVER. PACIFIC COAST DISTRICT, CHRONICLE BLDG., SAN FRANCISCO. NORTH WEST DIST., WASHINGTON BLDG., PORTLAND, ORE. SOUTHERN DIST., COTTON EXCHANGE BLDG., NEW ORLEANS. CANADIAN DIST., BANK OF COM. BLDG., TORONTO, CAN.

WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment.
Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964		3,964
Westinghouse		27,710	27,710
Edison		10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	[illegible]		734
Ball	613		613
Western Electric	566	250	816
Indianapolis Jenney	734		[illegible]
Fort Wayne Jenney	[illegible]	720	935
Jenney (Ind. or Ft. Wayne not specified)	324		324
Van Depoele	285		285
Waterhouse	222		222
Heisler		100	[illegible]
Remington	159	300	459
Sperry	130		130
Excelsior	90		[illegible]
Hochhausen	60		60
Weston	30		30
Fuller	10		10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77 203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc.	Inc
Thomson-Houston	16,927	[illegible]
Brush	6,090	[illegible]
Westinghouse	321	49,067
Edison	[illegible]	[illegible]
American	1,537	175
United States	632	6,141
Schuyler	1,166	[illegible]
Ball	962	6
Western Electric	788	[illegible]
Fort Wayne	1,756	8,005
Van Depoele	450	[illegible]
Waterhouse	287	[illegible]
Heisler	[illegible]	[illegible]
Remington	129	[illegible]
Sperry	[illegible]	[illegible]
Excelsior	205	30
Hochhausen	[illegible]	[illegible]
Weston	[illegible]	[illegible]
Fuller	[illegible]	[illegible]
Reliance	30	[illegible]
National	[illegible]	1,000
Bernstein	[illegible]	[illegible]
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	[illegible]
Number of incandescent lights operated	55,890	[illegible]

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Automatic Switch Co.....xxviii
Ansonia Brass & Copper Co i, xxviii
Allis, E. P. & Co.....xxviii
American Electrical Works.. xix
Abendroth & Root Mfg. Co.. viii
Aluminum Battery, Electric Light & Power Co.... xxviii
Ball Engine Co.....xxviii
Baggot, E.....xx
Barton, Geo. P.....—
Bernstein Electric Co.....xxiii
Brush Electric Co.....xxxv
Butler Hard Rubber Co. xxii
Bain Foree.....xii, xx
Brown, Frank T.....xx
Barnes, W. F. & Jno.....xxix
Baxter Electric Motor Co.....xxxvi
Bleckert & Nelson.....xx
Bunnell & Co., J. H.....—
C. B. & Q. R. R.....xxix
Chalmers, Spence Co viii
Cleverly Electrical Works.. xiii
Colburn & Co., I. W.....xx
C. & C. Electric Motor Co...xxvii
Central Electric Co.....xv
Continental Dynamo Co.....xi
Columbia Incandescent Lamp Co xxi
Crocker-Wheeler Motor Co... xix
Crosby Electric Co.....iv
Davidson, M. T..... viii
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xxii
Electrical Supply Co xxxiv
Empire City Electric Co.....xxii
Eastern Electric Cable Co. xix
Edison General Electric Co.,— Railway Dept.. xxix
English, Morse & Co.....xxi
Excelsior Electric Co..... ...xxvi
Elektron Mfg. Co.....xxiii
Eddy E ectric Mfg. Co..... xix
Electric Construction & Sup. Co viii
Edison Mfg. Co.....xxvii
Edison General Electric Co.,— Lighting Dept..... x
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co..... xi
Eureka Tempered Copper Co.. xxi
Easton Electric Co..... iv
Electric Merchandise Co....xxx, xx
Electrician Publishing Comp'y, xxiv xxv, xxi, xxii
Evans Friction Cone Co..... xxiii
Empire China Works xx
Fibrone Mfg. Co..... xix
Forest City Electrical Works.. xii
Fort Wayne Electric Co.....xxxvi
Fairbanks, Morse &Co..... xx
Fletcher & Fletcher Electric Co xx
Globe Carbon Co..... xxi
Greeley & Co., E. S.....xviii
Gibson Gas Fixture Co..... xxii
Giles Bros..... xii
Great Western Electric Sup. Co. v
Hazelton Tripod Boiler Co....xxvi
Heisler Electric Light Co.....xxvii
Hill Clutch Works..... xi
Holmes, Booth & Haydens..... xxi
Harmount, G. A..... xx
Hazazer & Stanley.....xviii
Holtzer-Cabot Electric Co..... i
Hawkeye Electric Mfg. Co....—
Holmes & Co., C. H..... xxi
Ireson, Chas. L.. i
Interior Conduit & Insulation Co. xxiii
India Rubber & Gutta Percha Co. i
Ide & Son, A. L.....xviii
Illinois Electric Material Co....xviii
Jewell Belting Co..... xix
Jones Bros. Electric Co.....xxviii
Knapp Electrical Works.....xxxiii
Law Telephone Co..... xix
Leclanche Battery Co..... xii
Lewisohn Bros.....xxvi
Laminar Fibre Goods Co..... xxi
Mitchell Vance Co.....xxxvi
Monitor Electric Co..... xx
Munsell & Co., Eug..... xix
Munson Belting Co., Chas.....xviii
Mason, Jas. H.....xxix
Magnolia Anti-Friction Metal Co i
N. Y. Belting & Packing Co...—
National Carbon Co..... iv
National Electric Mfg. Co..... xiv
Noye Mfg. Co., Jno. T..... xx
Northwest Thomson-Houston Co. ix
Ohio State University.....xxvi
Ostrander & Co., W. R. xxii
Okonite Co.....vi, xix
Partrick & Carter.....xxiv
Phoenix Glass Co.....—
Paiste, H. T..... xviii
Pond Engineering Co..... xx
Powell Co., Wm.....—
Pumpelly Storage Battery Co. xxvi
Phillips Electrical Works, E. F xix
Page Belting Co.....—
Purdue University..... xx
Queen & Co..... iv
Roeblings' Sons Co., Jno. A... xiii
Shultz Belting Co..... xxviii
Stilwell & Bierce Mfg. Co...xx, xxi
Standard Carbon Co..... xxiv
Stephenson & Co., Jno xxv
Schuyler Electric Co..... xxiv
Southern Electrical Supply Co. xxv
Sperry Electric Co..... xi
Sawyer-Man Electric Co..... xvi
Schoverling, A xxviii
Standard Paint Co.....xviii
Standard Underground Cable Co. i
St. Louis Electrical Supply Co. xxvi
Standard Electrical Works. ... xx
Sunbeam Incandescent Lamp Co. xix
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department xxxii
Taussig, S..... xx
Taylor Mfg. Co.....xxix
Triumph Compound Engine Co iv
Turner Brass Works..... ... xix
Union Hardware Co. xviii
United Electric Traction Co...xxix
United States Electric Lighting Co..... xvii
C. S. Van Nuis..... i
Woodbridge & Turner.. xxi
Westinghouse Electric Co. ....—
Wollensak, Jno. S.....xxix
Western Electric Co.....xxii
Weston Electrical Instrument Co.....xviii, vii
Western Power Construction Co. xxv
Wanted.....xviii, xxiii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co.
Pumpelly Storage Battery & Elec. Motor Co.

Aluminum.
Aluminum Brass & Bronze Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Aluminum Battery Electric Light & Power Co.
Bunnell & Co., J. H
Central Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Hazazer & Stanley
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Boiler and Pipe Coverings.
Chalmers, Spencer Co., The

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Lewisohn Bros
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Lewisohn Bros.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Automatic Switch Company.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Mitchel-Vance Co.

Electroliers and Combination Fixtures.—Continued.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
American Electrical Works.
Ansonia Brass & Copper Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Mitchell-Vance Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Electricians' Time Co.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamp Hangers.
Forest City Electrical Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.

Lamps, Incandescent—Contd.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank T.
Barton, Geo. P.
Bates, Wm. S.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Pumps, Steam.
Davidson, M. T.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Aluminum Brass & Bronze Co.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Lewisohn Bros.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

P. MINTURN SMITH, Pres't. S. N. ROBINSON, Secretary
WILLIAM D. PERRY, Vice Pres't. CHARLES TREMAINE, Treas'r
JAMES W. EASTON, Electn.

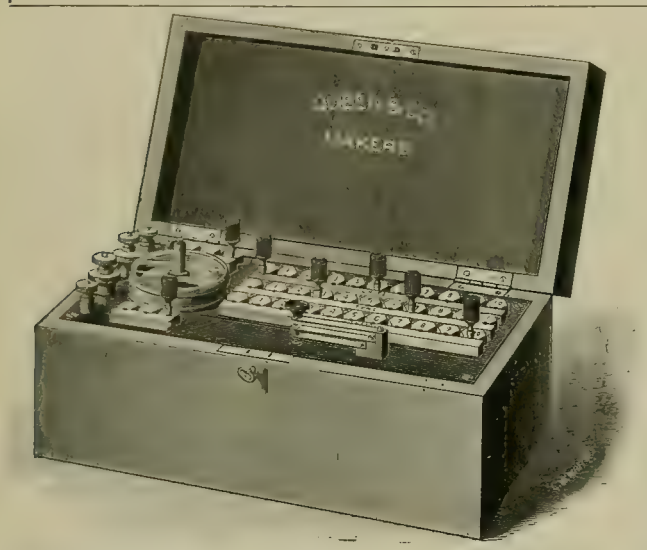
THE EASTON ELECTRIC CO.

ELECTRICAL APPARATUS FOR ARC AND INCANDESCENT LIGHTING

FACTORY BROOKLYN, E.D.

OFFICE 45 BROADWAY, NEW YORK.

J. H. REID, General Manager,
411 & 412 Royal Ins. Bldg. CHICAGO.



ELECTRICAL Testing Instruments.

WE INVITE SPECIAL ATTENTION TO OUR

NEW PORTABLE COMBINATION TESTING SETS,

DESIGNED FOR CONVENIENCE, PORTABILITY AND ACCURACY.

AMMETERS AND VOLTMETERS OF ALL TYPES,

FOR DIRECT AND ALTERNATING CURRENTS.

SEND FOR ILLUSTRATED CATALOGUE OF TEST INSTRUMENTS 1-66.

QUEEN & CO., Philadelphia.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE.

SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.
MADE IN ALL SHAPES AND SIZES.

—o(FOR)o— TELEPHONE ONE DOES THE WORK FOR LONG OR SHORT DISTANCE

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES
IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY,
DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

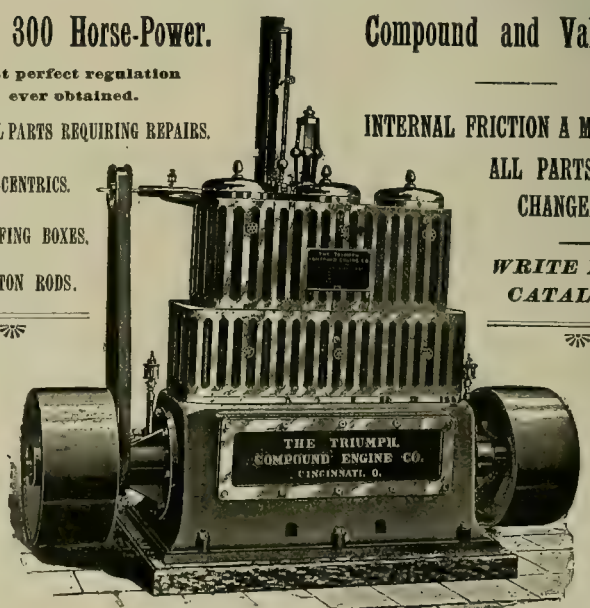
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

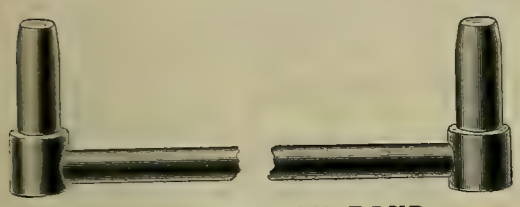
SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190–192
FIFTH AVE.,
CHICAGO.

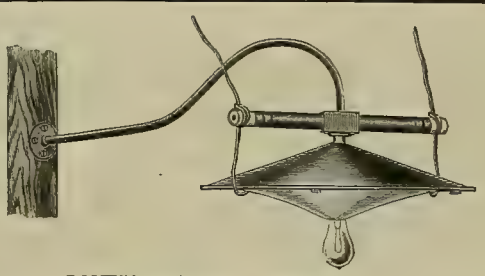
Makers of the Choicest Electrical Supplies.



ALL COPPER RAIL BOND.

THE WIRE FOR
Thoroughly Weatherproof
CIRCUITS.

SIMPLEX



CUTTER'S STREET HOOD.

ELECTRIC HOUSE GOODS:

Full Line of Gas Lighting Apparatus.
New District Telegraph Apparatus.
New Designs of Push Buttons.

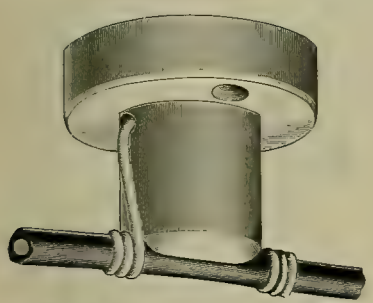
THE NEATEST AND MOST UNIQUE SWITCH MADE.

THE WIRE FOR
All Mining Work.

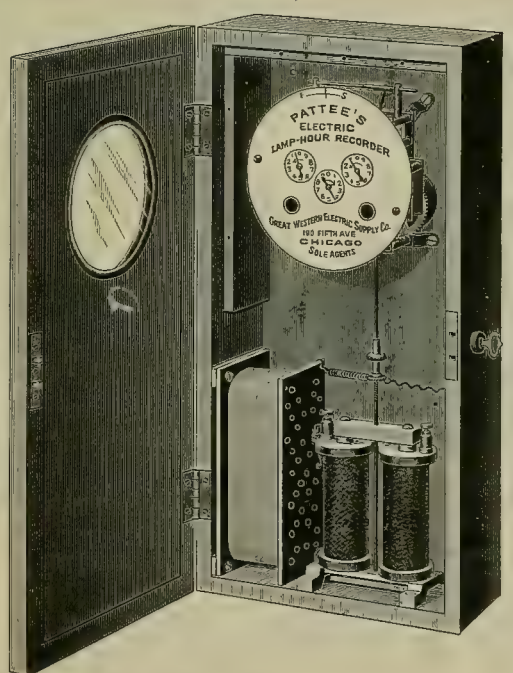
OUR ELECTRIC SPECIALTIES,

STEADILY GROWING IN NUMBER
AND IN PUBLIC FAVOR,
ARE DESCRIBED IN

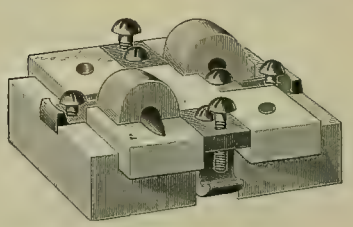
OUR SPECIAL CIRCULARS.



CUTTER'S E. L. PORCELAIN INSULATOR.



PATTEE'S LAMP-HOUR RECORDER.

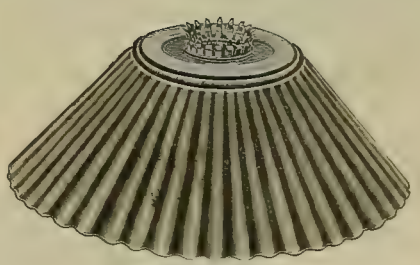


PORCELAIN BRANCH CUT-OUT.

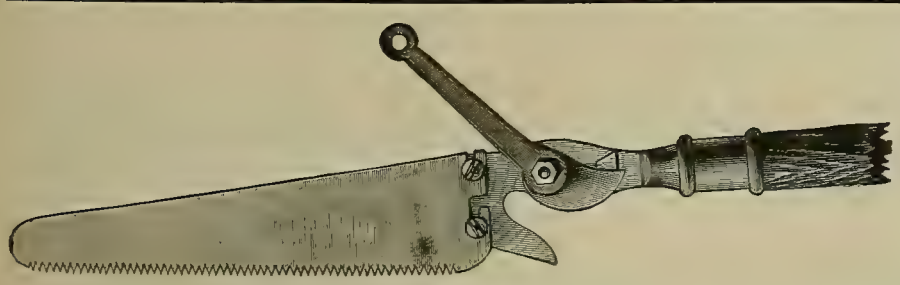
NEW MAKE OF ARMATURE PINIONS.

NEW DESIGN OF POLE TOP,
POLES AND INSULATORS

A FULL LINE OF
ELECTRIC RAILWAY SUPPLIES.



COMBINATION CONE SHADE.



COMBINATION TREE TRIMMER.

ELK HEAD ELECTROLIERS. MANY NOVEL DESIGNS.
ELECTRIC FIXTURES.
MOTOR CAR FIXTURES. SEND FOR CUTS.

Sir WILLIAM THOMSON, F. R. S.

THE UNIVERSITY, GLASGOW, June 19th, 1890.

I have tested the insulation of two specimens of Okonite Wire sent to me recently, and have found thoroughly satisfactory results for all ordinary temperatures and potentials.

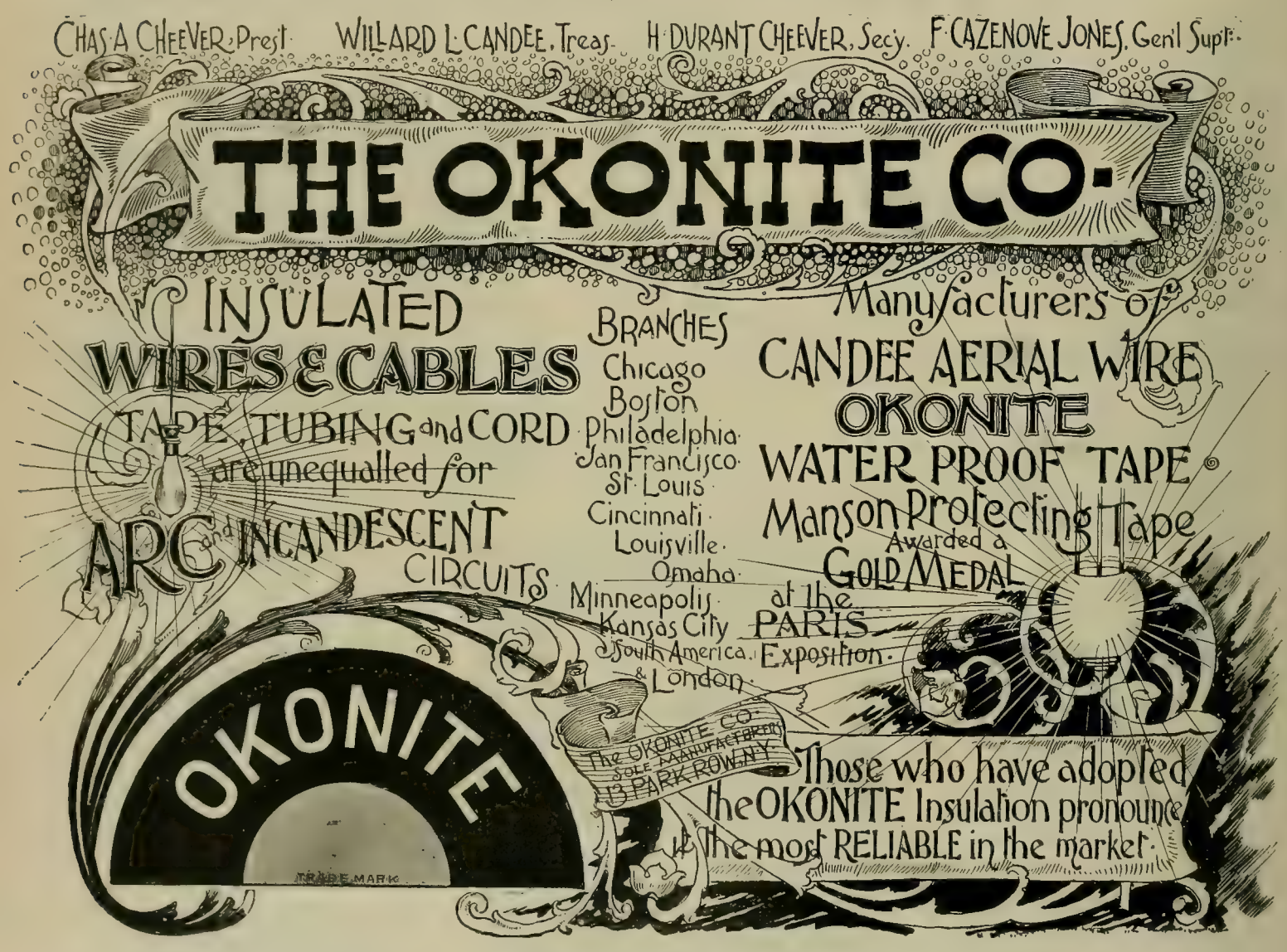
The thickness of the Okonite in these specimens was 1.8 millimetres (.072 of an inch), and its insulation resistance held good up to 7,500 volts. After the passing of current through it at this very high potential for some time, I found the insulation resistance for ordinary potentials only reduced from 6,700 (its original value) to 4,500 megohms per statute mile at 16° Cent.

I am well acquainted with Dr. Hopkinson's tests of December, 1886, which were submitted to me early in 1887, and I know the results of his recent tests of the same specimens, showing no deterioration, but actually an improvement, in the insulating quality after three-and-a-half years' keeping.

I have also seen the published certificates of many practical men of different dates from March, 1886, to December, 1888, which give trustworthy evidence of the practical success of Okonite Wire for telegraphs, telephones, and electric light and power.

With this evidence before me, in addition to my own electric tests and examination of the insulating material in respect to toughness and other mechanical qualities, I believe Okonite to be a very valuable material for the insulation of electric conductors in a large variety of practical uses.

(Signed) **WILLIAM THOMSON.**



Dr. JOHN HOPKINSON, F. R. S.

WESTMINSTER CHAMBERS, 5 VICTORIA STREET, S. W., June 19th, 1890.

In December, 1886, I made a series of careful and somewhat elaborate experiments upon Okonite Wire, and fully reported upon the same. My report, of which I append a copy, was as complete as it could be at the time. One point it was then impossible to determine, and that practically, the most important point of all, namely, the question of the durability of the insulation.

It is almost impossible, in most instances, to judge of the suitability of any particular insulating compound for wires until it has stood the test of time for some years. It so happened that samples of Okonite Wire that I tested in 1886 had been left with me, and have remained in my possession ever since, parts of the same having been used in my laboratory and for various other purposes.

I have now again tested these samples, and append the tests, together with the results obtained in 1886. In the case of A and C, the test is after one minute's electrification; in the case of B_1 and B_2 the test is a mean during an interval from one-half minute to five and one-half minutes from first electrification; the temperatures are practically the same, viz.: 15°5C. in 1886, 15° C. now. Samples A and C had been immersed in water for five days, B_1 and B_2 for a shorter time. B_1 is a sample which had been twisted in 1886 for the purpose of ascertaining whether the material would stand mechanical disturbance. B_2 has six kinks made in it for a similar purpose.

A, in 1886	...	...	6,180	A, now	...	...	7,000	...	Megohms per statute mile.	
C, in 1886	...	...	7,590	C, now	...	...	11,680	...	do.	do. do.
B_1 in 1886	...	...	5,435	B_1 now	...	...	11,740	...	do.	do. do.
B_2 in 1886	...	...	4,750	B_2 now	...	...	13,700	...	do.	do. do.

In my last report I stated that I was most favorably impressed with the qualities of the wire, both on account of its high insulation and mechanical reliability. Tests on the samples proved that the insulation was practically perfect, both for high and low potentials, and that the insulation would stand very rough handling and a considerable temperature, without injury, and indeed with but slight reduction of its insulation resistance. I can now add that the result of time has shown that not only is the insulation excellent when made, and that it will stand mechanical disturbance, but that for a term of three-and-a-half years it is perfectly durable, and remains as good as at the first.

(Signed) **J. HOPKINSON.**

THE STANDARD VOLTMETER.

THE STANDARD AMMETER.

Weston's Portable Direct-Reading Voltmeter.

Weston's Portable Direct-Reading Ammeter.

FOR DIRECT CURRENT CIRCUITS.

Used by all the prominent Electrical Companies and Schools of Electrical Engineering. Accuracy of measurement, heretofore attained only by the use of expensive absolute instruments, now placed within the reach of all users of electrical apparatus. Can be left in circuit for any length of time without any appreciable error. Scale readings begin at zero and extend over a wide range.

SOME RECENT TESTIMONIALS.

BRUSH ELECTRIC CO.

CLEVELAND, O., June 21, 1889.

Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:— * * * We wish to say that we are greatly pleased with these Voltmeters of yours, and regard them as decidedly superior to anything we have ever had before.

Yours truly,
THE BRUSH ELECTRIC CO.,
By J. Potter, Treasurer.

BRUSH ELECTRIC CO.

CLEVELAND, O., May 19, 1890.

Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:—We are now using a number of your Standard Ammeters and Voltmeters in factory work and outside engineering work, and find them to be very satisfactory indeed.

Truly yours,
THE BRUSH ELECTRIC CO.,
By J. Potter, Treasurer.

THOMSON-HOUSTON ELECTRIC CO.

LYNN, MASS., June 7, 1890.

M. M. Garver, Esq., Weston Electrical Instrument Co., Newark, N. J.

DEAR SIR:—Replying to yours of the 31st ult., concerning your (Weston) Voltmeters, would say that I know of no reason for changing my views as expressed in my letter to you of Aug. 21, 1889. Longer experience with your Voltmeters tends to emphasize the statement I made at that time, and can say that they are in every way satisfactory to us.

Yours very truly,
THOMSON-HOUSTON ELECTRIC CO.,
By A. L. Rohrer.

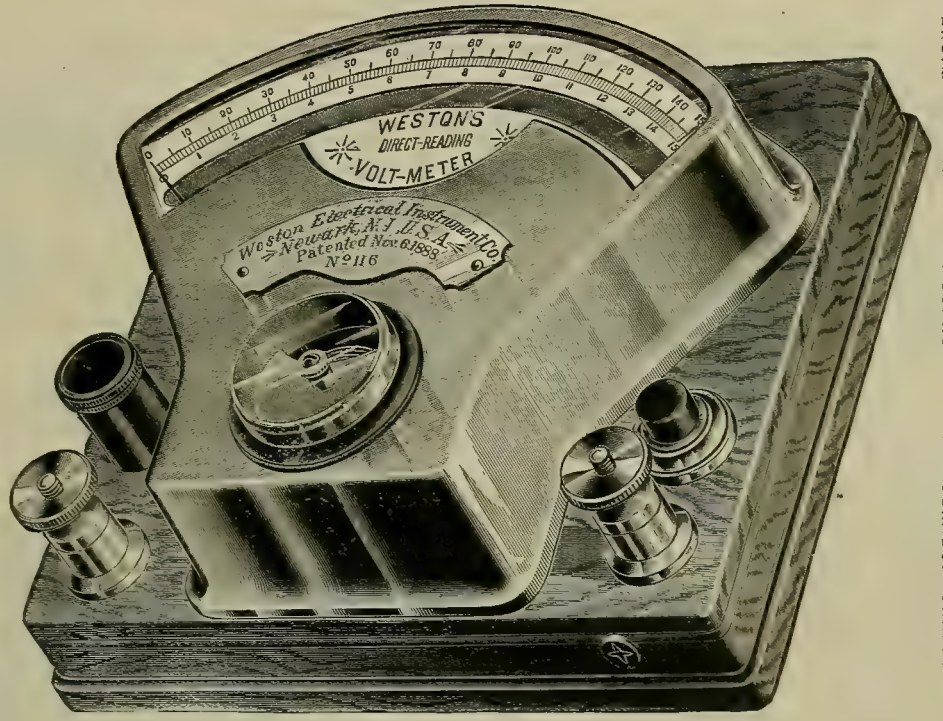
Office of A. J. DAY,
16 Dey Street,
NEW YORK, June 23, 1890.
George B. Prescott, Jr., Gen. Agent.

Mr. Edward Weston, Weston Electrical Instrument Co., Newark, N. J.

DEAR SIR:—In reply to your favor of the 20th inst., it affords me pleasure to state that additional experience with your ammeters and voltmeters, during the sixteen months which have passed since I last expressed my favorable opinion of them, has more than confirmed that opinion. For precision, reliability, portability and general convenience, I know of no instruments manufactured here or abroad, that can stand comparison with the Weston Voltmeters and Ammeters.

* ** ** *

Yours very truly,
GEORGE B. PRESCOTT, JR., Gen. Agt.



THREE-QUARTER SIZE.

Electricians Having Once Used these Instruments will not be Satisfied with Any Others.

SAWYER-MAN ELECTRIC CO.

NEW YORK, Oct. 2, 1889.

Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:—We are using a number of your Voltmeters in our factories and also in connection with our outside work, and it gives us pleasure to state that we have found them very accurate and reliable.

Yours truly,
SAWYER-MAN ELECTRIC CO.,
By P. H. Alexander, Gen. Man.

UNITED EDISON MFG. CO.

Leonard & Izard Co., "Rialto," Chicago.
CHICAGO, ILL., May 31, 1890.

M. M. Garver Manager Weston Electrical Instrument Company, Newark, N. J.

DEAR SIR:—I have been using the Weston Standard Portable Voltmeters and Ammeters ever since they came into use, and I must say that they are the most reliable portable instruments I ever used. I simply could not get along without them.

Truly yours,
F. B. BADT, Superintendent.

UNION ELECTRIC CAR CO.

BOSTON, May 19, 1890.

The Weston Electrical Instrument Co., Newark, N. J.

GENTLEMEN:—In reply to your inquiry of the 17th inst., we would say that the satisfaction expressed in our communication of Aug. 21, 1889, continues; and can only add that all of the instruments of various capacities since purchased by this company, and also the N. E. Weston Electric Light Co., have demonstrated by actual service the reliability, accuracy, and convenience of transportation and application of your instruments to the various purposes of commercial work.

Very truly yours,
UNION ELECTRIC CAR CO.,
E. H. Hewins, General Manager

JOHNS HOPKINS UNIVERSITY.

BALTIMORE, MD., April 28, 1890.

My Dear MR. WESTON:—I have been intending for some time to write you about the Voltmeter you sent us some time ago. It has been in constant and rather rough use for six or eight months. The constant has varied only a small fraction of one per cent. Its wide range, accurate reading, and general adaptability make it the most satisfactory instrument for commercial purposes that I am acquainted with.

Very truly yours,
LOUIS DUNCAN, Ph. D.

Every Electrical Plant should be supplied with them as Standards for checking the accuracy of station indicators.

At present we are prepared to supply Ammeters up to 150 amperes, and Voltmeters of any desired range.

WESTON ELECTRICAL INSTRUMENT CO.,

Office and Factory, 114 and 116 FRANKLIN STREET,

NEWARK, NEW JERSEY.

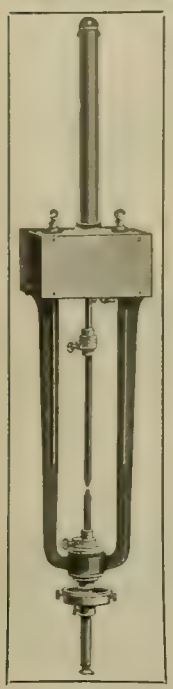
CORRESPONDENCE SOLICITED.

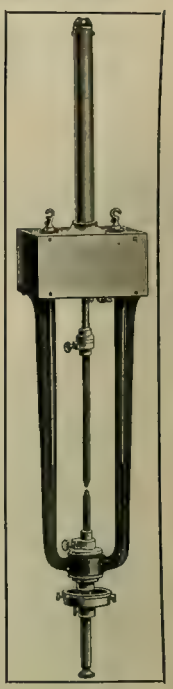
THE

ONLY COMMERCIAL ARC LAMP

FOR

INCANDESCENT CIRCUITS.





Burning two in Series on Circuits of 100 to 120 Volts.

WILL USE EIGHT AMPERES OF CURRENT.

WE ARE PREPARED to furnish SERIES LAMPS for any PRESSURE, CONSTANT POTENTIAL.

These Lamps, when burning TEN IN SERIES, on 500-VOLT CIRCUITS, use 8½ amperes, and give a CLEAR, STEADY LIGHT.

We guarantee our Lamps, Electrically and Mechanically.

PLEASE STATE SYSTEM AND VOLTAGE USED. ADDRESS

ELECTRIC CONSTRUCTION & SUPPLY CO.,

18 Cortlandt Street, NEW YORK.

BOILER AND PIPE COVERINGS

Made in Sections Three Feet Long to Fit Every Size of Pipe.

FIRE-PROOF NON-CONDUCTING COVERINGS

FOR
STEAM PIPES, BOILERS,
AND ALL
HOT SURFACES.

Copyrighted by THE CHALMERS-SPENCE CO.

ASBESTOS MATERIALS, FIBRE, BRAIDED PACKING AND CEMENT.

THE CHALMERS-SPENCE CO.,

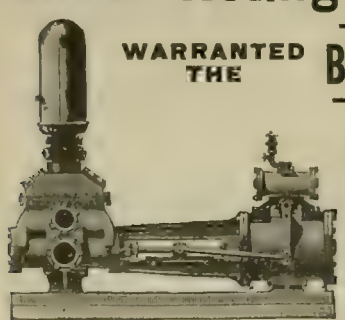
59 and 61 Liberty Street, NEW YORK.

BRANCHES:—CHICAGO, 86 E. Lake St.; BOSTON, 19 Pears St.; PITTSBURG, 414 Lewis Block; ST. LOUIS, 741 N. Main St.; PHILADELPHIA, 24 Strawberry St.

THE M. T. DAVIDSON

Direct Acting Steam Pumps.

WARRANTED THE **BEST MADE** FOR ALL SITUATIONS.



Electric Plant Pumps

A SPECIALTY.

Manufactured by

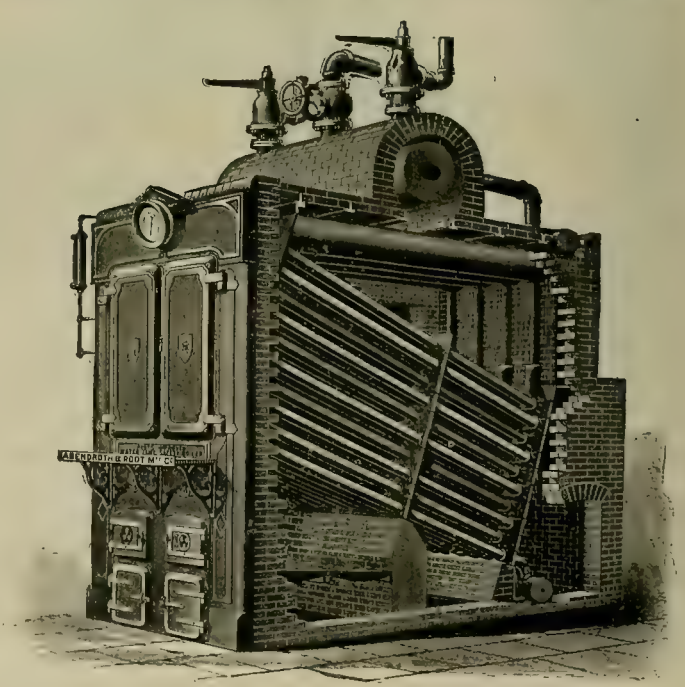
M. T. DAVIDSON.

Principal Office and Works:
43-53 Keap Street, BROOKLYN, N. Y.
Branches: 77 Liberty Street, New York. 51 Oliver Street, Boston.

ROOT'S NEW WATER TUBE

STEAM BOILER

Absolutely Safe. Simple in Construction.



Easily Erected, Very Economical.

Adopted by the Edison Electric Light Companies of Detroit, Cincinnati, Louisville, Columbus, St. Paul and many others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., NEW YORK.

BRANCHES:—BOSTON, CHICAGO, PHILADELPHIA, DALLAS, NEW ORLEANS.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

EDISON GENERAL ELECTRIC

COMPANY.

LIGHT AND POWER DEPARTMENT,

Edison System.

COMPLETE INSTALLATIONS CONTRACTED FOR ANY CAPACITY.

C — EDISON

The Pioneer System of Incandescent Electric Lighting.

E — *LAMPS Supplied of any Candle-Power and Voltage to Fit any Socket*

R — DYNAMOS MOTORS

CHIEF EXECUTIVE OFFICE:

Edison Building, Broad St., New York City.

DISTRICT OFFICES:

CHICAGO, Rialto Building.
SAN FRANCISCO, Chronicle Building.
NEW ORLEANS, Cotton Exchange.
DENVER, COLO., Masonic Building.
PORTLAND, ORE., Washington Building.
TORONTO, CAN., Bank of Commerce Building.

FACTORIES:

New York City. **Harrison, N. J.** **Schenectady, N. Y.**
Sherbrooke, Quebec. **Hamilton, Ontario.**

ANTIQUATED

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"TRIPLE" CARBON LAMP

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

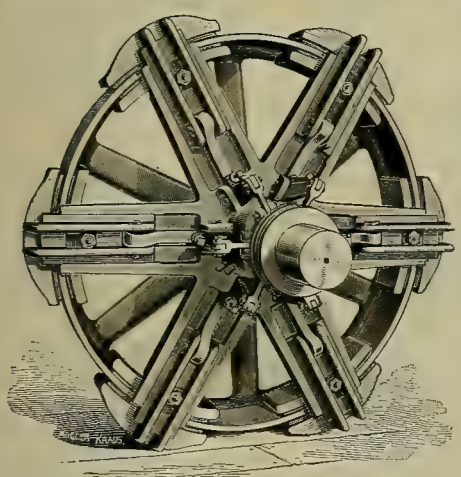
Old Lamps of all Styles, Single or Double, can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

Send for further particulars to the

SPERRY ELECTRIC CO.,

195 to 207 Canal Street, - CHICAGO.



COPYRIGHTED BY H. W. HILL.

HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

E-D-I S-O-N

Miniature Incandescent

ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

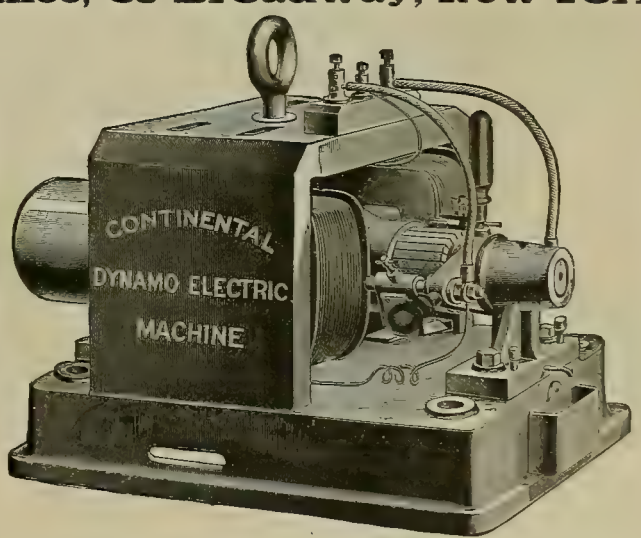
EDISON LAMP COMPANY, Harrison, N. J.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 68 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St—**NASHVILLE,** Tenn., J. W. B aid, 207 Union St, **DENVER,** Col., L. C. Rice, 1762 Blake St.

W-A-T-C-H-E-S.

The World's Exposition in Paris, 1889, awarded a prize medal to The Giles Anti-Magnetic Shield for watches. It has been proven to be the best practical and permanent solution to the trouble electricians have with their watches.

The shield can be applied to any watch, or is furnished in new watches by

GILES BROS., - CHICAGO.

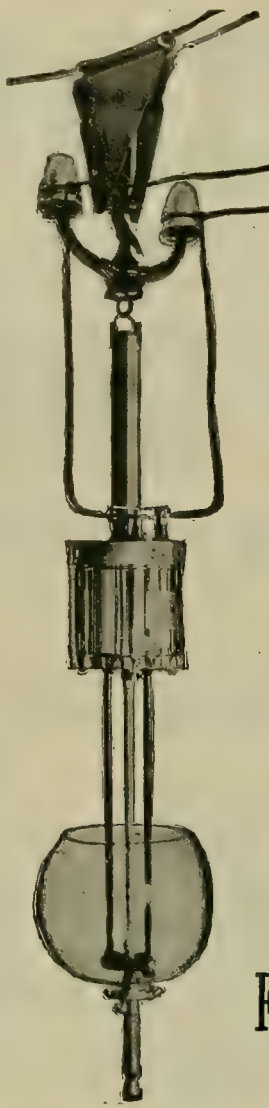
TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,

149 West 18th Street, - - NEW YORK.



THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

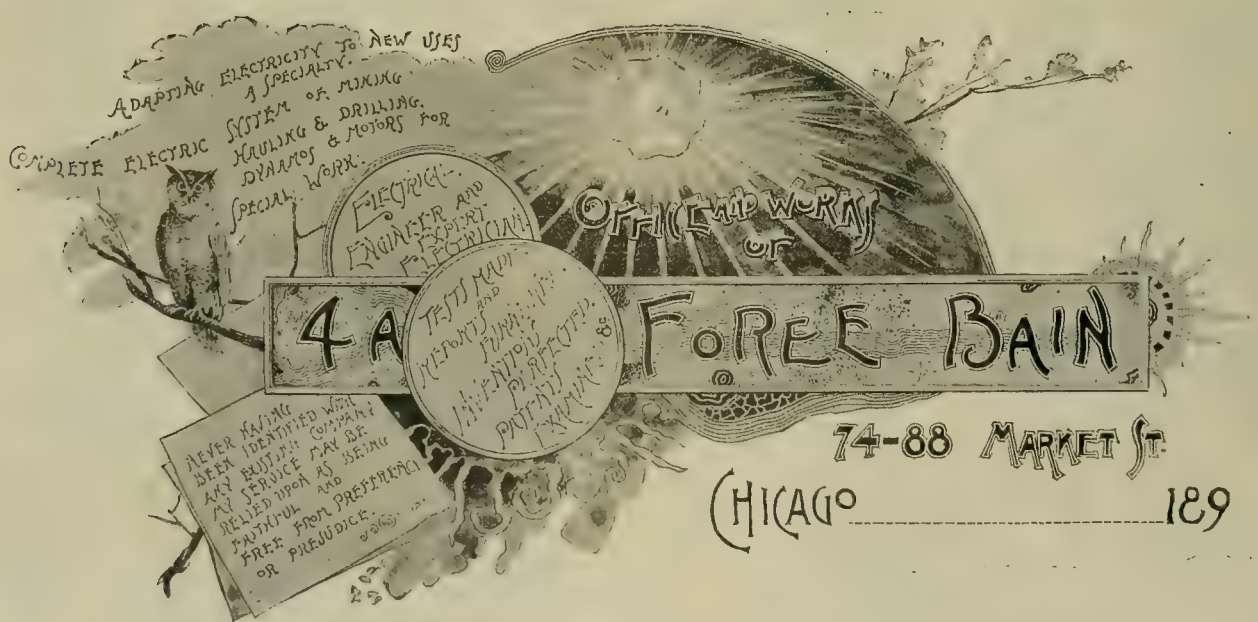
Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.



Electric Light Repairing.

SPECIAL DYNAMOS AND MOTORS,

From 1-200th to 300 H. P. built to order, 2 ozs. to 20 tons in weight, 2 Volts to 5000 Volts in E. M. F.

Cleverly
1018 CHESTNUT ST., PHILA.

Cleverly
1018 CHESTNUT ST., PHILA.

Electric Specialties to Contract.

I AM WITH YOU!
"'TIS PITY 'TIS TRUE!"

General Electrical Supplies.

Cleverly
1018 CHESTNUT ST., PHILA.

Cleverly
1018 CHESTNUT ST., PHILA.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

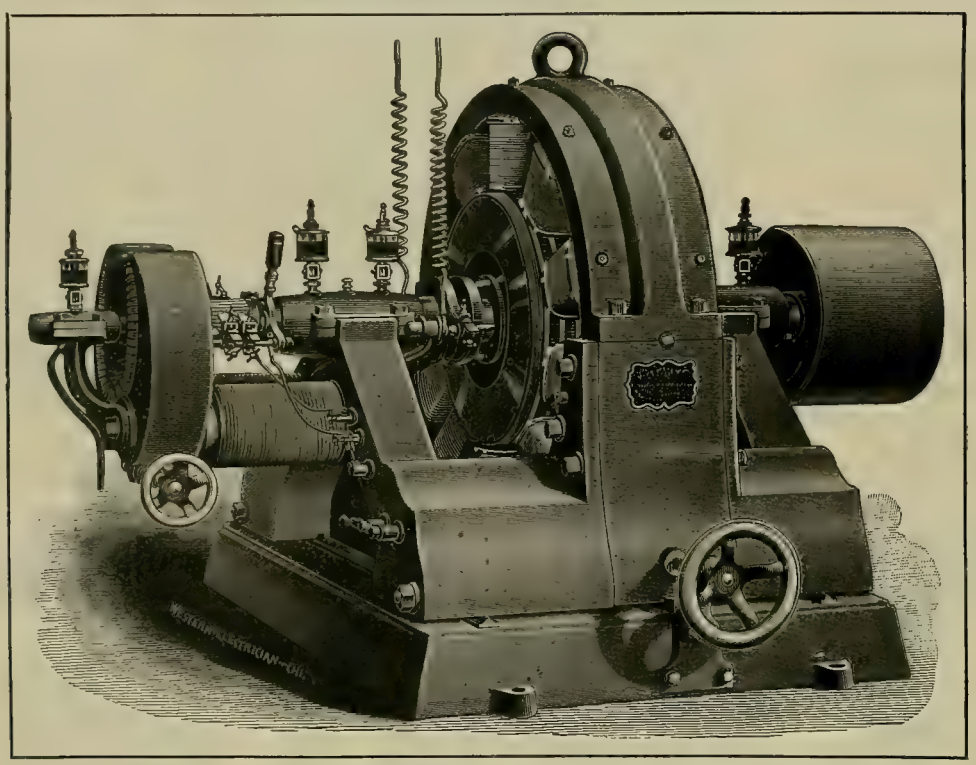
We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BEST OF ALL

THE NATIONAL TRANSFORMER SYSTEM OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., Seattle, Washington.
THOMAS WOLFE, Southwestern Agent, Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts., 141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts., 1517 Larimer St., Denver, Colo.
CHAS. M. BLANCHARD, Agent, Girard Building, Philadelphia, Pa.
L. N. COX, Agent, 16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent, Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts., 531 Wood St., Pittsburgh, Pa.

NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.
SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Agents, Winnipeg, Manitoba.
A. IRVINE, Agent, Emelie Building, St. Louis, Mo.

CENTRAL ELECTRIC CO..

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal Telegraph Cable Co.

WHY Do Wire Manufacturers claim that their wire is as good as Okonite ?

BECAUSE THEY know that Okonite is the greatest insulated wire ever made, and they only hope to equal it.

WHY Do Weatherproof Wire Dealers say they have a wire equal to Candee ?

BECAUSE Candee is the King of Weatherproof Wires, and THEY know it.

OUR OKONITE BOY KNOWS IT TOO.

SEE HOW IT MAKES HIM FEEL.

Our other specialties hold the same positions in their respective classes. Among them are:

THE BRADY MAST ARM,
THE BRADY SLEET PROOF PULLEY,
THE GLOBE FAN,
THE BURNLEY DRY BATTERY,
THE BUTLER HARD RUBBER GOODS.

Send us a sample order if you want it filled promptly and satisfactorily.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

THE SENSATION

AT THE CONVENTION

WAS

A-L-E-X-I-T-E

AS EXHIBITED

BY THE

SAWYER-MAN ELECTRIC CO.,

NEW YORK.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

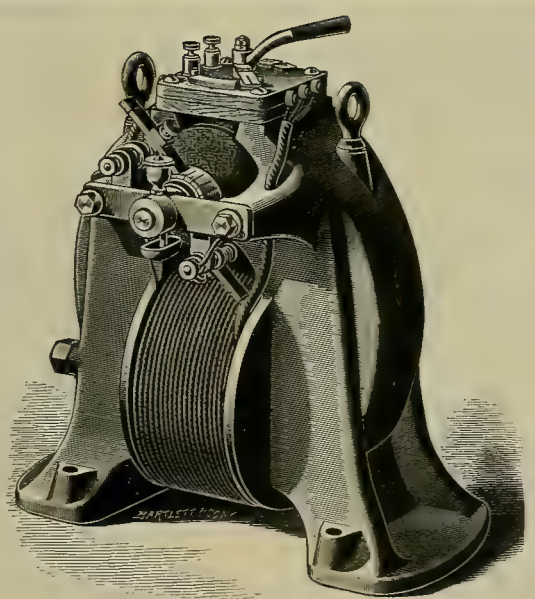
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

WANTED.

At once, experienced armature winders. Best of reference required.

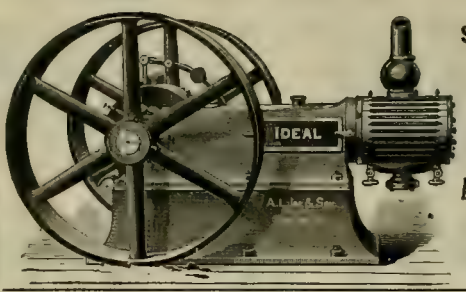
COLUMBIA ELECTRIC CO.,
207 E. Fourth St.,
ST PAUL, MINN.

WANTED.

A good second-hand incandescent electric light plant, 60 to 75 lights, of 16 c. p. Address, giving price and particulars,

JOHN ARPIN,
Grand Rapids, Wis.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

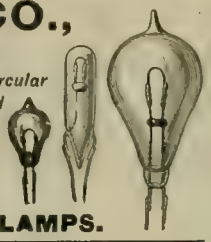
Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

THE E. S. GREELEY & CO.,

GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.

ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.



MINIATURE INCANDESCENT LAMPS.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,
32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

Messrs. Hazazer & Stanley.

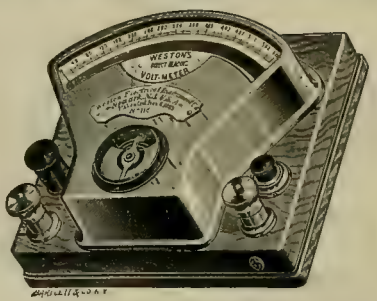
GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

Yours truly, *CHAS. E. GOODRICH, Electrician,*
503 Eighth Avenue.

T. W. NESS, Montreal, Agent or Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,
Office and Factory, 114 William Street, Newark, N.J.

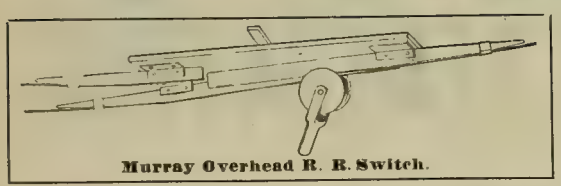
WHO KNOWS

WHAT IT IS WILL USE IT!

THE ONLY MOISTURE FIREPROOF WIRE on the Market.

CANVAS JACKET

Increase of 11 per cent. in Tensile strength, 40 per cent. longer life for Insulation.



Murray Overhead R. R. Switch.

Bishop Rubber Covered Wires

THE NE PLUS ULTRA OF ALL RUBBER WIRES.

CONVENTION INCANDESCENT SWITCH. (See Illustration last issue.)

POLES.

Trolley Hanger.

THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

DEALERS IN ELECTRIC LIGHT AND RAILWAY SUPPLIES

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co

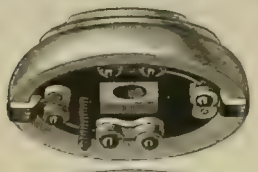
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

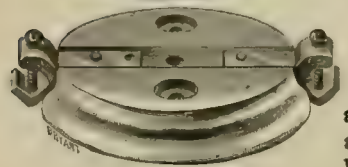
PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.





Patented.

DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.
Kept in Stock and for Sale by all Prominent Supply Houses.

GET THE BEST!

P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co.,
NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, AUGUST 30, 1890. No. 9

THE CONVENTION.

Of the National Electric Light Association at Cape May, N. J.

The twelfth convention of the National Electric Light Association was held August 19th, 20th and 21st at Cape May, N. J. The sessions of the convention were held in the assembly room of the Hotel Stockton. Among the members and visitors at the convention were the following:

MEMBERS AND VISITORS.

Abell, C. Lee.....Buffalo, N. Y.
Ackerman, P. C.....New York, N. Y.
Adams, F. M.....New York, N. Y.
Adams, W. P.....Chicago, Ill.
Alexander, P. H.....Boston, Mass.
Alfred, John S.....Atlanta, Ga
Almy, Henry N.....Philadelphia, Pa.
Angloch, H. L.....Pittsburg, Pa
Armstrong, E. A.....Camden, N. J.
Austin, G. L.....Boston Mass
Baird, M. E.....Windsor, Conn.
Barrett, J. P.....Chicago, Ill
Barton, S. E.....Boston, Mass
Bates, M. E.....Kansas City, Mo.
Barker, F. E.....Boston, Mass.
Baker, C. O. Jr.....Newark, N. J.
Barney, C. H.....New York, N. Y.
Beck, L. D.....New York, N. Y.
Bell, Louis.....New York, N. Y.
Bishop, A. G.....Flint, Mich.
Blaisdell John W.....Chicago, Ill.
Bowen, G. S.....Elgin, Ill
Bracken, Wm.....New York, N. Y.
Brady, T. H.....New Britain, Conn.
Bragg, C. A.....Philadelphia, Pa.
Brayton, Jesse.....Utica, N. Y.
Brooks, David.....Philadelphia, Pa.
Brown, Charles A.....Chicago, Ill.
Brown, Oliver A.....New York, N. Y.
Brophy, William.....Boston, Mass.
Bryant, W. C.....Bridgeport, Conn.
Burbank, A. N.....Boston, Mass.
Burnham, C. E.....Boston, Mass.
Burnham, Louis W.....Boston, Mass.
Burleigh, J. J.....Camden, N. J
Carrier, A. E.....Pittsburg, Pa.
Candee, Willard L.....New York, N. Y.
Caldwell, Edward.....New York, N. Y.
Cavell, E. V.....Chicago, Ill.
Castle, Wm. W.....New York, N. Y.
Cabot, F. E.....Boston, Mass.
Cleverly, H. A.....Philadelphia, Pa.
Cleveland. W. B.....Cleveland, O.
Clower, W. M.....Dallas, Tex.
Cobb, H. B.....Wilmington, Del.
Coles, Stephen L.....New York, N. Y.
Coggshell, H. F.....Fitchburg, Mass.
Conant, H. J.....Boston, Mass.
Conner, D. O.....Philadelphia. Pa.
Corriveau, A. J.....Montreal, Que.
Crouse, J. B.....Cleveland, O.
Crocker, Francis B.....New York, N. Y.
Cutter, George.....Chicago, Ill.
Curtis, C. C.....Cleveland, O.
Cunningham, Wm. E.....Philadelphia Pa.
Cullen, W. F.....New York, N. Y.
Davidson. W. F.....Port Huron. Mich.
Daniels, A. L.....North East, Pa.
DeCamp, A. J.....Philadelphia, Pa.
Deacon, F. H.....Philadelphia, Pa.
Degenhardt, Fred.....Chicago, Ill.
Dickerson, J. W.....Chicago, Ill.
Drysdale, W. A.....Philadelphia, Pa.
Duncan, L. A.....Pittsburg, Pa.
Dusinberre, G. B.....Pittsburg, Pa.
Duncan, H. E.....Boston, Mass
Edgar, C. L.....Boston, Mass.
Eddy, Henry C.....Chicago, Ill.
English, James.....New Haven, Conn.
Eustis, H. H.....Boston, Mass.
Faben, C. R.....Toledo, O.
Field, C. J.....New York, N. Y.
Fisher, G. H.....New York, N. Y.
Fleming, Wilfrid H.....New York, N. Y.
Foote, Allen R.....New York, N. Y.
Francisco, M. J.....Rutland, Vt.
Freeley, W. R.....Boston, Mass.
French. H. M.....Boston, Mass.
Garratt, Allan V.....Boston, Mass.
Gallagher, R. E.....New York, N. Y.
Gordon, W. H.....New York, N. Y.
Goddard, C. M.....Boston, Mass.
Godfrey, J. W.....New York, N. Y.
Gregory, Charles E.....Chicago, Ill.
Gray, R. J.....New York, N. Y.
Greenfield, E. I.....New York, N. Y.
Groetzinger, A.....Allegheny City, Pa.
Harris, C. O.....Dallas, Tex.
Hall, A. M.....New York, N. Y.
Hazelton, Wm.....Philadelphia, Pa.
Hart, G. W.....Kansas City, Mo.
Halm, W. G.....Hartford, Conn.
Hammer, Wm J.....New York, N. Y.
Hartwell, George H.....New York, N. Y.
Hart, S. J.....New Orleans, La.
Hart, L. N.....Boston, Mass.
Haines, H. M.....New York, N. Y.
Hageman, George H.....Kansas City, Mo.
Hood, W. R.....Philadelphia, Pa.
Holmes, C. H.....St. Louis, Mo.
Huntley, C. R.....Buffalo, N. Y.
Jenks, W. J.....New York, N. Y.
Johnson, E. H.....New York, N. Y.
Johnston, W. J.....New York, N. Y.
Kelly, James F.....New York, N. Y.
Kimball, W. A.....Fort Wayne, Ind.
Kreidler, W. A.....Chicago, Ill.
Lanby, Theo.....New York, N. Y.
Lawrence, A. B.....New York, N. Y.
Leonard, H. Ward.....New York, N. Y.
Little, E. W.....New York, N. Y.
Lovejoy, J. R.....Boston, Mass.
Lucas, H. P.....Chicago, Ill.
Lufkin, H. L.....New York, N. Y.
Magee, Frank A.....New York, N. Y.
Marshall. Norman.....Philadelphia, Pa.
Martin, T. Commerford.....New York, N. Y.
Marsh, J. W.....Pittsburg, Pa.
Mason, A. F.....Boston, Mass.
Madden, O. E.....New York, N. Y.
Manson, Geo. T.....New York, N. Y.
McCoubray, T.....New York, N. Y.
McDevitt, W.....Philadelphia, Pa.
McDonald, W. H.....Buffalo, N. Y.
McQuaid, J. P.....New York, N. Y.
McIntire, W. C.....Philadelphia, Pa.
McKinlock, Geo. A.....Chicago, Ill.
McMath, Robert.....St. Louis, Mo.
Mead, Morris W.....Pittsburg, Pa.
Meeker, George H.....New York, N. Y.
Miles, Benj. R.....Cleveland, O.
Moore, Alfred F.....Philadelphia, Pa.
Moffit, C. C.....St. Louis, Mo.
Morrison, W. E.....New York, N. Y.
Myerson, E.....New York, N. Y.
Newton, A. D.....Windsor, Conn.
North, E. C.....Boston, Mass.
Orford, J. M.....Bridgeport, Conn.
Paine, Chas. McL.....New York, N. Y.
Parker, Russell.....St. Louis, Mo.
Pennock, George B.....Chicago, Ill.
Perrine, F. A.....Trenton, N. J.
Perry, Marsden J.....Providence, R. I.
Pettengill, F. E.....Boston, Mass.
Peck, E. F.....Brooklyn, N. Y.
Phelps, George. M.....New York, N. Y.
Pine, Charles R.....New Bedford, Mass.
Pierce, O. D.....Philadelphia, Pa.
Platt, O. S.....Bridgeport, Conn.
Platt, F. B.....Ansonia, Conn.
Powers, E. L.....Chicago, Ill.
Porter, George F.....Philadelphia, Pa.
Prescott, George B., Jr.....New York, N. Y.
Price, C. W.....New York, N. Y.
Renshaw, A. M.....Washington, D. C.
Regan, R. W.....New York, N. Y.
Royce, F. W.....Washington, D. C.
Rose, Geo. H.....San Francisco, Cal.
Rodman, C. L.....Camden, N. J.
Roberts, H. C.....Plantsville, Conn.
Rosentamm, S.....New York, N. Y.
Robinson, Herbert C.....Camden, N. J.
Ross, R. F.....Boston, Mass.
Russell, D. R.....St. Louis, Mo.
Salom, Pedro G.....Philadelphia, Pa.
Scott, Charles E.....Bristol, Pa.
Schieren, C. A.....New York, N. Y.
Serrell, Lemuel W.....New York, N. Y.
Seely, John A.....New York, N. Y.
Shay, J. W.....Chicago, Ill.
Shay, J. H.....Chicago, Ill.
Shaw, A. C.....Boston, Mass.
Shoemaker, W. H.....Philadelphia, Pa.
Shainwald, Ralph L.....New York, N. Y.
Shippy, H. L.....New York, N. Y.
Slattery, M. M. M.....Fort Wayne, Ind.
Smith, H. S.....Philadelphia, Pa.
Smith. T. Carpenter.....Philadelphia, Pa.
Smith, H. M.....Worcester, Mass.
Smith, G. M.....Chicago, Ill.
Smith, Jesse H.....Detroit, Mich.
Small, H. H.....Chicago, Ill.
Spear, C. W.....New York, N. Y.
Stanley, H. D.....Bridgeport, Conn.
Stagg, J. R.....New York, N. Y.
Stagg, H. R.....Plantsville, Conn.
Storke, H. L.....New York, N. Y.
Stump, C. E.....New York, N. Y.
Stadelman, W. A.....Philadelphia, Pa.
Swetland, H. M.....New York, N. Y.
Taltavall, J. B.....New York, N. Y.
Taber, Robert.....New York, N. Y.
Temple, William H.....New York, N. Y.
Tolles, C. L.....Hartford, Conn.
Underwood.....New Bedford, Mass.
Van Gestel, J.....New York, N. Y.
Van Nuis, C. S.....New York, N. Y.
Warner, C. D.....New Haven, Conn.
Wade, E. C.....Colorado, Colo.
Warder, F.....New York, N. Y.
Wetmore, Jean A.....New York, N. Y.
Weeks, E. R.....Kansas City, Mo.
Wetzler, Joseph.....New York, N. Y.
Western, Benj. R.....New York, N. Y.
White, Charles E.....Pottstown, Pa.
White, R. T.....Boston, Mass.
Whiting, Francis P.....Hartford, Conn.
Whitney, L. C.....New Britain, Conn.
Wheeler, Schuyler S.....New York, N. Y.
Whipple, Fred. H.....Detroit, Mich.
Wilmerding, C. H.....Chicago, Ill.
Winston, H. S.....Chicago, Ill.
Wisner, F. P.....New York, N. Y.
Willyoung, Elmer G.....Philadelphia, Pa.
Williams, Harry W.....New York, N. Y.
Williams, E. F.....Beloit, Wis.
Wilbur, G. A.....Philadelphia, Pa.
Wilkins, E. Ward.....Philadelphia, Pa.
Wiley, G. L.....New York, N. Y.
Wirt, Charles.....Orange, N. J.
Wood, E. E.....New York, N. Y.
Wood, George, H.....Providence, R. I.
Wunder, F. A.....Chicago, Ill.
Young, John.....Chicago, Ill.
Young, A. M.....Waterbury, Conn.
Young, C. G.....New York, N. Y.

Tuesday's Proceedings.

President Marsden J. Perry called the convention to order at 10:30 A. M. Tuesday. He made the following address:

PRESIDENT'S ADDRESS.

You are here to-day to erect, by mutual action, another mile-stone, in the form of the volume that will be created to contain a record of your proceedings, to mark the progress of the development of the electrical industry. Short as the history of this development is, it has been so crowded and broadened by the eager enterprise that is characteristic of our people that no records are to-day sufficiently ample and complete to give any of us a correct knowledge of the present condition of the multitude of undertakings employing electricity in some form of practical application.

To supply this deficiency a "Memorial and Statement" has been presented to Congress in the name of this association, urging that the fullest possible investigation and report be made on the electrical industries by the eleventh census. This association can do no more important work for the interests it represents than to select from the census reports certain points of inquiry and adopt measures to keep them continuously written up to date. Recommendation looking to this end may be presented by the committee on data.

As a general statement it may be assumed that there is to-day a central lighting and power station in operation in every town of any importance in the United States. An estimate recently published makes the following showing:

Number of stations	1,379
Capital invested	$118,758,500
Number of Arc Lights	127,441
Number of Incandescent Lights	1,590,967
Engine capacity H. P.	356,755

Eloquent as these figures are of enterprise and progress, they tell but part of the story. One startling omission is that of the electrical transmission of power for stationary and locomotive work. The statements, however, may

serve the purpose of helping the imagination to picture the results that are to be shown by the census of the century in the year 1[illegible]

It is a safe assertion that there is not a station in this country with a present capacity sufficient to satisfy one-twentieth of the demand for light and power that exists within the area of its practical working limits. To reach the consummation of ultimately doing the entire lighting and power service that is to-day being supplied by the use of agents other than electricity, is an undertaking worthy of the united efforts of all who are interested in the electrical industry. The foundation for such a growth must be laid in an unquestioned demonstration that investments in central stations for supplying light and power by the use of electrical currents are safe and profitable, that the service is—in comparison with that rendered by other agents used for similar purposes—a protection to life and property, and that the service can be employed with advantage in economy, health and comfort, by all users that can not be realized by the use of any other agent.

Those who know best what is required to meet all issues and to establish a business involving the complex factors and conditions assembled in undertakings for central station work, are those who have invested their money in it and are employed daily in its management. To them and their interests, which includes that of all who manufacture apparatus and supplies, as surely as the greater comprehends the lesser, this association is pledged for well-considered and effective work.

In your deliberations and discussions you have an opportunity to show your thorough knowledge of the subjects in which you are interested. By your actions you can prove yourselves masters of the factors that induce progress and invariably lead to successful issues.

The twelfth convention of the National Electric Light association is now open for the consideration of such subjects and business as may come before it.

At the close of the president's address the secretary announced that Edward R. Weeks, M. J. Francisco and John A. Seely had been appointed a committee on credentials. A. F. Mason, C. H. Wilmerding and C. A. Huntley were appointed a committtee on resolutions.

The following paper, prepared by Prof. J. P. Barrett of Chicago, was read by J. W. Blaisdell of Chicago:

Electrical Industries and the World's Fair.

BY J. P. BARRETT.

It has been stated by competent authority that had it not been for the exhibition of the speaking telephone at the Centennial Exhibition at Philadelphia, the telephone would have been ten years later in receiving popular recognition and becoming a success. It is well known that the individuals who were nearest the telephone invention looked upon it with distrust, considered it a toy and an invention of no great practical importance. But Sir William Thomson, who was in 1876, as he is now, the recognized authority in electrical science, seeing the telephone at the Centennial Exhibition, became enthusiastic over it and indorsed it so warmly that it directed public attention to the invention and made it an immediate success.

Great as are the interests resulting from the telephone which was first publicly exhibited at the Centennial Exhibition at Philadelphia, the importance of this invention extends beyond the particular interests directly concerned. The public attention attracted by the telephone has stimulated activity in electrical industries which warrants the statement that the exhibition of the telephone marked a new era in electrical progress. The telephone and the relation of the Centennial Exhibition to the promotion of its popular success, is mentioned simply as an illustration of the importance of the World's Fair to electrical enterprises. Fourteen years have passed since then, and in three years more the Columbian Exposition in Chicago will be looked on to exhibit the progress which has been made since that date, and to be commensurate with an industry so progressive as to have absorbed an investment of $500,000,000 in the past ten years. It is not unreasonable to say that there will be more interest in the development of electrical science and in the evolution of the art of electricity as applied to various industries, than in any other one branch of the World's Fair. The rivalry in invention has led the United States to outstrip all other nations in the practical application of electricity. Thus it was the electrical department of the United States Exhibition at the Paris exposition saved the United States from complete disgrace; and yet the electrical department of the Paris exposition was the weakest feature of the entire show. Probably the United States in the Columbian Exposition cannot hope to equal Paris in the matter of its general exposition, but in machinery and in electrical matters particularly we should do a great deal better.

The most striking failure of electricity to play its proper part at the Paris exposition was exemplified by the Eiffel Tower, which was not only not lighted by electricity, but even had its numberless gas jets lighted by hand, after the old fashioned way. Then the general lighting of the show was not made a feature, but only a very subordinate affair. The only place where electric lighting can be said to have been a feature was in the working of the colored fountains, an English invention and already rather old, but a fine thing and worth repeating at Chicago, with better facilities for spectators. The next most striking lack of the Paris exposition was in the matter of electric street railways. It would seem that an exposition in these days should have an organized system of electrical locomotion for carrying a lot of passengers quickly and cheaply from side to side and from end to end of the entire grounds. Paris had a steam dummy going around two sides of the ground, but that was insufficient, and the cars were usually crowded just when people wanted to use them. That, however, was on account of the exposition being such an unexpected and tremendous success. The only means of electrical locomotion used at Paris was an electric crane running from end to end of the machinery building, very slowly, to give people a chance to see the various exhibits from above and incidentally some rest and some air.

There was also no organized telephone exchange system at Paris. Considering that the Melbourne exhibition of 1880 had a telephone exchange in full operation inside the grounds, doing substantial service to exhibitors, as well as to the officers of the exhibition itself, Paris is to be pronounced behindhand in this respect. There was something done in the American section at Paris for the offices of that section and for some exhibitors, but it was not very well done and was on a very small scale. There may have been other similar telephone exchanges at work, but there was no good general system for everybody and in connection with the city.

It is the intention in the following paper to point out some lines in which the exhibition of that branch of industry, in which we are all interested, should be protected and promoted according to the brief consideration which the writer of this paper has been enabled to give the subject.

In the first place, electricity will find numerous applications in the way of actual service in carrying out the plan of the exposition. By this I refer to the fire alarm protection signaling apparatus, electric lighting, both arc and incandescent, transmission of power, telephoning and telegraphing. The location of the main exposition having been rightfully settled in favor of the Lake Front, which is practically in the heart of the city of Chicago, and within five squares of the telephone central office, the fire alarm central office and the Western Union and Postal Telegraph offices, it will be a matter of no serious difficulty to make such connections with the general city electrical service as will give the exposition the benefit not only of its own special outfit in each of these directions, but also the advantage of its outside connections. Aside from this application of electricity to the utility and necessities of the exposition, the features in which we are all particularly interested are those which illustrate the progress that has been made in the science and in the art. The success that has attended recent electric exhibitions, such as the one in Philadelphia in '85, and the one in the American Institute Fair in New York, give us some idea of what can be accomplished in this direction with the immensely multiplied facilities at the World's Fair in Chicago, and with the incentive to manufacturers and inventors which comes from having the attention of the whole world directed to their work.

As is generally known, the fundamental patent on the telephone will expire in 1893, and we may expect not only the inventions accumulated and hoarded by the American Bell Telephone company for the years that they have had control of the business, to be exhibited at the World's Fair, but also numerous other inventions which will be stimulated by the opening of the field to competition. Thus this feature should be given a much greater consideration, and more attention should be paid to it than in any other previous exhibition. We have seen only the beginning of the growth of the telephone business. This is shown by the fact that in the city of Berlin there are now 13,500 subscribers, and the exchange there is growing at the rate of 3,500 per year. I predict that in the city of Chicago inside of ten years there will be 30,000 telephones in use. Such a great increase in the use of telephones calls for apparatus and appliances, the invention of which will tax the best talent of the country for years to come. Of course, in addition to the historical exhibition, and the exhibition of recent inventions in telephones and apparatus applied to telephony, there will be immense numbers of telephones used in and about the buildings of the exposition.

The matter of telegraphy also should receive its due share of attention. The different forms of quadruplex, the use of dynamos for furnishing the current instead of batteries, and other inventions in which the recent history of the telegraph is prolific, should each and all be suitably presented. Police and fire alarm apparatus of the latest design and the best manufacture, together with all appurtenances, will attract a large share of attention.

The telautograph, which by 1893 will undoubtedly be a practical success, even if it shall not have ceased to be a novelty, will also come in for purposes of exhibition as well as for extensive practical use.

Motors for driving machinery, furnishing power for various purposes, running street cars, etc., will perhaps be even of more practical benefit than any other application of electricity; while electric lighting apparatus of various kinds will take the lead undoubtedly, as it now does, over all other electrical industries.

It is proposed to connect the two parts of the World's Fair, one situated on the Lake Front and the other at Jackson Park, by means of a railroad built out on the lake. The expediency of adopting electricity for motive power on this railroad is at once obvious. Thus the two features of usefulness and exhibition can be readily combined, and in addition to the direct transmission of power, storage batteries could be employed for traction purposes on this road.

It is difficult in enumerating the different departments of electrical enterprise to foresee all of them, and particularly to foretell the relative importance of the different ones three years from the present time. In no field of human activity is invention so active and enterprise so energetic, and when we speak of the different forms of application of this science which are well known at the present day, we all know that we are simply on the threshold of future developments which may be confidently expected. No time in the history of the world has there been so great activity in any given direction as there now is in the department which we represent; and too much cannot be said with reference to the importance of having adequate facilities in the coming World's Fair to display the various industrial and artistic applications of electricity.

What will be exhibited at the World's Fair will undoubtedly be a revelation to the visitors. It should be the aim of the people having the exhibition in charge, to so organize and classify the exhibits as to present clearly and forcibly the progress of the art and the present state of the art in its various departments. A chaotic exhibition of the products of the different manufacturers would accomplish something in the way of creating astonishment and mystifying the beholder. This is not what is desired. It is desired that the World's Fair, as a whole, and the electrical exhibition, as perhaps the most industrial feature of the exhibition, be made an education. It is not too early now to lay plans for the proper presentment of electrical industries for this great exhibition of 1893. The combined intelligence of the men who are to-day pushing forward electrical enterprises, working in harmony, will be able to accomplish great results, results which will surprise all of us. But the element of time must enter into all calculations; especially is this the case with a subject so large and so involved as the suitable presentation to the public of the rapidly growing electrical enterprises in their various fields.

The exposition should be made just what its name implies, a practical exposition of the progress and advances made in the several branches of the science of electricity, and the exhibits should be so arranged that the various improvements may be seen and be appreciated at a glance. Thus will the real object of the exposition be accomplished, and a saving of much valuable time to the visitor be effected. For it is quite probable that fully 50 per cent. of the visitors to the electrical section will go there with the earnest desire to become thoroughly familiar by practical observation and study with all that has been done in some certain industry, either to aid in carrying on a certain line of study or with a view to select what they may there conclude is the apparatus best adapted to their needs. In either case, time will be an important and valuable factor, and how to enable each visitor to quickly and understandingly grasp the more important details and points of superiority of any exhibit should be the main object of the respective exhibitors.

The usual method followed in the small expositions has been to allot a certain space to each exhibitor and allow him to place therein whatever he may desire to bring to the notice of the visitor. This is a good plan, and one which proves economical in many ways to the exhibitor. Another plan would be to allot space for the various types of apparatus, irrespective of the main display of the exhibitor. That is, to place all telephone apparatus and everything pertaining thereto in close proximity; the same with telegraphic apparatus, arc lighting dynamos, incandescent machines motors, etc. The carrying out of such a plan will, of course give two or more separate exhibits to each manufacturer, and thus entail some slight additional expense, both in the matter of suitable furniture, and possibly in the matter of attendance; but all this additional outlay would be more than returned in the excellent results attained, and in the simplifying of the study of any particular type of apparatus, to say nothing of the greater publicity given each exhibit. Of course there would be no objection to an exhibitor reproducing a complete display of all his wares in the space allotted to him for his headquarters irrespective of the fact that many articles may also be shown in the respective space to which they belong.

As far as possible a complete specimen of every article and every size should be placed on exhibition. For instance, in the line of motors, there should be one of each size from the smallest to the largest turned out; and so with dynamos, batteries, etc. In the space allotted to the display of testing instruments the showcases should be placed on a flooring above a foundation made sufficiently solid to prevent oscillation of the needle, or injury to the more delicate parts from vibration or other similar cause. Every article should have a neatly printed card attached, of size uniform in proportion to the character of the object displayed, containing the name of the article, the manufacturer's address, and a brief description of its intended use, the same appearing in English, French, German and Spanish.

At the present time there are about 430 separate companies or individuals whom we can expect to apply for space, many of whom will have but a single article or two to exhibit. But every one of this number will probably defer action until the last possible moment, unless the importance of securing the necessary space and having his exhibit in readiness within the appointed time, is impressed upon him. Some of the manufacturers will have to be coaxed into making exhibits, while others will hesitate on account of the expense entailed. The chief or his secretary must attend to all of this, and must spare no pains to secure not only an exhibit, but the *best exhibit* possible for each manufacturer to make.

Great assistance in carrying out a comprehensive and systematic plan for the exposition may be looked for in the United States Census, the report of the electrical department of which is looked for with great interest.

THE DISCUSSION.

Mr. Faben: There certainly will be no one enterprise presented at the World's Fair that will interest central station men as much as will the electrical department. The amount of detail required to develop a proper exhibition of the appliances presented there, and to induce manufacturers to present those features of their business that will be not only of interest to themselves but to central station people as well, and the amount of work involved in the undertaking, demands that action should be taken by this association now. This being a central station association, the central station people ought to go to work very promptly to lay plans for securing a proper exhibition at that time. For that purpose I would like to present a motion as follows:

That a committee of five be appointed, of which number the president of the association shall be ex-officio one, the other four members to be appointed by the chair, to meet the authorities of the Columbian Exposition and secure suitable facilities for the proper exposition of electrical manufactures and appliances, and in general to work for the interests here represented, and to offer to the authorities of the exposition the co-operation of the National Electric Light association to aid in making the exposition a success.

"That the committee request the selection by the

authorities of the Columbian Exposition, of John P. Barrett of Chicago, to have the practical charge and control of the electrical department of the World's Columbian Exhibition."

MR. PHELPS: I take great pleasure in seconding the resolution which Mr. Faben has offered, and of both features of it: That is, the appointment of a committee to secure suitable facilities, and tendering the cooperation of this body with the authorities of the Fair, and also recommending for appointment John P. Barrett. The paper which has been read to us this morning is about as good evidence as we might need perhaps of the fitness of Mr. Barrett for that work, although doubtless the most of us knew that well enough before. A further reason is that Mr. Barrett has already been commended to the World's Fair commissioners by the signatures of very many of the most prominent electrical people, electricians, electrical engineers, manufacturers and users of light and power I think that it would be eminently fit and proper for this association to take such action at this time as has been proposed The sooner such action can be had the better it will be for the exhibition.

MR. ARMSTRONG (of New Jersey): I am most heartily in favor of all of the resolution except that part of it which recommends the appointment of some particular individual. I think that this association would make a serious mistake if it did that thing. I have myself recommended the appointment of Prof. Barrett, and personally I am heartily in favor of his appointment and personally am willing to do everything possible to secure that appointment; but it seems to me that the association would be making a serious mistake if it lent itself to a recommendation of any individual for any appointment. We do not want to have the slightest possible suspicion that we are biased in any direction. Therefore I am very glad to vote for this resolution, if we may have that part of it omitted. I may say to the gentlemen who have moved and seconded the resolution that I am willing to join with them, individually, in doing everything possible to have the gentleman who has presented such an interesting paper to us appointed to the position they desire to see him appointed to; but do not let this association adopt such a resolution.

MR. ALEXANDER (New York): This morning I received a copy of the electrical journal of the West, THE WESTERN ELECTRICIAN, and its first editorial speaks of mistakes made by the association at a former meeting at which it voted to have the World's Fair held in New York instead of in Chicago, and especially recommends that we take no action whatever, and do not commit ourselves further in any way whatever, without first having due deliberation. I do not think that Prof. Barrett would like the resolution to come up now. If notice had been given by these gentlemen that such a resolution would be brought up in the course of the session it would have given opportunity to gentlemen who are interested in the subject to confer with each other. I therefore move that the resolution be tabled.

MR DEGENHARDT (of Chicago): I would be untrue to the city of Chicago, and to my friend, Prof. Barrett, if I did not raise my voice in support of his appointment. As I understand it the resolution has for its object the successful operation of the World's Fair. In the appointment of a neutral man like Prof. Barrett we have a man who possesses all the qualifications set forth in the resolution; and I would like to add that the very support which has been granted to him by signatures throughout the United States is a sufficient guarantee of the feeling which must exist. Prof. Barrett is known throughout the United States as an absolutely neutral man. He has no affiliations that we know of, and is therefore a man qualified for the position. I think that this association owes the city of Chicago as a debt the adoption of this resolution

After some discussion in regard to the order of business it was voted to refer the resolution to the committee on resolutions.

THE COPPER TARIFF.

THE PRESIDENT: The next order of business is the report of the committee on copper tariff, by Charles A. Brown of Chicago.

MR. BROWN: We had expected that by this time Congress would have passed a tariff bill and that thus there would be some definite result with reference to the duty on copper in securing which the committee could claim some part. But you all know what the present situation regarding the tariff bill is. The original bill introduced by the committee on ways and means provided for a reduction of fifty per cent. of the duty on various forms of coppper. This provision of the bill as introduced into the house was not changed in the house. In the senate the clause relating to the duty on copper was amended by further reducing the duty to one-half cent per pound on ores and one and one-quarter cents per pound on ingots, bars, plates, and pigs, being a reduction of seventy per cent. in one case and eighty per cent. in the other from the present schedule of duties. It is reasonably sure that if the tariff bill becomes a law at the present session of Congress the duty on copper will be reduced at least fifty per cent. Your committee has secured something over 500 signatures to a petition addressed to the committee on ways and means requesting the abolition of the duty on copper. We have mailed something over a thousand circular letters and have made in addition to that a good many personal solicitations. Mr. Phelps of the committee, personally went to Washington with the signatures to this petition and presented them to the committee on ways and means with a brief but forcible argument in favor of the petition. As no appropriation was made by the association to meet these expenses the members of the committee themselves advanced the necessary money for postage, traveling expenses, express, etc., to the amount of $110 in carrying out what seemed to them to be the spirit of the instructions contained in the resolution appointing this committee.

The report was adopted and the committee continued. It was also voted to reimburse the committee for the expenditures it had made.

THE PRESIDENT: The following topic has been proposed for discussion: "The Proper Classification of the Lighting Power of Incandescent Lamps."

The convention took a recess until 4 p. m.

AFTERNOON SESSION.

After calling the convention to order President Perry announced that he had received a telegram from M. D. Law of Denver, in which he expressed his regret at being unable to be present.

LIQUID INSULATION.

THE PRESIDENT: The first thing on the opening of this session will be a five minutes' talk by David Brooks of Philadelphia, on the use of liquid insulation for underground conductors.

MR. BROOKS: The five minutes that I take will be a brief reference to the advantage of a liquid insulation for underground conductors carrying currents of high voltage. Since electric lighting came into use it has been found that the ordinary tests for insulation do not apply; that is, a test with a galvanometer and a voltaic battery of say one to five hundred cells. That fact has become apparent, and they have adopted other means in Paris and in London for testing the insulation of conductors that have to carry very high intensity currents. We have seen this noticed in many periodicals. William Mayer, Jr., in an article published March 1st, of the present year, states that a cable measuring twenty thousand megohms per mile, for insulation in the factory, broke down by a dynamo current of six hundred volts after being drawn into a conduit. Now, in the ordinary test, if a person should measure the insulation of an electric light cable and he found it was twenty thousand megohms per mile, and he took another system of insulation and found that it was only half a megohm per mile, as a general result he would take that which stood twenty thousand megohms to a mile; but if you apply it to a current of high voltage from an induction coil or a Holtz machine you can prove that the one with the twenty thousand megohms insulation per mile was broken down by from five to ten thousand volts. Now you take the same No 4 conductor and insulate it in oil for twenty feet, just as an experiment, and raise the temperature to 200 degrees Fahrenheit and apply the galvanometer, and it is now half a megohm per mile - just about one fortieth part of the one that Mr. Maver speaks of; but when you come to apply the induction coil or the Holtz machine and test it to produce what is sometimes called the break-down or a disruption, it can not be broken with five hundred thousand volts. There is the difference between the testing of the insulation of a cable, or an insulator, or a dielectric, if you please, using the ordinary delicate galvanometer, static galvanometer, and testing it for a current of high voltage. Now if the current applied to a conductor tests half a megohm per mile, the temperature of the insulation being 212 degrees Fahrenheit, that would not show much; no one on first sight would buy it; but if you are going to purchase a cable and test it as they do in England, or give the guaranty as they do now in England, there would be five parts of current going through the insulation, to five hundred thousand and five parts going through the conductor; and the small proportion going through the insulation is a mere bagatelle, but it stands the current. These are experiments that I have made in Philadelphia, and I would do it here with a Holtz machine, but the atmosphere in the summer and especially on the sea shore is very unfavorable to the use of a Holtz machine.

If the insulation is punctured, it is restored at once by agitating the liquid. In iron pipes the liquid is continually moving, owing to contraction and an expansion of the oil, from changes of temperature and no chance for the current, through a fault or weak spot, to develop into a perfect ground.

And how about conduits or subways? I learn from official statements that they charge a thousand dollars per mile per annum for the use of a duct in Chicago and New York, and further, that an electric conductor carrying a thousand volts costs a thousand dollars per mile or more, for maintenance. Two thousand dollars is the interest on thirty three thousand dollars and over, at six per cent. Can arc lights be furnished under those conditions at a living profit?

I shall not go into the cost, inconvenience and dangers of subways. Those that have used them, and otherwise not interested, can tell all about them

Underground conductors and underground systems are not popular on account of cost. As before stated. they are as cheap by this system as overhead wires and cost comparatively nothing for maintenance.

THE PRESIDENT: The next thing in the order of business of the afternoon session is a paper on "Dangers from Electricity," by Professor Henry Morton, of Stevens Institute of Technology, Hoboken, New Jersey, and will be read by P. H. Alexander.

THE DANGERS OF ELECTRICITY.

BY PROF. HENRY MORTON.

When the development of electric currents on a large scale and at a small cost, first became possible by reason of the discoveries of Faraday, Wilde, Gramme, Siemens and others, the question of the dangers to life and property attending their use was brought prominently before the public; just as the dangers attending the use of steam, of rapid locomotion on railroads, and of dynamite, were brought to the attention of the world when these powerful agencies first left the experimental laboratory of the chemist or engineer, to take their part in the ordinary labor and business of life.

In each instance alike there was a class of people who took the narrow and impartial view that if an agency was dangerous it should be excluded altogether from public use or what amounted to the same thing, be surrounded with such exclusions and limitations as would rob it of nearly all its capacity for usefulness, and restrict all possibility of advance and development in its application.

Thus laws were actually passed in England, on the first introduction of steam, limiting the pressure in boilers to 30 pounds on the square inch.

The first railroad charter contained a clause limiting the speed of trains to twelve miles an hour, and when a speed of thirty miles was suggested it was ridiculed in a prominent journal of the day, as an idea simply insane, and it was said that people would just as soon be persuaded to allow themselves to be fired out of cannon as to be hurled along at such fearful velocities, which would without doubt have the most disastrous effects upon the circulation of the blood and other vital actions.

Some of us can also recollect the excitement produced and echoed in the press, on the introduction of dynamite, and the stringent laws regarding its transportation, which in many cases only increased the danger to the public by occasioning its surreptitious conveyance in passenger and ordinary baggage cars.

We shall have to be very young indeed not to remember the great popular excitement brought about by the daily press when electric lighting first appeared in the streets of New York, and when flashes of flame were described as proceeding from a horse that had run against an electric wire.

In all the older instances matters have settled themselves in accordance with the laws of human progress and the diffusion of intelligence, and we now have boilers running at pressures of 140 pounds and upward, trains going more than a mile a minute, and gunpowder largely superseded by dynamite.

What is more, the accidents and injuries actually produced by these several agencies have been vastly less than those caused by the things which they replaced.

A much smaller number of people are killed or injured by high pressure boilers than by low pressure ones. How rarely do we hear of the explosion of locomotive boilers which usually carry 140 pounds' pressure?

The accidents to express trains are as nothing compared to those occurring with freight trains, and the loss of life and injury to passengers by rail, is insignificant in its percentage to the number carried, when compared to similar loss and injury incurred in the days of stage coaches.

The same relation has been found between dynamite and gunpowder, the former having largely reduced the proportion of accidents and injuries compared with the work done. Two lessons are very plainly taught by the facts of history above alluded to:

First. The world is not going to be frightened away from a new and valuable source of power by the circumstance inseparable from the very nature of all powerful agencies, that it is dangerous if not adequately controlled; but on the contrary will develop the new power to an ever-increasing and therefore more (possibly) dangerous intensity.

Second. Intelligently managed and controlled, the most powerful, and therefore, in a sense, dangerous agencies, become the most efficient protectors and servants of man, and not only aid him in his mission of subduing and utilizing nature, but actually protecting him in his work.

Without these "dangerous" agencies, men would be reduced to the lowest condition of savagery where he would be at all times helplessly at the mercy of the "elements" or the blind forces of nature.

With them he not only defies and subdues the beasts which would otherwise be his superiors, but even conquers and renders tributary to his comfort and advancement those vast forces which control the entire matter of the universe.

Applying these lessons taught by the past history of the world in parallel cases to the problem of the distribution and use of electricity, we see in the first place that the way to deal with its dangers ought not to be the timid, obsolete way of prohibition, or of unintelligent restriction, such as that which proposed the exclusion of locomotives from railroads, or the limiting of their speed to twelve miles an hour; but the sensible way of providing adequate safeguards to the new power and with these allowing it to follow its natural line of development and growth into higher and higher ranges of intensity and consequent efficiency.

It is too well known to all, to need statement, that the methods thus pointed out by history and taught by experience, have not been by any means universally advocated or followed, and that while many have loudly demanded the exclusion of powerful electric currents the limitation of their intensity to what they suppose to be necessarily harmless ranges, the users of such electric currents have in too many cases neglected the most obvious precautions.

It is only fair to say in explanation of this latter statement that this neglect has in many cases been brought about by obstructions thrown in the way of good work by those who were exciting themselves for the total abolition of dangerous currents, and who like certain "total abstinence" advocates, objected to every mitigation of the evil they attacked, because any such improvement weakened their case against it.

As regards dangers to property from fire, the matter fortunately fell at an early period into the hands of the Board of Fire Underwriters, who in a judicious and business-like way, investigated the subject, and formulated such rules as have proved eminently satisfactory, and have proved that under proper regulation as to good work and means of protection, electricity is by far the safest means known to us for the distributing and development of light, so far as fire-risks are concerned.

In view of the satisfactory results thus obtained I regard it as a fortunate circumstance that the other part of the problem, namely, that relating to dangers to human life, has been recently taken in hand by a similar organization known as the Employers' Liability Assurance corporation.

This association, after collecting a mass of material from a great variety of sources, has some time since formulated a series of rules for the protection of those employed in erecting and operating electric apparatus involving the use

of powerful, and, therefore, dangerous currents. These rules have been examined and approved by several of the managers of prominent electric companies, and so far it would appear as if no accidents have resulted from the use of electric currents where these rules have been followed, and that most if not all the accidents which have occurred would have been prevented had these rules been followed and obeyed.

Having had something to do with the framing of these rules it is my chief object in presenting the present paper to secure their criticism by those best able to perceive their imperfections, and such suggestions as may lead to their beneficial modification or extension.

I therefore quote them as follows:

"1st. Do not touch or handle any electric wire or apparatus of any sort while standing on the ground or while in contact with any iron work, gas or water pipe, or stone or brick work, unless your hands are covered with rubber gloves, and you are provided with such properly insulated tools as have been declared to be safe and in good order by the electrician or other competent officer of this company.

"If it is at any time necessary to stand on the ground, or any surface not insulated from the ground, while handling electric wires or apparatus, rubber boots or an insulated stool should be used.

"In moving wires, hanging on or lying over electric light wires, lamps or fixtures, use a dry hand line.

"2d. Never handle any electric wire or apparatus with both hands at once when this can be avoided, and if it is necessary to do so, be sure that no current is present, or that one or both hands are protected by rubber gloves or other efficient insulation.

"3d. When handling line wires, treat each and every wire as if it carried a dangerous current, and under no circumstances allow yourself to make contact between two or more wires at the same time.

"4th. Never open a circuit which has been in use without giving notice to the superintendent or whoever is in charge, of your intention to do so, and at the same time request that the same line be opened at the main station, and kept open, until you have given notice that your work on that line is complete.

"5th. In the dynamo-room never go near the belts or dynamos, nor touch any apparatus unless you are fully informed and instructed how to do so.

"Tools used by linemen should be provided with insulating handles of hard rubber or other equally good insulator. It is the duty of each lineman to look after his own tools and see that they are in good order, especially as to their insulation.

"6th. Lamp trimmers, and others engaged in the care of lamps, must see that the switch putting the lamp in circuit is turned off before they handle the lamp in any way.

"In construction work a space of at least twenty inches must be left between the holes for pins on the cross arms, so that a lineman may get to the top of the pole and work without danger."

The same insurance association has collected the authentic records of a number of so-called electric accidents or accidents happening to the employes of electric companies. I have now before me the abstracts of ninety-one such cases.

The first thing that presents itself in looking over this set of abstracts is that very few of the accidents are in any way attributable to electricity directly, but would have occurred had the establishment in question been any kind of a factory where power was being used, or any place where heavy objects were being moved. A few examples will illustrate this, thus:

No. 1. While steadying with a pike-pole a large electric light pole which was being placed in position, a passing "low-gear" belonging to the Standard Oil company ran over ankle.

No. 2. While assisting in hoisting a stick of timber from the street to the second floor of electric station, was injured in right foot by having the stick fall upon it.

No. 9. Was going to dynamo, stepped on iron plate temporarily covering a belt hole in floor. The plate tipped and he fell partly through the opening, injuring himself internally.

No. 17. Was oiling rocker shaft of engine near fly-wheel; leaned back too far and was struck on head by spider of fly-wheel.

The above are fair samples of the rest, and in fact out of the ninety-one cases but fifteen (or about sixteen and one-half per cent.) have any direct relation to electricity.

As I have already mentioned, of the fifteen cases in which the injury was in any way caused by electricity there are none in which the action would not have been avoided if the above quoted rules had been observed. Thus, beginning with the first in order as arranged in the abstracts, all before it having no direct connection with electricity, we have:

No. 11. While removing the wire from a Brush dial or regulator which had become short-circuited was slightly burned on two fingers of right hand.

In this case the beneficial effect of rule No. 2 was manifestly expressed and had the spirit of rule 7 been complied with, even the slight injury experienced would have been avoided.

The next in order is No. 20. Was putting carbon in electric lamp which was out of order and failed to burn. Received charge of electricity which caused him to fall down from step-ladder on to steam radiator. Two ribs broken.

This would clearly have been avoided by an observance of rule 7.

Time will not permit me to quote all the fifteen cases and I will therefore only repeat that they would all of them have been avoided by a strict observance in form and spirit of the seven rules of directions quoted above.

Of course I do not mean to imply by this that these rules are perfect or complete, but only that they seem to be in the right direction and to furnish a starting point, from which further developments may proceed.

No one having even an elementary knowledge of electricity as it existed ten years ago needed or needs to be convinced of its power to do harm where all safeguards are removed, and the occasional declarations of its harmless character which have been uttered can only be accounted for by reference to that combative disposition which impels some minds always to take a view in opposition to any which may be expressed, and gives birth now and then to a book or pamphlet disproving the law of gravitation or the solar origin of light and heat. To say this is however, far from agreeing with the other extremists who would banish electricity from our daily walks and occupations, or place it under restrictions which *might* render it harmless but which *certainly would* render it relatively useless for the countless purposes in which its efficiency demands its full development.

The true opinion is that which is supported by past experience, and which advocates the fullest development of power to which this agency can attain, combined with the use of all the means of protection by which human intelligence can protect itself while using to the utmost this potent and therefore dangerous weapon in our victorious contest with the inimically destructive forces of nature.

DISCUSSION.

MR. FREELEY: In my observations on Professor Morton's paper I should have liked to avoid if possible all reference to the company that I represent, because it might be said that my company, like a great many individuals connected with the business, has its axe to grind. Well, my company has. But my company has another object in view which I think will commend itself to you, and that is to bring about a better condition of things than exists at the present time in connection with the instructions to employes of electric light companies with regard to the dangers which surround them in carrying on their daily operations. When my company started in business here a few years ago they found that in consequence of their being the first to introduce what is known as employers' liability insurance in the United States, that they had really no experience to guide them upon which they could base rates of premiums for the various electric risks The company therefore had to refer to experience in England. But there they found themselves somewhat in the same difficulty, as electric lighting was in its infancy, and very little or no attention had been paid to the collection of statistics with regard to accidents to electric light employes. They therefore laid down this basis of charging a rate to the electric light companies: To consider an electric light company in the nature of an ordinary producer of an article, and to add to that a certain percentage for the known or unknown risks which might be incidental to their business. They therefore established what they considered to be a fairly reasonable rate to charge the electric lighting employes in order to protect them in their legal liability for accidents to employes. But, in the course of a short time they found that the rate was inadequate. They found that several serious accidents occurred among their policy holders, and what was of greater importance to them in carrying on their business, they found that the prejudice of the public, which was aroused by the press from time to time, whenever an accident occurred, for instance those which occurred in New York, was so great that when a suit was brought against a company for an accident which had occurred to an electric light employe, and he demanded compensation or damages from his employer for his injuries, it was utterly impossible to carry that case before a jury.

It was considered that electric light companies were carrying on their work regardless of the dangers by which their men were surrounded. As these cases went on accumulating we were compelled as business men to consider what was best to be done, First of all, we had to protect ourselves from loss, and the result was that we were compelled to increase our rates of premium by nearly one hundred per cent. We then set ourselves to try to find out whether we could do anything to bring about a better state of things with regard to the employes of electric light companies, and, if we could do so, whether it was not possible to reduce the rate of premium charged to electric light companies. We accordingly issued a circular to our policyholders asking them to send us for our consideration copies of their regulations for the guidance of employes in carrying on their work. We told them that we contemplated submitting those regulations to an eminent electrical authority that he might formulate a set of simple regulations which might have the effect of minimizing the dangers surrounding electric light men. We received many replies from companies who stated that they had no regulations of the kind at all. Others sent us their regulations, but we found that they did not cover the whole ground. Others sent us on some very good regulations. The result was that we found that there was no general kind of action existing among electric light companies on this subject. We submitted all these regulations, and the matter generally, to Professor Morton. He has drawn up the set of regulations which we have read, and we consider them very good. We also requested him to write a paper for the consideration of this convention.

Now, as Professor Morton says, possibly these regulations are not complete; I therefore ask you to take those regulations into your best consideration and if you can aid us, either individually, or as an association to complete them, we shall think it a great favor.

MR. FRANCISCO: Suppose that I insure my own company, with a view to protecting it against any claim which can be brought for accidents to workmen. What would be your price, as you stand now?

MR. FREELEY: The premium is based upon the wages or upon the payments. We should charge one and a half per cent.

MR. FRANCISCO: I find from his statement that he charges one and a half per cent. to insure me against any claim that my employes may make. I have been running a station where for five years we have not had an accident of any description. Why should we pay for protecting ourselves against the claims of these men nearly double what other manufacturers would pay for the same privilege? It is a fact that I can insure a quarry company, employing a thousand workmen, for less than half what you say you would be obliged to charge me for protecting the employes of an electric light company. In the quarry the men are certainly exposed to very great dangers; and several of the quarry men have been killed during the very time that our station has been running with no accidents at all. I claim that if a station is properly prepared and the lines are properly run, there is no more danger in running an electric light station than there is in any other ordinary business—that is, in any business where you would classify them as an ordinary risk. Why, therefore, should electric light men and electric light stations be called upon to pay additional premiums?

Mr. Alexander offered a resolution recommending that a copy of the rules prepared by Prof. Morton, as embodied in the paper, be conspicuously posted in every electric light station. The resolution was adopted.

E. A. ARMSTRONG: For over five years we have operated our station, and have had no accident of any kind, with but one single exception. I believe that a door of the boiler room fell down on one of our employes and hurt him somewhat, but you would hardly charge that against the electric light station. The company insuring us told us last week, when our policy expired, that they would require double the amount of premium that we had paid; but so far as I have been able to see, there has been no warrant for that increase in the accidents which actually have occurred; and the report made in this paper fully justifies the conclusion that I reached. A representative of the company says, however, that because of the ignorance and the prejudice concerning this very subject, the companies have been compelled to pay largely in excess of what they ought to pay. Now, it strikes me that on such grounds there can be very little justification in raising the rate as it has been raised upon us; but still the rate is raised. If by the observance of these rules the 16⅔ per cent. can be further reduced, then it is well; if, however, by a careful examination by the officers of this association, and by a careful report from every company and member of this association, it can be shown that the accidents in electric light stations are less proportionately than in other stations, merely because the men are more careful, dealing, as they do, with dangerous things; merely because the men are more watchful, having, as they do have, graver responsibilities, then we ought to have the full benefit that other companies get in their insurance. I move that the committee on data be requested to examine into and report all accidents happening in electric light stations, and to what they may be attributed.

The motion was carried. A vote of thanks was extended to Prof. Morton for preparing the paper.

THE PRESIDENT: Mr. Cutter of Chicago, will now present the report of the Committee on National Insurance Rules.

MR. CUTTER read the report as follows:

REPORT OF COMMITTEE ON HARMONIZING INSURANCE AND ELECTRIC LIGHT INTERESTS.

Your committee has at this session simply to report progress, as the object for which it considers itself appointed has not been completed, viz, the codification of a set of rules regarding electric light and power installations which shall become national in character, and be used instead of the many sets of rules put forth by the different insurance associations throughout the country.

We have written the following letter to many insurance associations throughout the United States:

"CHICAGO ILL., April 8, 1890.

"DEAR SIR: At the last meeting of the National Electric Light association in Kansas City, a committee was appointed to select delegates or representatives from the different insurance associations in the country, and also from the electric light companies to a national electric insurance committee This committee will probably consist of eleven or thirteen members, the majority to be insurance men. They are to devise a set of insurance rules concerning electric light installations which shall be enforced all over the country. It is found at present that different rules are in force now in different parts of the country, and in many places two sets of rules, more or less conflicting, cover the same territory. We hope to remedy the evils of this by devising one set and have this set supported by insurance men throughout the United States.

"In order to have these rules the best for the purpose, they should represent the average opinion of the various men who have had experience in this particular line, and also who represent the different interests involved It is our aim to get a committee thoroughly well balanced as to the conflicting interests, so that the resultant opinion of them all will be so strong an expression of the best methods for electric work as to meet the support of all the insurance people and the electric light people also.

"We wish you would name your choice as a representative upon this committee. We are already accumulating a great deal of information on insurance rules all over the world, so that when this committee hold their meeting they will have the work so far advanced, that a good set of rules can be arranged without very much delay.

"As there are many electric light inspectors who have had valuable experience and understand the subject pretty well, whom we expect to have on this committee, we feel that such a committee will be a great benefit both to insurance and electric light interests. It is our ambition to have this committee so carefully selected that it will become a body of referees to settle all important questions arising in relation to proper electric work. We trust you will realize the importance of this, and give it prompt and careful attention, and be prepared to support the decision of such a committee.

"Hoping to hear from you soon, and to have your support in this valuable work, we remain,

"Very resp'y yours,

GEO. CUTTER,

Chairman Ins. Committee, N. E. L. A."

The answers to these letters were almost universally

favorable, and contained many expressions of appreciation on the part of the insurance people of the efforts made by this association to work in harmony with them in devising these rules and in advancing information leading toward good and safe construction

You can, of course, readily understand that it has occupied much time and correspondence to determine just what associations to approach, and how to approach them, and get them to fully understand our object in order that they should send a representative to act upon this committee. As a result of this work we have the pleasure of informing you that the following gentlemen have come to Cape May as representatives of the various associations and companies named:

COMMITTEE ON NATIONAL INSURANCE RULES.

GEO. CUTTER, Chairman.

COMPANY.	REPRESENTATIVE.
Edison	W. Jenks
Thomson-Houston	J. R. Lovejoy
Westinghouse	P. H. Alexander
Engineering Firms	T. Carpenter Smith
Electrical Supplies	George Cutter
Philadelphia Bd. of Fire Underwriters	Wm. McDevitt
New York Bd. of Fire Underwriters	Wm. D. Boughton
Underwriters Ass'n of the Middle Dep't.	H. O. Eline
National Bd. of Fire Underwriters, New York.	A. A. Anderson
Associated Factory Mutual Ins. Co., Boston	Capt. Brophy
Boston Board of Fire Underwriters	F. C. Cabot
Western Union Fire Underwriters Ass'n	C. E. Bliven
Cleveland and Chicago B'ds.	John P. Barrett
St. Louis Board	Robt. H. McMath
Central Station Insurance	S. E. Barton
New England Ins. Exchange	C. N. Goddard
Southeastern Tariff Ass'n	Jno. S. Alfred
Underwriters Association of N. Y. State	Babcock

These gentlemen have been in session most of the time for several days discussing the different rules, and laboring to outline a framework, so to speak, or what they term generic rules. It was the general feeling that these rules should be made concise, and as few as possible, and still cover the basic principles of good work.

Your committee have the pleasure of stating to you that the insurance representatives were quite generally agreed with a feeling of good will toward electric light and power installations, and they do not feel afraid of them.

The deliberations upon these set of rules have been referred to a sub-committee for further study, both to eliminate any mistaken positions, and also to frame them in proper wording.

They have also taken the necessary steps to communicate with one another for the purpose of arranging these rules so they can meet the approval of the different representatives and be adopted in place of the rules now in force. It is the opinion of these gentlemen that this work will be accomplished, and that they will enable your committee to report to the next meeting of this association the uniform set of rules that you have wished for, and also that they will be supported by the various insurance associations.

It was voted at the last meeting that we should express to you their appreciation of your efforts to work in harmony with them in this direction and assure you of their good will and reciprocity of feeling in the same line.

Your committee has also corresponded with various European authorities to learn their methods of inspection, and also to secure copies of the rules they have in force, and we have in our possession various sets of rules from England, France, Germany and Italy, and these sets of rules with their accompanying information will probably influence to a considerable extent the rules which we will adopt. The force of this can be especially appreciated by quoting part of the report of the committee on lighting, heating and patents, appointed by the National Board of Fire Underwriters, which report was presented to the National Board last winter:

"The great problem before us to-day, however, is the management of the various systems of electric lighting so as to insure safety from fire. When such lights were first introduced, underwriters congratulated themselves that at last the long sought means of illumination without danger had been found. No matches, no kerosene explosions, no swinging gas brackets would hereafter vex them, but a steady, safe and brilliant light, which could do no possible harm, had come among us, and all were happy.

It did not take many months, however, to discover that the electric light was not the harmless thing we had imagined, but that it was a most prolific source of danger, and its introduction has cost the insurance companies more than any method of lighting heretofore in use. It has come to stay, and some time it will probably be as safe as any light in use, but our knowledge of its properties and of its management must be vastly increased before that time appears. We see the danger, but as yet are too ignorant to point out the remedy. What yesterday seemed a safe method of installation, to-day proves dangerous, and what we regard as safe to-day is likely to develop danger to-morrow. We can only wait and study."

For a number of years the National Board has followed the action of the New York Board in the matter of rules of regulating electric light equipments. Those rules were revised and reissued by that Board, January 15, 1890, and it is recommended that they be adopted by this body as thus revised, and promulgated to members.

In this connection, it is proper to say that the National Electric Light association asks the National Board to nominate a representative upon a committee to be drawn from bodies of underwriters and electrical experts in different parts of the country to devise and recommend rules for electric light installations, which shall be uniform throughout the land, and tend to throw safeguards about the use of such lights. Your committee recommends that the invitation be accepted, and a representative appointed. Certainly, nothing but good can come out of the deliberations of such a committee, and it is necessary that we should in every way increase our knowledge of what has become so important a factor in our business, and if possible, remove some of the dangers now attending it.

Precisely what is expected of this committee in regard to the third topic named in this report, viz "Patents," they are unable to say, but nothing in this department has been brought before them which seems to require any report.

And then to show the opposite opinion held by insurance companies in Europe as well as many in this country: The Phoenix Fire Office Rules of London were issued in 1882, and their edition of 1889 contains the following statements, viz. "Notwithstanding the number of years that these rules have been in force not a single fire has yet occurred from any electric installation that has been placed up in compliance with them. The electric light is the safest of all illuminants, and is preferable to any other when the installation has been thoroughly well put up."

The electric light and power interests are of great importance in Italy and the only rules in force in that country are those established by the government to protect its telegraph and telephone circuits. There are no insurance rules in Italy, and no insurance inspection of electrical installations, and places lighted by electric lights have the benefit of a diminished rate

In conclusion, gentlemen, your committee respectfully ask for time to complete their work.

THE DISCUSSION.

MR. DUNCAN: There is a statement made in that report to which I desire to call the attention of the chairman of that committee. The committee places itself upon record as making the statement to this association that electric lighting up to the present time is the most dangerous illuminant in this country; and in the latter part of the same report, since 1882, in England, it makes the statement that it is the safest illuminant in the country. Is that correct? Where is the quotation from? That is what I am trying to get at.

MR. ARMSTRONG: The National Board of Underwriters.

MR. DUNCAN: That is the insurance standpoint. The last statement made is based upon what?

MR. CUTTER: That is a quotation from the last edition of the Phœnix Fire Office rules.

MR. DUNCAN: In other words, the two statements upon which the committee's report stands are from two standard authorities upon insurance matters, one diametrically opposed to the other I hope that this committee in its pursuit of facts and in its pursuit of knowledge will so sift the insurance statements, that when it comes before this body again it will be able to say from its own standpoint what are facts and what are not.

MR. ALEXANDER: Perhaps the reason why the Phœnix rules show such good results is because on the very first page is printed a very terse sentence, and very much to the point. It says, "In examining your tenders for work for different electrical companies be careful not to accept the lowest tender until you have thoroughly examined all and find that the work will be done just as good at the lowest figure as the highest given." This short sentence, or one using similar language, is printed on the first page, and owing to that, perhaps, they had such good results with their rules.

S. E. BARTON: There seems to be a little bit of misunderstanding on the part of my friend Mr. Duncan in relation to the quotation in that paper. The report of the National Board of Underwriters which was quoted in the paper is the most asinine conglomerate mass of stuff that I ever read. I have taken the trouble to express myself on the subject. The whole basis for the statement made in that report was founded upon the assumption that the one great fire in Boston last November was due to electrical causes; and Mr Chairman, there is not a shadow of foundation for that assumption, and I make the statement boldly and challenge any refutation of it. The fire cost the insurance companies something like three and a half or four millions of dollars. In a certain statistical paper it swelled the losses chargeable to electric lighting more than five hundred per cent.; still it was only one fire, only one incident, and that one incident was without foundation of authority. Those are the facts. The number of reported fires which occurred last year from electrical causes was only seventy-three, as compared, I believe, with one hundred and nineteen the previous year for the whole United States. The number of fires was actually twenty-five or forty per cent. less; the amount of loss attributed to fires five hundred per cent. greater. As I have repeatedly made the statement, if that kind of reckoning is fair and is right, why, then you may fairly say that a cow and a lantern are the most prolific source of danger that is known, because they burned up the city of Chicago, with two hundred millions of dollars. The whole subject of the report of the National Board of Fire Underwriters of New York is not worth talking about I am ashamed of my profession that ever such a report should have emanated from it.

MR. MASON: This seems to be a case where, more than any of which I have had knowledge, the doctors disagree. It does seem to us as if the insurance people had not much confidence in each other's judgment. An insurance man characterizes the report of the largest insurance organization perhaps in America as "asinine," and we are all cheering him; and, if it will be taken in the pleasant way in which I speak it, I rather think it is a fact that insurance men enjoy hugely disagreement with each other. We appointed a committee last year, the committee of which Mr. Cutter, the chairman, has just made a report. We had a more or less definite thought in our minds as to the scope of that committee's work. They have done a work undoubtedly valuable and one that must live and must go on. Yet I have been questioning whether this association does not want to do something itself, and I have thought of presenting a resolution asking the committee to give us a set of rules which it can recommend, and we will consider them here.

MR. ALEXANDER: I want to say that there are several gentlemen here who have come many miles, insurance men, who do not consider that they have a right to the floor, being merely here on complimentary tickets. I think it would be merely fair play to permit these gentlemen to express their ideas. But before you call on them I want to say that I have found these gentlemen, not as Dr. Mason has described them, when I sat with them three long days, but rather inclined, many of them, I will say, inclined to do the best they can in our favor. In fact, one inspector said this—and he is an inspector well known, Mr. Goddard of Boston—"If you and Mr. Jenks and Mr. Lovejoy say that my rules are wrong, I will consider that they are wrong unless I can present an argument and convince you that I am right, because you have had experience in the business which I have not had."

MR. CUTTER: I will first undertake to explain to one gentleman who has asked about the contradictory statement. That arose because the chairman considered the report before the National Board as unfair; therefore, a careful consideration of my report will find that I have embodied the statement that the insurance men here have expressed themselves in a different tone, and that insurance people abroad have expressed themselves in a different tone; and our only object in embodying it in our report was simply to put the two statements side by side for consideration, to show the absurdity of the position taken by the committee of the National Board; that that opinion is not sustained by the insurance people in this country, and I intended to so word my report as to convey to this association the idea that the insurance people that we have met here have given us to understand that they do not concur in that view of the case.

Now, in relation to instructing us to devise an independent set of rules to present to this association, I would like to state that we are not active members of this association, none of us. Ours is a labor of love. We do not care very much about how your rules are; we simply want good work; and I for one am willing to do what I can toward bringing about that good work. In doing that we have brought insurance people here, twelve or thirteen of them from different parts of the United States. All told it represents considerable expense and time lost; and for what? If you tell us to devise a new set of rules and present them to this association, you thereby tell those insurance people that you do not care for them to continue their work toward devising a uniform set of rules which they will support. If you appoint a separate committee, whether they be active members or not, you take practically the same position, and you put us in a very embarrassing one, because the insurance representatives have most of them gone home. We have taken the necessary steps to reach them. We have appointed a sub-committee to enlarge and perfect the instructions we have given them, and in harmony with what they supposed to be the wishes of the National Electrical Light association. Your committee, to speak candidly, felt itself toward the last of the deliberations in a very embarrassing situation, Working here and not being members of the association, and not knowing whether it would be supported or not, we could not complete our labor; therefore, in order not to block the work we made our arrangements with the National Electric Insurance committee, so called, to hold itself together—and your committee of five are upon it—to work out this set of rules; and in my report I have said that we hope to present them to the next meeting of this association for your approval, to do as you please with them; and also with it a statement that those rules will meet the support of the insurance people. When they come before you at the next meeting we believe you will not have to refer them again to the different insurance people for their approval.

MR. MASON: I think there is not a member of this association but appreciates the work, not only of Mr. Cutter, but of those who are joined with him. I hope the pleasantry in which I indulged regarding insurance people will not be taken as serious. But this I am very serious upon. Here is a committee which is not responsible to us, and which will do doubtless a valuable work; a work which may or may not live; I trust it will live. One thing is sure; this association appointed a committee because it wanted to adopt certain rules, and it is competent to do it. Whether insurance people like the rules afterward or not is a secondary question. Now my resolution looks simply to this: That our committee shall, if it believes that the rules that shall be formulated by this larger body are the best possible, present them to us; if not that they will make such changes as their independent wisdom suggests; but that finally we shall have a report to us of our committee of rules which the Electric Light association may consider and upon which it may pronounce, absolutely independently of any and all other organizations.

MR. BARRETT: I have had the honor of representing the Board of Underwriters of Chicago at this meeting, and I found there some of the ablest men in the profession of inspectors in this or any other country, willing to work and co-operate with this association for the purpose of the common good One of the great difficulties with which we contend in this country is the various rules set down in different parts of the country; and the great purpose of this meeting, as I understand it, was to harmonize those rules, and to get a set of rules for inspection and installation. I understand that this report, when finally made, was to come to this association and receive its approval or rejection. It had arranged to receive reports from all parts of the country, and I would be sorry to have this arrangement disturbed until the next meeting of the association, so that we may have an opportunity to lay something before them.

MR. ALEXANDER: What I want to find out here is

just the question that Dr. Mason asked, who are that committee? I find in the printed report of the Kansas City convention no mention made of any committee being appointed, but simply a resolution to appoint, and that resolution so to appoint a committee of five, which in turn shall appoint three electric light men as a committee of conference.

MR. CUTTER: I will explain about that committee. The resolution was passed at the last moment of the meeting at Kansas City. The committee was appointed by the president later on, and if the report has been published without the names of the committee, that is not an explanation of it. The committee consists of C. J. Field, T. Carpenter Smith, S. E. Barton, H. Ward Leonard and George Cutter.

MR. BARTON: I believe if the electric lighting interests had had it in their power in the beginning to have made their own rules, to have abided by their own rules, to have gone on doing good work in accordance with good rules, irrespective of the insurance interests, absolutely ignoring them, it would have been far better for them; but they did not do it in the beginning. I further say that this National Electric Light association can never enforce any rules. If it had representatives from all of the people who are installing electric lighting apparatus, if every local company, every central station in the United States, or a large majority of them even, were represented in this National Electric Light association, firm believers in it and supporters of it, then I would say with Dr. Mason, have your own rules and let the insurance companies do what they please; make rules that are right and fair and safe, and such rules as you want, and enforce them, and you will be all right. But unfortunately that is not the condition of affairs. If you make rules how much of them can you enforce? When it comes down to a matter of fact, the only way you can enforce rules, in the competition that is so fierce all over the country, is by the pressure brought to bear from the insurance interests, and no other. Now, then, this committee that Mr. Cutter represents is nothing but the outgrowth, the continuation of a committee formed because there was a threatened disruption between the insurance and electrical interests; and that committee's name signifies that it was a committee for harmonizing insurance and electric interests. My friend Alexander was the chairman of it and he did noble work and harmonized the interests. In perpetuation of that thing, in carrying it on, and in order to do better work another committee was appointed, of which Mr. Cutter was chairman, and that committee has gone on disinterestedly, and has done equally good work. It has gotten together, as I said before, these insurance men; and as Prof. Barrett has said, it has brought inspectors that have a national reputation, inspectors that are not influenced either one way or the other, except by the one desire to see good work done; and the result will be a perfect set of rules, and those rules will be in operation before your next convention comes, and you will be feeling the good results of them.

MR. MASON: I move that this whole subject be laid upon the table.

The motion was carried.

CLASSIFICATION OF INCANDESCENT LAMPS.

THE PRESIDENT: The next thing in the order of business will be the consideration of the subject of the proper classification of the lighting power of incandescent lamps, and the discussion will be opened by Dr. Louis Bell of New York.

DR. BELL: I have raised this question for the consideration of the National Electric Light association because it seemed to me a very curious thing that the whole subject of the classification of electric lights has not been more thoroughly gone into at previous meetings, and that there is now no general accord, either in the classification of incandescent lamps as regards their light-giving power, or the methods in which that light-giving power shall be measured. It is rather a singular thing that light should be one of the most difficult things to measure absolutely that we have—not difficult to measure relatively, except in certain cases with which we are unfortunately only too familiar; but it is exceedingly hard to find anything like an absolute standard of light. The last desperate effort of the convention in that direction only resulted in perhaps as impracticable a standard as was ever brought before the consideration of a scientific body. The question of classifying electric lamps is coming to be rather an interesting one, and one that is of importance to those who supply the lamps. We have various sizes and sorts of incandescent lamps, of all sorts of nominal incandescent candle powers, the most usual in this country being the 16-candle power lamps; but is there any common accord as to what is meant by a 16-candle power lamp? I think not. And when the matter comes to be tested we find that it is not so. Of the various lamps which are now in use rated at 16-candle power nominally, some of them give the full candle power called for by their names; others give 10, 12, 14 or 15; and some of them give more than the rated candle power, while others give more or less than 16 candle power, according to the method of measuring which is used. We do not know at first sight whether it is fair to say that a lamp is 16-candle power when its mean horizontal intensity reaches that figure, or when its spherical intensity reaches that figure, or when its hemi-spherical intensity reaches that figure. That whole question is open, and certainly ought to come under consideration by this body. Then again, suppose we take one of those particular candle powers to be the standard; for instance, suppose that we take the horizontal candle power, which is, perhaps, the easiest to measure. Are we then in any better position? It might seem so at first, but a moment's consideration will show that the size, or rather the shape of the carbon filament has a very important bearing on the distribution of the light, and that consequently a light which gives in any one direction 16-candle power may give considerably less in any other direction. Again, if we attempt to fix a standard direction, as, for instance, a direction normal to the plane of the filament for measuring the candle power, we again get into trouble, for the reason that while the filament of a circular section gives a nearly equal distribution of light, a rectangular filament necessarily, theoretically and practically, gives an unequal distribution, the maximum intensity being at 45 degrees off of the plane of the filament, or thereabouts. So that looking at it in any way we like we find that when we are speaking of a 16-candle power lamp we may or may not mean the same thing. With the arc lamp we unfortunately know that the case is even worse, for instead of having an approximately equal intensity throughout a reasonable range around the lamp, we have a maximum intensity in a zone perhaps 20 degrees wide and deflected 45 degrees below the horizontal plane of the arc. Furthermore, we know only too well that the nominal candle powers of arc lamps are quite different from the real. The whole subject is in a tangle which at first seems almost hopeless. Heretofore it has not been specially important in the early stages of electric lighting, because people did not look so closely then into the exact conditions under which the light which they purchased shall be given; but as the electric lighting business comes more and more down to close competition and hard commercial lines it becomes more and more necessary to look after these things, and to define just what we mean by the lights which we contract to furnish, and to arrange some way by which there shall be general consent as to the meaning of the terms which we use. I am happy to say that, as most of you know, the practice abroad tends toward something quite different from the candle power measurement; it tends toward the selling of electric energy by watts, even when it is furnished as light—the kilo-watt hour being the British Board of Trade unit; and it is a question which I think we should take up, whether it is not perhaps advisable to classify by watts, a quantity which can be measured with the greatest ease, instead of by candle power, a quantity which is only measured with extreme difficulty. I pass over for the time being the difficulties in actual photometric measurement depending upon the difference in color, as they are subsidiary; but the great question seems to be to find some one definite thing which we can all agree to call a lamp of a certain size, whether it be 16-candle power, or 16 watts, or whatever you please to call it. Of course, certain objections to the watt classification instantly arise, and among them is the possibility that it may tend to develop a type of lamp which will not be quite as efficient as those which are now generally used. That, of course, is simply a possibility, but it is one of the things that we want to bear in mind, for, objectionable as candle power measurement may be, it is not well for us to be blind to the difficulties that come up with any other form of measurement.

I desire to bring this subject prominently before the National Electric Light association, because it is one in which I have felt a great deal of interest, and which I have had occasion to study somewhat, although perhaps more from the scientific side, in the matter of photometry. I believe it is a subject which calls for action on the part of the association as a body, because I think the time is coming, and is in fact now here, when some such definite standard of measurement is needed and should be had; and this is the only body that has the power to make and to enforce any classification of light which may seem desirable after a consideration of the whole subject. I think that it is a case for action by the association, and that it should take measures that shall lift us out of the very puzzling difficulty into which we have fallen simply through negligence, and through no fault or intent to deceive, but simply because the whole matter has been allowed to slide, and everybody has gone on in his own particular way instead of having, as we must soon have, something definite, something exact, something perhaps not scientific, but something which shall be at least empirically definite.

MR. GARRATT: It must be a matter of pleasure to all of us to have this subject brought before this convention. There certainly is no one thing which has caused so much aggravation to the soul of the average electrician as the effort to find some basis on which you can talk about the candle power of lamps. The trouble with trying to establish in America a practice similar to that of the Board of Trade in London is the fact, which we might as well recognize, that the National Electric Light association can not enforce anything. Some years ago I made no less than five hundred thousand figures for this association to enable it to measure wires. I made enough figures to reach from the city of Boston to the city of Providence. But, after having made those figures, and after they had met the approval of a majority of the members, we found that we were totally incapable of making anybody use them

There is certainly nothing better for the unit of incandescent lamps than the kilo watt hour, provided there is proper precaution taken that the makers be not led to turn out a lamp which may possibly not be as efficient as the customer ought to have. Taking the kilo-watt hour as the unit of energy for each lamp, and fixing the length of the life of the lamp, would seem to tie up our friends the lamp makers pretty tight with regard to what we should call a ten, a sixteen or a twenty candle power lamp. It is quite impossible to make the purchaser of the lamp, the householder, ever talk about kilo-watt hours. They will purchase what they know as a candle power lamp. But this association might very properly suggest to the manufacturers of lamps that a sixteen candle power lamp or a twenty candle power lamp should absorb so many watts; and the unit of charge to the customer might be based upon watts as against hours. That might be perhaps best brought before us in proper form by the action of a small committee who could bring the subject before the next meeting of this association in a paper and if it is satisfactory to the body it might then be recommended to the lamp manufacturers. It is a thing which I do not think the general public will do very much with; and I do not see that it is a thing which the National association can very well enforce. But I am positive that the kilo-watt hour would meet the approval of all the electric light fraternity in the country.

MR. ALEXANDER: Not many years ago I attended a lecture given by a gentleman on incandescent lamps. He was a very learned man indeed. He told us all about incandescent lamps; and in fact he made one statement—and it is that particular statement that I want to allude to—that in order to give a certain efficiency to a lamp the carbon filament should be of a certain structure, and should be .0188 of a millimetre in thickness. I was talking about it with a gentleman who was very much interested in the subject, and he illustrated several facts with a great many equations, and he had it all printed for the edification of his hearers, and I had it in my hand, and looked at it hopelessly and put it in my pocket. I commenced to say that when he mentioned that the carbon filament should be .0188 of a millimetre in thickness I was reminded of my youthful days, when a man was pointed out to me who was quite a genius; and that gentleman had a grease spot on his coat, and he immediately went to studying chemistry to see by what means he could best get that grease spot out of that coat without injuring the texture of the fabric; and he studied day and night for two years, until he finally got it; but when he got it the coat was all to pieces and he could not wear it. It is not a scientific lamp or a laboratory lamp that you want; it is a commercial lamp for everyday use. When Dr. Bell brought up this subject (which is certainly a very interesting one) I thought at first, why don't you speak about the candle power efficiency of the arc lamp? There is certainly much more variation between the so-called 2,000-candle power of the arc lamp and its actual power than there is of the incandescent. I recollect a measurement made three or four years ago by which it appeared that a 2 000-candle power arc lamp varied from 134 to 1,386 candles, according to the measurements made then; but still they were all called 2,000-candle power lamps.

I want to ask why you do not measure your arc lamps by watts, and why you measure your incandescent lamps by watts. The efficiency of the lamp to the consumer is of the greatest value only in some cases If I have a water power to run my central station, as the power does not cost much of anything, I do not want an efficient lamp, but I want a long-lived lamp; but when I use coal at $5 per ton I want a very efficient lamp. It is a fact that I have had from one railroad company a letter in which they asked me for a very efficient lamp, because it costs them more to move their storage battery in and out of the car than the breakage of the lamps amount to. They have by figures furnished by their electrician shown that a very short-lived lamp—say a lamp that lasts them but 100 hours, is cheaper than one which lasts them 600 hours but needs a great deal of current. In measuring lamps Dr. Bell has no idea but that we can measure a lamp very carefully and nicely, and then put it in as an actual 16-candle power lamp; but when he will consider that in manufacturing three little girls, who are paid from $4 to $7 50 per week, have to measure from 2,000 to 2,500 lamps on a photometer per day, he will see that a commercial lamp has to be made at a price that the central station would not want to pay if every lamp was figured right down to the one-hundredth or one-tenth of a candle power. It is impossible to do it. In the lamp with the twisted filament, as you know, the light can be measured upright, and you get an equal diffusion of light; while in another lamp you would have to make, of course, two measurements, and the mean measurement of those two ought to be sufficient and come near enough to the actual measurement of the other lamp with the twisted filament to offset any commercial distinction.

MR. BELL: I am not speaking of the laboratory lamp at all. I am speaking of the practical commercial lamp with which we are to deal. I am not asking Mr. Alexander nor any one else to make a lamp which shall have exactly 100-candle power; I only wish to have our incandescent lamps certainly classified within 25 per cent. of their proper value. We do not have to see far to find lamps put out on the market as 16 candle lamps which do not give efficiently 13-candle power. That is the kind of inefficiency I am talking about, and not about any question of measuring the hundredths of candle power. What do we care about hundredths of candle power, or what do we care about a difference of one-half a candle power in different directions? If the difference rises, as it sometimes does, to be 4 or 5-candle power in different directions, then it is something that we ought to take cognizance of. I am not speaking of laboratory tests or of laboratory lamps; I am speaking only of practical commercial incandescent lamps. The question of arc lamps I felt tempted not to touch upon for the reason that we have not been in the habit of measuring those anywhere in the world by the watt. The incandescent lamp is supplied frequently by meter, and that is what brings the matter of classification into special importance. We all know very well that the arc lamp is a great sinner in the matter of the distribution of light, and in the difference between theoretical and practical efficiency; but at the same time we ordinarily do not measure the power supplied to arc lamps in watts, as is getting to be somewhat the custom as to incandescent lamps. I should certainly be in favor of including the arc lamp in any action which the association might take on this question. I am not here to malign the incandescent lamp. I think it is a matter of wonder that the incandescent lamp is as generally efficient and successful as it is; but I think the time is coming when we ought to come to some definite conclusion as to what we mean when we say that a lamp is a 16-candle power lamp, and sell it for such, knowing as I do that the lamps now in the market known as 16-candle power vary rather more largely than even the conditions of commercial service make desirable.

MR. ALEXANDER: May I just say that I consider that when a lamp is sold as a 16 candle power light and gives but 13 candles, it is a dishonest thing; as to the other question, about selling efficient lamps, that is your business. I saw in New York city the other day bills which were made out by watts, which I considered a very proper thing to do.

THE PRESIDENT: I was in conference with a young man representing a lamp concern; and the question came up as to the price and efficiency of lamps, and he said: 'It is altogether a question for us whether you sell by meter or by contract. If you are going to sell by meter, and your cus-

tomer pays for the lamp, we will give you an inefficient lamp so that the bill will pile right up on him; but if you are going to sell by contract we will give you a very much more efficient lamp, and you can furnish a lamp that will be much more efficient and you can make the same money." That shows that the young man who represented the lamp understood how to meet the demands of business.

In making a test of the lamps of six different makers I found that the variation in 16-candle power incandescent lamps is much more extreme than would be called a fair ordinary commercial average. I found that in two lamps the variation was from 17.25 candles to as low as 6.42 candles; and the watts per candle varied from 3.13 to 8.2 watts per candle.

MR. GARRATT: Were those all new lamps?

THE PRESIDENT: They were.

MR. ALEXANDER: That is a subject that I am interested in; and I want to say that a lamp that will measure at the start 12 or 13 candle power, after 200 hours will likely give more light than a lamp which measures 17-candle power at the start. All these matters have to be considered. If I desired to make an actual test I would measure the lamp after 15 hours' burning, and then I would get a good result.

THE PRESIDENT: We are now going through with tests and measuring every 25 hours. I will say, however, that a lamp which gives 17.25 candles was the lamp which at the end of 1,000 hours showed the least blackening of any lamp we had, but unfortunately it was not as efficient a lamp as I would like to have.

MR. COGGESHELL: Were those lamps tested, by one maker?

THE PRESIDENT: They were made by six different makers.

MR. GARRATT: I simply move that the president be instructed to appoint a committee who shall report at the next meeting of the convention on the proper classification of the lighting power of incandescent lamps.

The motion was carried and the president stated that he would name the committee later.

The association adjourned to Wednesday at 10 A. M.

Wednesday's Proceedings.

After the convention had been called together Wednesday morning President Perry asked for the report of the committee on patent legislation C. H. Wilmerding stated that as there seemed to be no other member of the committee present and as no report had been made for several meetings he moved that the committee be discharged. The motion was adopted.

REPORT OF COMMITTEE ON LEGISLATION.

The report of the committee on legislation was read by C. H. Wilmerding as follows:

The membership of the committee is as follows, the states not mentioned having no representatives:

California, George H. Rose; Colorado, C. H. Smith; Connecticut, John C. English; District of Columbia, George C. Maynard; Georgia, H. E. W. Palmer; Illinois, C. H. Wilmerding; Indiana, John Caven; Kansas, L. A. Beebe; Kentucky, A. H. Barrett; Maine, William R. Wood; Maryland, J. F. Morrison; Massachusetts, F. A. Gilbert; Michigan, J. E. Lockwood; Missouri, Joseph A. Corby; New Hampshire, Alonzo Elliott; New Jersey, Henry W. Pope; New York, E. A. Maher; North Carolina, D. A. Tompkins; North Dakota, Vincent S. Stone; Ohio, Charles R. Faben, Jr.; Oregon, P. F. Morey; Pennsylvania, A. J. DeCamp; Rhode Island, Marsden J. Perry; South Carolina, George B. Edwards; Vermont, M. J. Francisco; West Virginia, John B. Carden; Wisconsin, S. S. Badger.

At the eleventh convention this committee was instructed to report for the action of the next convention, such changes in the constitution as would in its opinion best provide for the membership and representation of state associations in the National association.

After this action had been taken, the convention raised a special committee charged with the duty of making a general revision of the constitution of this association. In view of this, this committee has considered itself discharged from further consideration of the subject.

By action of the eleventh convention this committee was instructed "to co-operate with the New York state association in securing such an amendment" to the execution law of the state as to require a special apparatus to be devised for the purpose, that shall generate a current of not less than 10,000 volts.

No request has been received from the New York state association for such co-operation, and so far as this committee is informed, no effort was made during the last session of the legislature of that state to so amend the law. In the light of the reports made regarding the experimental execution that has since taken place in that state, it is now probably as clear to the public as it has been to this committee that if executions are to be made by the use of electric currents, the amendment to the execution law recommended by this association at its eleventh convention is demanded by every humane and equitable consideration.

To give practical effect to the "Memorial and Statements," presented to Congress in the name of this association by its president, which was presented in the United States Senate by Senator Hale, on August 5th, and was referred to the committee on the census, and ordered printed: A member of this committee has prepared a bill which was introduced in the senate of the United States, August 15th, by Senator Hale. It was read twice and referred to the committee on the census.

The report gives the text of the bill. Its object is the appropriation of $50,000 for the special investigation of electrical industries for the census. The report continues:

During the legislative season of 1889-1890, comparatively few state legislatures were in session. During the coming legislative season 1890-1891, a large number of state legislatures will be in session.

If legislation touching electrical interests proves as attractive to the coming legislatures as it was to those that have recently been in session, there will exist an exciting cause sufficiently urgent to fuse all central station companies in every state into compact organizations for the protection of their mutual interests.

That ill-advised legislation will be met with in every state admits of no doubt. So long as would-be law-creators think it a factor of popularity to show in their legislative records that they introduce bills or advocate measures that are intended to be, or are in fact, antagonistic to the practical development of the electrical industries, such things will be done; or, so long as persons interested in patented apparatus, and systems, think they can gain a commercial advantage for such interests through legislative enactments, they will seek to secure such enactments regardless of their effect on electrical interests in general.

That those interested in the electrical industries in each state will be thoroughly organized and equipped to meet the emergencies that will be thrust upon them, is very much in doubt There is no sense of security equal to ignorance of danger. For those who are ignorant of a danger it has no existence. This we fear is the condition of most central station companies in this country, regarding impending dangers from legislation. In view of this, the greatest service that may now be performed is to so state the threatening dangers that they can no longer remain in ignorance of them. To do this there is no need to speak of unreal things that are but creations of imagination. Sufficient material for the purpose is found in the record of things that are.

To show the tendency and animus of thought of those intrusted with the responsibility of legislating for the good of the people, a critical analysis is asked for the following brief reports on the work done by the legislatures of a number of states during the last season.

CONNECTICUT, Senate Bill No. 4. Chapter IX. An act relating to Attachments and Judgment Liens.

MASSACHUSETTS, No better presentation can be made of the subject for the state of Massachusetts than to present in full the report of the counsel of Massachusetts Electric Lighting association, made at its first annual meeting under date of July 8, 1890.

NEW JERSEY, February 12, 1890, a substitute for "Assembly 113" was introduced "by Committee on Municipal Corporations." "An act relating to electric, telephone and telegraph wires and creating boards of electrical control in cities of the first and second class." February 14, 1890 Assembly No. 6 was introduced by Mr. Smith and referred to the committee on corporations: "An act in relation to telegraph, telephone and electric companies in cities of this state."

NEW YORK, January 21, 1890, in Assembly 160, introduced by Mr. Whipple, read once and referred to the committee on ways and means: "An act to create a board of electrical commissioners and to define and regulate its powers and duties." February 20. 1890, in Assembly No. 598, introduced by J. H. Stevens, read once and referred to the committee on electricity, gas and water supply: "An act authorizing water companies to manufacture and use electricity for the lighting of streets, public places and private buildings in cities, villages and towns within the state." February 21, 1890, in Assembly 629, introduced by Mr. Whipple, read once and referred to the committee on electricity, gas and water supply, "An act to protect life and prevent accidents in the use of high tension electric currents." April 4, 1890, in Assembly 1887, introduced by Mr. Molan, read once and referred to the committee on electricity, gas and water supply, "An act to create a state board of commissioners of electrical control and to define and regulate its powers and duties." April 18, 1890, in Senate 618, introduced by Mr. Erwin, read twice, and by unanimous consent ordered printed and when printed committed to the committee on general laws: "An act to create a board of electrical commissioners and to define and regulate its powers and duties." April 18, 1890, in Senate 634, introduced by Mr. Erwin, read twice and by unanimous consent ordered printed, and when printed to be committed to the committee on general laws:, reported favorably from said committee, with amendments, and committed to the committee of the whole: "An act to create a state board of electrical control and to define and regulate its powers and duties."

In transmitting copies of these bills to the chairman of this committee, J. W. Eaton, Jr., of Albany, N. Y., writes as follows:

"None of these bills have become laws. I am of the opinion that an attempt will be made next year to rush through the legislature a bill, combining most of the principal features of those sent you. unless some determined opposition develops in the meantime. I believe there is also a movement in favor of adding an electrical expert to the present railroad commission, and putting the matter under their charge. There was no law of general interest affecting electrical lighting passed this session."

OHIO The legislature of this state was urged to action by the following highly electrified paragraph in the inaugural address of Governor Campbell: "The application of electricity is rapidly opening up new fields of legislation. Unless something be done to prevent the sacrifice of life daily resulting from the effect of electrical wires, the companies which put up and control them will have grown so rich and powerful that the passage and enforcement of proper laws will be difficult. Municipalities have attempted to enforce regulations for protection from such dangers, but without satisfactory results. The duty of investigating the generation and distribution of electrical currents is one which presses upon you. The investigation should be prompt and thorough; the result thereof made public, and such action taken as may, in your judgment, throttle this evil in its infancy."

The following were introduced into the Ohio legislature: "A bill concerning electric wires and circuits dangerous to life and property." "A bill to authorize the construction of subways and underground conduits in which to place electric wire cables and other electrical conductors in cities, towns and villages of the state." "A bill to regulate electric light companies so as to protect the public from accident and damage from the same." "A bill relating to electrical conductors for electric lighting in cities of the first grade, of the first class, and the removal of overhead wires."

VIRGINIA. Senate Bill No. 238, a bill for the prevention of danger from electric currents, Patron — Mr. Loewenstein. Referred to the committee on general laws.

While this report does not completely cover the ground owing to the difficulty experienced by this committee in obtaining copies of bills and definite information regarding action taken on them, the showing is sufficient to demand attention from all those interested in the electrical industries, and will enable them to form some idea of the legislative work that is near at hand during the season of 1890-1891, when the legislatures of some thirty-seven states will be in session.

This committee desires to call attention to the fact that all legislation is directed to the regulation of the use of electrical apparatus, not to its manufacture and sale. This use includes all forms of apparatus, the telegraph and telephone, as well as the generation and transmission of electric currents for light and power. Such legislation affects primarily the interests of those who have their capital invested in plants for furnishing such service, and thus establishes a community of interest between them. The interest of manufacturing companies and supply houses in such legislation is secondary, as they are only affected through the effect on operating companies. For these reasons, and in view of the fact that legislation is confined to state legislatures, there is a real necessity for the operating companies in every state to form themselves into associations for the development and protection of their mutual interests.

In analyzing the subjects of legislation this committee would be untrue to the interests it represents, should it fail to bring to notice the fact that most of the so-called antagonistic legislation is not the result of popular demand, but issues from those interests that seek a commercial advantage by legislation that, either directly or by implication, would create conditions favorable to their particular apparatus or systems. A diminution of efforts of this kind may be reasonably expected, as the art of generating, distributing and using electric currents becomes more and more a matter of common information no electrical systems approach more nearly to the zenith of their development.

ADDRESS BY GEORGE S. BOWEN.

THE PRESIDENT: I learned with much pleasure this morning of the presence here among us of the first man who ever occupied the chair of the National Electric Light association. I have great pleasure in introducing to you Mr. Bowen.

MR. BOWEN: You certainly have placed me under great obligation by the graceful compliment which you have conferred upon me. It is true, as the chairman has stated, that I called a convention to order in Chicago; and I did it after some weeks of labor in sending out circulars, etc., inviting the men who were engaged in the electric lighting business to get together, to become acquainted, to rub together slightly and see what the effect might be. My own opinion was that it would be useful to us all, and to that end we created a little committee in Chicago, and I was made the chairman of it, and I had the honor of sending out those circulars; and in responding to the circulars there were about one hundred and fifty gentlemen who came from all quarters of the Union to Chicago. I mention, as I stand here before you, an incident which often has come to my mind. Mr. Morrison of Baltimore said to me, on being acquainted, "What are your plans?" I said, "Well, we have no underground plans or overhead plans. My plan has been simply this, to invite the electric light men to come together, to become acquainted with each other; and after I have called the convention to order and you are all in the room which has been provided for you, my duty is done. I have no plan at all, because I have the utmost confidence in the capacity of the men that have taken hold of this great business, the lighting of the world, to take care of themselves, and so I have made no plans whatever."

I do not make any prediction, but I say to you, gentlemen, you have only opened the first page. I expect to live to see the day when all these little towns all over the country, shall be illuminated with electric light and we shall not have to grope about in darkness, as much as we have heretofore; because some of you, gentlemen, I see it now cropping out in your brains, are going to develop a plan by which all the world may have the light at an expense so cheap and so nominal that they cannot afford to be in darkness; and so the world will be indebted to the electric light men for all of that. If it shall happen in the course of your discussion here in regard to the action that has been taken by our of the state legislatures make use of electricity to take human life—if that agitation shall finally develop into an expression of thought in the minds of the American people, that human life is too sacred to be taken by any means whatever, I shall thank God for that; because I do not believe it is for the power of men to take human life—something you cannot restore. Certainly, the man whom you would execute under these laws, and who has committed an act deserving, under the laws of the state, to be executed by electricity, or the rope or any other means, is unfit to die and he is quite unprepared to live. My plan to get along with that kind of men is to educate them; give them good cold water baths, and hot too, inside and out, and wholesome food and plenty of work, but let them live long enough to be fitted and prepared either to live or die, just as God in his wisdom shall see fit.

It has only fallen to the lot of a few of the great inventors of the world to see the work of their hands finally culminate in great success; and as I look over this body there comes to my mind an incident which occurred a few years ago. I was riding down through the state of New

[illegible] with [illegible] I. Blair, the great railroad builder, and passing [illegible] he said: "There is where Professor Morse used to live, in that little house." "What did you think of the old man," I said, "when he was trying to make you think and believe that he could send a message on a wire?" "Oh," he said, "we all thought he was a crazy old fool." Now, that was about the idea expressed in regard to him; and here is some bright, young electrician, who may bring to you something and you will say, "Oh, get away. He is a crazy fool." But let me tell you, my dear friends, it is these "crazy old fools" that have stirred the world from its foundation. I need not recount the history of Prof. Morse's experience about going to Congress and his labors, and finally getting his telegraph wire from Baltimore to Washington and sending that first message over that line, that wonderful message, ignoring himself completely, this "crazy old fool," saying, "What hath God wrought?" Not me, but what hath God wrought? And then when he stood on the platform of Cooper Union and with that same simple messenger sent that other message flying around the world, "Glory to God in the highest and peace on earth, good will to men," what more could come to fill his soul with all that was great and noble, and successful in life? There stood this "crazy old fool," the admired genius of all the universe. Nothing could be more magnificent and grand in its accomplishment than that. And so I expect to see the day when these young electricians shall accomplish other things. I do not think we have got to the end by any means.

I hope some day to see the wires underground, carefully put away where they will be kept dry and operative, and than you will get good results and we shall not be hearing of these terrible accidents. Either put them down underground where they are safe, or else put them up so high that they won't disturb people; and when you put them up make them secure. Whatever you do, let it be done well; that is my idea, and then you will get good results.

I expect to see the day when every house, every little household in the land, shall have its little storage battery and electric lights. We are going to dispense with tallow candles and even with kerosene oil. Why, just think to it, in the Island of San Domingo they use kerosene oil tof day all over the island. There was a concession brought to me a few weeks ago for lighting the island; and, gentlemen, you could scarcely get anybody in this country to go there and put in electric lights, because they say it is too much of a venture; and still there is a field that is just as full of riches as any gold mine in Colorado or California; and it is all there just waiting for you to take it; and if I was a young man twenty years of age, I would plant myself down there in some of those countries and I would make my fortune about it.

On motion of Mr. Weeks Mr Bowen was elected an honorary member of the association.

CENSUS BILL.

Dr. A. F. Mason presented a resolution, indorsing the bill presented by Senator Hale, appropriating $50,000 for the special investigation of the electrical industries for the census. The motion was adopted.

M. J. Francisco, of Rutland, Vermont, read the following paper:

MUNICIPAL LIGHTING.

BY M. J. FRANCISCO.

The electric spark that Franklin gathered upon his key lay dormant for years, until from the fires of genuis, guided by the finger of science, there flashed forth the electric light. This has been increased and magnified, until today America stands as the exponent of this science, with 300,000 arc and 4,000,000 incandescent lamps flashing like meteors across the continent. Thus has science aided nature in lighting up the streets and highways of our native land, from the shores of the Atlantic, across the snowy peaks of the Rocky Mountains, to the golden shores of the Pacific.

This vast industry, requiring an army of over 300,000 men and an investment of $300,000,000, is the result of American genius and enterprise. Truly we may well congratulate ourselves that we are here to-day as the representatives of this science and industry, which is revolutionizing the world. Not only has the globe been encircled with telegraph symbols and the human voice sent flying across space for thousands of miles, but the ocean itself has been studded with electric lights, guiding the mariner across its waste of waters and flashing its brilliant hues as a welcome beacon upon the weary eyes of many a watching crew, whose vessel was sinking in mid-ocean.

This science, fraught with so much good for mankind, which has put millions of money into circulation and furnished employment to thousands of laboring men and others, is now menaced by men, who, posing as economists, desire to use this power for political and other purposes, as well as for their own aggrandizement, regardless of the interest of the masses of the public welfare. The plain English of this movement is, municipal control of electric lighting plants.

Who are the great apostles of municipal ownership of electric lighting plants, claiming that municipalities can furnish lights cheaper than private corporations? Mostly visionary, theoretical dreamers. Not one has had a single day's practical experience in the electric lighting business. For example, we were treated to a specious article in the New York *Independent*, purporting to come from a professor of Johns Hopkins University. An examination of the article shows at once that the author has no experience or practical knowledge of the business, and proves to be simply a youth from Omaha, Neb., who has been studying there for a couple of years He is now told to cry monopoly, and this article is the result. These are the persons who are being used by professed economists, wirepullers and others as figure-heads; who make statements based upon a state of things that do not exist, and use such statements in contradiction of the actual experience of practical men and the best scientists of this generation, who have not only made the subject a study, but demonstrated the same by testing it every night for years.

If a municipality can sell electricity cheaper than private corporations, why should they not manage all other industries and trades of the country? All cities have large amounts of printing done; why not have the city own and run paper-mills and printing offices; also street cars, and own mines and sell coal. They also use immense quantities of stone, building material, etc.; then have them run a marble quarry. The taxpayers use carriages; let the city build these also. And so on with every industry requiring the investment of private capital. If municipalities can save the taxpayer money in controlling and manipulating one industry, why not all? If they can do it cheaper, then every taxpayer would receive the same proportional benefit as is claimed for electric lights.

The great argument used in support of municipal control of lighting plants is a list of cities, with what purports to be accounts of the cost of their electric lights, where over half of the expense of the lights has been charged to other departments. Among these are Bay City, Bangor, Dunkirk Chicago, Ypsilanti, Topeka and Lewiston.

We will examine a few of the claims made as to the cost of lights in these cities.

The city superintendent of Bay City, Mich., reported that the cost of the electric lights was only $40 per year. The Council of Bay City appointed a special committee to investigate the expense of city lights, and they submitted a report showing that the city was running 137 lights at a cost of $59.42 each per year, not including taxes, water rates, interest or depreciation. Including interest, 5 per cent. on $35,000, cost of plant, taxes and water rates, 2½ per cent., 10 per cent. depreciation, the cost was $104 per year each lamp, running only dark nights. A short time since, during a thunder shower, the city was left in darkness, because the city superintendent was afraid of burning out an armature if he ran the lights. A gentleman passing an evening in Bay City recently inquired why they did not have street lights, and the answer was, "We do have them," and sure enough, at 9 o'clock, they started the lights. Still the price charged by electric light companies for first-class service, with lights every night, even when obliged to compete with the rival forces of heaven's batteries, is compared with such service as shown in Bay City.

The city of Bangor claims that the average cost of burning a light each night is 12 2-3 cents; that is $46.23 per year for each lamp. The electrician is paid $78.50 per month, or $942 per year; his assistant receives $520 per year; one lineman is employed at $624 per year; two trimmers at $1,248 for the year—making $334 for wages of these men, being $22.82 per lamp per year. They run all night, requiring double lamps and four carbons for each and every day, calling for 1,460 carbons per year each lamps. For these they pay $13 per thousand, and in addition pay 96 cents per thousand for freight and 5 cents per thousand for cartage from the freight-house, making cost of carbons $14 per thousand, or $20.44 per lamp per year. Allowing $2.97 per year for oil and waste, we find the amount paid by the city for wages, carbons, oil and waste was $46.23 per lamp per year. This is 12 2-3 cents per lamp per night, just what is claimed as the entire cost to the city for running their lights. The plant cost $35,000, and this does not include anything for the water power nor for any portion of construction of the dam or cost of its maintenance, or for the station buildings. Interest on $35,000 at 6 per cent, $2,100; depreciation on electric apparatus, 10 per cent., $3,500; broken globes during the year, $130; wall-controller burned out, costing $160; 15 lamps broken, repairs costing about $300; damage to mastarms, repairs costing $100; repairs at station, $500; also $730 paid for coal. Here is $7,520, which is part of the expense of the electric lights charged to some other department, while to get the true cost there must be added to this the repairs to the dam interest on the cost of the buildings, wages of an engineer when engine is used, cost of new brushes and segments; also taxes and water rent, which the city would receive from a private corporation if running the lights, which, at the lowest estimate, would be over $1,000 per year, thus making a total cost to the city of $15,271.86 for running 146 lamps one year, being $104.59 per lamp. and that, oo, with water power all the time, except for about six weeks.

The favorite place quoted by advocates of municipal ownership is Dunkirk, N Y. I herewith give the report of the water commssioners of Dunkirk. As a specimen of expert bookkeeping, and a sample of the way accounts are kept by cities, I recommend the plan to all electric light men; for if you are endeavoring to satisfy your constituents or stockholders that electric lights can be run without money and without price, it cannot be excelled. The report reads as follows:

"PAID ON ACCOUNT OF ELECTRIC LIGHT.

For linemen's salary	$ 540 00
For fuel	933 24
For supplies	447 60
For labor repairing line	41 42
For repairs on engine and boiler	65 64
For repairs on machinery	99 40
For miscellaneous accounts	14 60
	$2141 90

"The above statement shows very distinctly that the most sanguine predictions as to the cost of running the electric lights of this city have been more than realized. After a trial of one year and eight months, the machinery and line are in better and more perfect condition than when first started. The cost of our electric light does not exceed 1 cent per hour for each light."

Here we have a report from the city authorities stating that the entire cost to the city of running 55 arc lights one year was $2,141.90.

You will notice one item is repairs on engine and boiler; also one item for fuel, showing that the plant was steam power, and, what is far better, a style of boilers and engine that ran the entire year, starting and stopping at proper times automatically, without any one to look after them except a man occasionally to make a few repairs—the coal walked into the furnace without assistance, and no one was employed in or about the station, neither did the plant cost the city anything.

Here is a sample of the reports made by the politicians and those professed economists, which shows just how reliable they are. Of course, a man of practical experience and knowing that electric lights do not run without human agency, would look further before accepting such a statement, and when we examine the accounts of the waterworks we find engineers and fireman paid $3,555; supplies, $449; general expenses under superintendent, $995; miscellaneous accounts, $240; superintendent's salary, $720; interest on bonds, $7 025—making $12,984 additional. Even if only one-third of this is charged to electric lights, we have $4,328 to add to the $2,141, making $6,469 for 55 lights, or $117 each per year. Consistency, thou art a jewel!

Chicago, it is claimed, is the center of the world, and the only place on this mundane sphere where mortals can be happy, and where life can be spent without thought of money or the hereafter, because their electric lights only cost $73 per year. We admit that Chicago has triumphantly secured the World's Fair, and is now transposing our national air to "Hail, Chicago! happy land." But they have not yet seen the bills for the electric lights as furnished by the city, and used on that occasion. When they do the city electrician will need to add something more to his stereotyped answers that the cost of city lights "does not include any expenses such as you mention—taxes, water rent, interest on investment, insurance, repairs, depreciation or renewal of plant in general;" neither will it be expedient to charge the wages of the electric light linemen to the fire alarm telegraph department, notwithstanding it works very nicely now, and helps wonderfully to make the cost of an arc light appear small.

Upon investigation of one of their stations of 275 to 300 light capacity, I find that the chief engineer receives $1,200; assistant, $1,030; four firemen, $2,880; six trimmers, $3 240; line-tester, $720; three linemen, $2,520; cost of carbons, $3,800; fuel, $12,000; interest, $14,000; depreciation, 2½ per cent., $8,750; oil, waste, repairs, globes, taxes, etc., $7,000—making $57,190 a year expense for running 300 arc lamps, being $190.63 per year per lamp, and this makes no provision for salary of electrician, superintendent, or for armatures burned out or any accidents or damages. With the linemen's wages charged to the fire alarm telegraph department, we can reduce this $2,520. Now, to what other department do they charge the other expenses to reduce it to $73 per year per lamp?

Ypsilanti, Mich., is the Mecca toward which all advocates of municipal ownership turn their longing eyes, and we are informed that the entire cost of a 2,000-candle power lamp is $23.61 per year, when the truth discloses the fact that Ypsilanti pays $72 per year only running eighteen nights a month until midnight. Wishing to have the views of the prominent authorities of this wonderfully managed city, the following questions were propounded, and I give both the questions and answers:

Q. 1—With your experience, are you in favor of cities doing their own lighting? A.—No.

Q. 2—Why? A.—Political preferences and frequent changes of management are too expensive. Incompetent engineers, linemen and trimmers kept in place by a committee for political or other purposes; poor carbons, lack of attention generally grounding of wires, breaking of globes, infringement of patents constant repairs etc., make this system expensive and an unknown amount till the year expires. *The wear and tear is immense*, all kinds of complaints and no responsible head, is the rule. On the contract plan for light you pay for what you get only, and know what to provide for in the estimate for tax levy.

Q. 3—If your city had the work to do over again, do you think they would do the same? A.—No.

Q. 4 –Has the municipal operation of your plant met all expectations and requirements? A.—No.

Topeka is another place where electric lights furnished by the city are cheaper than sunlight, and the city jubilant over their purchase. I quote from a letter written by a prominent official of the city of Topeka, which seems to prove that their millennium has not yet arrived. He says: "The agreement for all night lighting was $6 per light per month. We find that the cost of operating the plant of 184 lights for all night has been $11 per month. The agreement further provided that the lights should be 2,000-candle power; all the tests we have made do not show them to be over 500-candle power. Our light so far has been very unsatisfactory My own opinion of the matter is that it would be much cheaper in the end for the city to have contracted with some of the electric light companies here to furnish the city with its lights at so much per light. We would then have known at least just what they would cost. As it is we have to take our medicine, which is liable to be a very expensive dose. It is a very expensive luxury, and there are so many expenses coming up that we cannot foresee; therefore, I say, when you take everything into consideration, interest on the investment, wear and tear on machinery, dynamos, etc. (the contractors are already building over ours, and they have not run two years yet), consider well before contracting for a plant." Here is the opinion of an honest official who has had experience with a city owning a plant.

Lewiston, Maine, is another brilliant example of municipal ownership. They have a plant of 100 arc lights, which cost the city $15,000. They burn, on an average, 24 nights per month on moonlight schedule, and the mayor says the actual running expenses are $4,200 per year. Add interest on cost of plant, depreciation, 5 per cent., taxes, rent of water power which the city would have received from a private company, therefore it is costing the city for 100 arc lights, using water power, $7,200, or $72 per lamp per year, while the local electric light company offered to furnish the same lights for $5,760, being $1,440 less than it costs the city to run their own lights; and still

it has been advertised broadcast that the cost of arc lights in Lewiston was only 14 cents per night.

I have secured reports from fifty municipal plants, embracing nearly all of the cities and towns in the United States owning plants, and find that the cost of these has been $1 511,225; that they are using 3,725 lamps; 12 places running all night and 38 until midnight or on the moonlight schedule; that the average price paid for coal is $2.34 per ton; that the actual running expenses have been $251,194; that the interest on the cost of these plants is $90,691; depreciation at 5 per cent., $75 576; cost of replacing armatures actually burned out, $12,000; taxes city would have received from private corporations, if they had furnished the lights $15,715—making the total expense to these 50 cities of burning 3,725 lamps (two-thirds of them only until midnight) for one year $444,486, or an average cost of $119 24 per lamp per year. In the figures going to make up the cost of plants and the running expenses I have taken the statements and amounts as given by the city officials, but when we are told that the total amount paid for a complete plant of 68 arc lamps, with engines, boilers, dynamos, etc , was only $1,300, and informed that the total running expenses of a plant that cost $12,000 are only $1,100 and in the same communication the statement is made that they pay their engineer and linemen $125 per month, making an annual bill for these men's wages of $1,500, we naturally long for the secret which enables them to settle this amount and pay for repairs, oil, coal and other expenses with an expenditure of only $1,100.

I have statistics from 365 electric light companies furnishing 35,100 arc lamps for street lighting, three-fifths burning their lights all night and two-fifths burning until midnight or on the moonlight schedule. The average cost of coal is $2.76 per ton. The average price charged per lamp for street lights is $118 per year. This is the price when furnished by electric light companies, who have assumed all the risks and liabilities incurred in the business, and who must furnish first-class lights. This is the cost with lights burning every night without a break as the contract calls for, and necessitating a rebate if lights are out, which would reduce the price paid by the city.

Only one-third of the cities owning plants run them all night, while of street lights furnished by private companies three-fifths burn all night. Lamps all night and every night would burn 4,000 hours per lamp, while the moonlight schedule would only require about 2,100 hours per lamp The cost to companies, of course, is much more for all night lights than it is until midnight, and had lights run by municipal plants been burned the same length of time as lamps furnished by private corporations, the average cost would have been still more, as lights must have burned about twice as many hours

It will be noticed that the average cost of coal used by municipal plants was $2.34 per ton, owing to the fact that the majority were located near the mines or places where coal was cheap, and the average as shown for electric light companies is $2.76 per ton, owing to the fact that coal was transported long distances at high rates of freight. Even with this factor against them, it shows conclusively that private corporations are furnishing cities with lights for less money than they can themselves produce them while owning the plant. This, too, with the expense of operating city plants figured as given by the various cities, which their own report shows is incorrect, and less than actually paid.

It is well known that if a private corporation is furnishing municipal lights, when they are out for a short time or are not up to standard, a rebate has to be made, amounting in the aggregate to many thousands of dollars; but you will never see this item deducted when advocates of municipal control are quoting the cost of lights. Neither do they allow the fact of the city's liabilities for damages and accidents to be developed. If the municipality own the plant they assume these chances, and here is a feature of responsibility which in most states rests upon the individual as well as the city. The property of any citizen can be held for an execution against the town for injuries caused by a municipal plant, no matter if it amounts to thousands of dollars, and thus he might be deprived of his most valuable personal rights and liberties. If electric light companies furnish the lights, they must meet such claims and protect the city from loss, and the court records show that electric light companies have paid heavy damages on this account.

In the reports received from city officials regarding the cost and operation of their lights, one says: 'No expenses charged to lighting account." Again: "Lights are not started for an hour after dark." Many say: "Whenever a thunderstorm approaches lights are shut down and city left in darkness." Another says: "Have not had lights for past two weeks, owing to some trouble at station;" while many report wages of employes charged to water department, and others that no account of lighting expenses is kept. Here we have the basis upon which reports are made that the cost to cities owning plants is so much less than it is when private corporations furnish them, simply deceiving the taxpayers by charging part of the cost to other departments, while raising a hue-and-cry about the extortion of electric light companies.

No sane or fair minded man will, with the corruption and fraud practiced by politicians at the present day, attempt to prove that it is for the best interest of the taxpayer to place faith in the honest or conservative management of any enterprise which can be manipulated in the political arena for the advancement of the men in power. The histories of New York, Philadelphia and many other cities are samples of such methods and their purifying effects upon politics. Hypotheses and theory may do on paper, but actual results obtained by practical application and experience are the only reliable data upon which to base any statement relating to the cost of street lighting. In every case these have shown, where all the facts are given, that it has been for the best interest of the citizens and taxpayers to contract with an electric light company for lighting the streets of any city.

Many cities have found by actual experience, after spending a large amount of money, that this is a fact. The city of Greenville, S. C., has sold out its municipal electric lighting station, the purchasers agreeing to relieve the city of all pending liabilities in connection with the light plant. The city has agreed to pay $100 per year per lamp for not less than 40; the agreement to run for 15 years. Negotiations are pending in several other cities for a sale of their plants to the local or private electric lighting company, as they have found it was impossible to produce the light, when managed by politicians with no interest in the business, as cheaply as could be done by a private corporation whose managers were financially interested in its success.

There is another feature of this business that it is well to consider. Under the authority and sanction of the legislatures of the states, private capital amounting to millions of dollars, has been invested in the enterprise of electric lighting The benefit that municipalities have received from this capital is enormous, and it is a question whether the private capital thus locally invested under the sanction of the state can be jeopardized and endangered by the action of municipalities who are subject to and under the control of the state. In England this matter is fully settled, and no municipality can operate its own plant, if by so doing it will interfere with any local or private company authorized by Parliament.

Judging the future by the past, with the mighty strides that have been made in electrical inventions, two years from now the entire apparatus at present owned by municipalities may be consigned to the scrap pile, and necessitate a new outfit costing thousands of dollars What is to be done in this case? Levy another tax or issue more bonds, and thus load the city with more debts? Electric light companies have already had this experience, and I can cite a case where the company paid $4,500 for their dynamos, and after a little over two years could only realize $300 from those same machines. Why is this? Simply that improved plans and apparatus have been discovered which reduces the cost of producing electricity, and unless companies can control these new patents they will be stranded in the race of invention.

Consider, then, for one moment the effect upon the business world if to-day it were possible to blot out electricity and electric lights, with all their conveniences, comforts and luxuries; to stop the progress and development of this wonderful science, and shroud America in a gloom that could only be expressed by Byron when he "had a dream which was not all a dream," and

"The bright sun was extinguished,
And morn came and went—and came—and brought
no day,
And all hearts were chilled into a selfish prayer for
light.
The rivers, lakes and ocean all stood still,
And the clouds perished. Darkness had no need
Of aid from them—she was the universe."

THE PRESIDENT: The chair will announce the appointment of the committee of three on the proper classification of the lighting power of incandescent lamps: A. V. Garratt, Louis Bell, P. H. Alexander.

DISCUSSION.

MR. DECAMP: It is known to every man on the floor of this convention who is engaged in the business of electric lighting that municipal ownership of electric light plants has its origin among a few politicians who wish to add another plum to the public pudding, that they may pluck it. There is no question about that. There is no sentiment in it; it is a simple matter of fact. The public, who have to pay for this know nothing else excepting perhaps the two or three points which the public know fully as well as their servants in these matters; and one of them is the fact that there are certain things in connection with municipal management that are always notably extravagant. It is not the fact that a municipal government has no right to engage in anything in which it is the sole consumer. I do not admit that at all. I admit it to be for the general good for them to keep their hands out of everything, and let whatever profit there may be in it go to the taxpaying citizens. But that is my view, and that is perhaps a radical view. If you take it on the ground that the public should do their own printing,—then there is a measure of truth in that, and there is a measure of justice in that which does not apply to anything like the municipal ownership of an electric light plant, or a gas plant, from the fact that their ownership of that effects nothing except their own trade. Printers do business just the same as other concerns do business; they are not obliged to go to the state legislature and get a charter, or to pay municipal taxation on their charter rights. For that reason they are excepted from the conditions which apply to electric light companies. But there is one point that might well go forth in some shape, and which would waken the people up a little who have the final decision of these matters. I suppose that it is pretty nearly a correct statement that from fifty to sixty per cent. of the total cost of producing electric light is in the labor account alone It is one of the most difficult problems that electric light companies have to contend with. It is something that is the hardest to control Now, if there is anything under God's heaven in which there is extravagence practiced by municipal governments it is in the matter of labor. For a municipal government it invariably takes two men to do one man's work. Some time ago a man left our employ who was getting what we thought good wages, two dollars per day. He was not a skilled laborer in the true sense of that term. He took a position under the city government at two dollars per day, in which he worked eight hours per day, whereas he had been working twelve hours; and he took a position in which two men had been doing the whole duty, yet he made the fourth man who went in there. Figuring this up it means about two hundred per cent. increase on the cost of labor for that one particular thing. I would like to see this report printed, and I would like to have copies for free distribution among the members.

MR. ARMSTRONG: I feel myself very much obliged to Mr. Francisco for this paper The instances he cites were used against our company about a month ago when we made our annual bid for lighting our city. It so happened that our general manager had the answer ready to the most of these criticisms and yet a new member of the city council, flushed with his victory at the polls, and believing that the eyes of the whole community were upon him, and that upon his shoulders rested the protection of the taxpayers against a grasping monopoly that had the lighting of the streets, went into the city council and claimed that our bid for lighting the city was entirely too high, and that Bay City, Bangor, Dunkirk, and all the rest, were having the lighting done at so much less. The answer to all those criticisms was made in such a manner that nothing further could be said. But how much better we could have answered it had we just this paper to hand to every member of the city council, so we could say to them, there is the author's name; there are the facts; now say what you please concerning it.

Under no circumstances does a Municipality desire to engage in business. Why then does it own waterworks? Why does it own gas works? Why does it own electric light plants? Usually because it cannot find citizens who are willing for the public benefit to put their own money into the enterprise, because the enterprise at the time it starts is too large to enlist the citizens or induce them to enter it. When you start an electric light plant in your city you do it with the distinct understanding that for a long time you are to get no returns; you do it looking to the future. If you start a gas plant, if you start a railroad, if you start a water plant, if you do anything of that kind to supply the public, you do it, of course, expecting an ultimate return to yourself and to your stockholders; you do it looking to the future. Sometimes cities are enterprising enough to look out for the future themselves, without asking the citizens to do it, and without expecting the citizens to do it. Now I venture the assertion that no economist who has studied the question, no economist who has gone over the whole ground, will ever advocate taking from a private enterprise anything like electric lighting, or like waterworks, or like a gas plant, or like printing or like the railroads, or any other such enterprise and putting it under municipal control. I will ask the managers of electric light companies here, if they were managing for the public, if they had a public treasury to call on for anything and everything they wanted, whether they would be—and I think they are perfectly honest and upright men—as careful of their expenditures as they are compelled to be to-day? If my purse were unlimited I would have the very best that there was; I would indulge in the most costly experiments, for I would have wherewith to pay for them. And so would you It is a natural thing, and a proper thing, I take it. Therefore it is we say that the cost of lighting must be far greater to a municipality, by necessity, than to a private enterprise.

MR. BARRETT: I do not advocate the absorption of a commercial business by any municipality. The city of Chicago, through its electrician, has simply performed the orders which he received. This statement strikes me as rather a singular thing. I find here that the cost of municipal lighting is set forth very clearly, very extensively and very expansively; but I have never, in all my experience with this association seen a tabulated statement of what it costs to light a commercial plant, per light. Now, this is what strikes me as rather singular. Why cannot a city light its streets as cheaply as a commercial company can? Is not the market open to the city to purchase its material? Can't it hire its laborers as cheaply as anybody else? Has it not an officer, and is he not compelled to report expenditures just as clearly and distinctly as does the head of any private concern? Why should it cost the city more than it does anybody else? This is rather different at home. I have charge of the municipal service, of the police, fire, Board of Health, and the city lighting. Therefore I get economy as to materials I do not claim that I can light a lamp any cheaper than anybody else. I do not claim that it costs me any more than it does anybody else to light that lamp, except in labor alone. We do have to pay more for labor than anybody else. If I could get this lighting from corporations, anywhere here, for what it costs us to maintain our own lights, I assure you, gentlemen, that I would recommend it.

MR. GARRATT: It seems to me that the simplest reply which can be made to the question why, or why shall not a city do its own lighting will be found right in the words of President Cleveland, on the tariff question, when he said: "In this matter we are dealing with a condition of things and not with a theory." If we were dealing with a theory there is absolutely no reason why a municipality cannot do any business that any citizens are engaged in more profitably than the individual citizens can do it themselves. We are dealing with a condition of things, which, in the United States under our form of government, is this, that the government shall not in any way interfere with the rights and privileges, the pursuit of happiness and the success of its citizens; that the citizens themselves shall do the industries of the country; that the government shall be as small and as insignificant as is possible to hold people together in a civilized community. That is the simple question. Theoretically speaking I see no reason why a municipality cannot bake the bread for the people, or why it cannot butcher the beeves. There is no reason why, except that in the condition of things under which we are living it is entirely infeasible.

MR. DECAMP: I think Mr. Barrett put the true question when he said, "Why can't it be done?" Well, there ought not to be anybody more competent to answer that question than Prof. Barrett himself, because he is right in the business; but he doesn't do it. Now in reply to the other point, in which he says that no commercial plant has come forth to say what their lights have cost them, there is a plain answer to that. That has not yet become necessary, and it is not customary, except by the lowest bidder. Now the figures which Prof. Barrett has named and set forth and published broadcast over the world—or which have generally gone forth, I don't say that he published

(Continued on page 113.)

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building. - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers, in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

NATIONAL ELECTRIC LIGHT CONVENTION.

Members and Visitors 103
The President's Address 103, 104
Electrical Industries and the World's Fair. By J. P. Barrett, and Discussion 104, 105
The Copper Tariff 105
Legislation 105
Dangers of Electricity. By Prof. Henry Morton, and Discussion 105, 106
Report of the Committee on Harmonizing Insurance and Electric Light Interests, and Discussion 106, 107, 108
Classification of Incandescent Lamps. By Dr. Louis Bell, and Discussion 108, 109
Report of the Committee on Legislation 109
Address by George S. Bowen 109, 110
Census Bill 110
Municipal Lighting. By M. J. Francisco, and Discussion 110, 111, 113
Editorial 112
Reports of the Committee on Resolutions 113
Value of Details in Electric Light Stations. Address by A. J. De Camp, and Discussion 113, 114, 115
The Proper Basis for Determining Electric Motor Rates. By H. L. Lufkin (Illustrated), and Discussion 115, 116, 117, 118, 119, 120
Standards of Economy in the Generation of Power. By H. H. Swetland, and Discussion 120
Proposed Constitution, and Discussion 120, 121
Report of Secretary and Treasurer 121
Action on the Death of Miles M. Goodyear and C. McIntire 121
Report of Finance Committee 121, 122
Report of Committee on Underground Conduits and Conductors 122
Report of the Committee on the Relation between Manufacturing and Central Station Companies 122
Election of Executive Committee 122
Exhibits and Convention Notes 122, 123

DEPARTMENTS.

Correspondence 123, 124

THE WESTERN ELECTRICIAN heartily rejoices in the establishment by the National Electric Light association at its convention at Cape May, last week, of the precedent that specific resolutions of the character referred to in our editorial of last week shall not receive its approval. It is well worthy of note that the action of the convention was in exact accord with the spirit of that editorial. It was read on the floor of the convention, and the association stamped it with the seal of its approval by carrying out to the letter the suggestions which it contained. The resolution introduced at the first session of the convention relating to the World's Fair and to Prof. J. P. Barrett's candidacy for electrician-in-chief were general as far as the World's Fair was concerned, but specific as far as it related to Prof. Barrett. The latter portion, therefore, came within the scope of the editorial of last week. Very properly, as we think, the convention divided the resolution; it passed the general portion which recommended the co-operation of the association with the authorities of the World's Fair, but tabled the specific recommendation that Prof. Barrett be electrician-in-chief. We think and trust that this action will constitute a precedent which will serve as a guide for the association when, in the future, similar resolutions are presented for its consideration. Furthermore, we believe the establishment of this precedent will result in the prevention of many an unseemly squabble and in the saving of much valuable time at future meetings. Action by the Chicago Electric club, by which a precedent of this kind was established, has saved it from falling into many a pitfall, and we thoroughly believe the position taken at Cape May by the association will be equally beneficial to the latter organization. While thoroughly believing in the general principle established by the association, we must admit we deeply regret that the action establishing the precedent involved Prof. Barrett's candidacy for the position of electrician-in-chief of the World's Fair. Lest the convention's action in regard to this matter be misunderstood by the public, the statement should be made here that the objections to the resolution indorsing Prof. Barrett's candidacy should by no means be considered as opposition to the latter's appointment. A general principle only was under consideration from beginning to end. In the discussion not a word of opposition to Prof. Barrett was expressed; in fact, only the best of feeling toward him was displayed. It was greatly regretted by the majority of the delegates that adherence to a general principle prevented them from passing a resolution to which, as individuals, they were ready to give their heartiest approval. The public should clearly understand that Prof. Barrett already has the general indorsement of the electrical fraternity, and to-day he is far in advance in this respect of all other candidates for the important position in the World's Exposition. At the very time the discussion was taking place Prof. Barrett had in his possession the written indorsement not only of almost every delegate, but of almost every member, who felt obliged for the sake of principle to oppose the passage of the resolution. We are informed that Prof. Barrett knew absolutely nothing about the resolution, and very naturally was singularly embarrassed by its ill-timed introduction immediately after the reading of his paper. One or two hot-heads among Prof. Barrett's friends endeavored to make it appear that those who opposed the resolution took this position because of their hostility to his candidacy. They also sought to create the impression that the editorial in the last number of the WESTERN ELECTRICIAN was aimed at Prof. Barrett, and was designed to strike a blow at his hopes. The statement is unqualifiedly false. We make the statement positively as far as the WESTERN ELECTRICIAN is concerned, and with almost equal certainty in regard to those true friends of the National Electric Light association, who felt that a general principle necessitated their opposition to the resolution. We would suggest to some of the injudicious friends of Chicago's well-known electrician that they are far from advancing his interests when they strive to make it appear that his real friends are his enemies. Had it not been for their injudicious and ill-timed action, Prof. Barrett's name would not have appeared in a resolution which the association on general principles was bound to table.

We have made this extended reference to this matter in order that the general public may not misconstrue the action of the association in regard to Prof. Barrett's candidacy. The WESTERN ELECTRICIAN repeats the hearty indorsement of Prof. Barrett, to which it gave utterance a few weeks ago. Judging by present indications he is extremely likely to secure the prize.

THE next convention of the National Electric Light association will be held in Providence in February next.

THE figures presented in the address of President Perry on the growth of the electrical interests in this country, will convey some idea of the magnitude of this branch of industrial activity. It is to be regretted that more information on this feature is not obtainable from reliable sources, and it is therefore to be hoped that the movement inaugurated by the association may result in securing a special investigation of electrical industries by the census department. The importance of the industry warrants the undertaking, and the information that will be secured in this way will be of incalculable value to all who are interested in electrical matters.

IN the report of the committee on harmonizing electric light and insurance interests, this statement appears: "Your committee have the pleasure of stating to you that the insurance representatives were quite generally agreed with a feeling of good will toward electric light and power installations, and they do not feel afraid of them." The committee announced that the work of framing a set of rules for the installation of electric light and power plants was well in hand and would be completed as soon as possible. It is expected that the committee will have completed its work and be prepared to present the result of its labors at the next convention. An interesting discussion followed the presentation of the report.

THE report of the committee on copper tariff was presented by Charles A. Brown of Chicago, and was one of the most interesting communications to the convention. It showed that the influence of the association had been felt and that there was a tendency in the right direction. It is not too much to expect that before another year passes the duty on copper will be materially reduced, if indeed it is not entirely removed. The McKinley bill which passed the house, provided for a reduction of 50 per cent. in the duty, and the senate amended this provision making even more favorable terms, reducing the present tariff 60 per cent. in some cases, and 80 in others. This is certainly a most favorable report, and the committee deserves the thanks of the fraternity. Its members have labored zealously in the interest of the association, and although they have not yet accomplished their purpose, the progress they have made and the interest they have succeeded in awakening in the subject proves conclusively that they have worked persistently and intelligently.

AN interesting incident of the convention was the appearance of George S. Bowen of Elgin, Ill., who presided at the meeting at Chicago which resulted in the formation of the National Electric Light association. Mr. Bowen was actively engaged in the work of organizing the association, and it was through his individual efforts largely that the assemblage of gentlemen representing the electrical interests was gathered at Chicago when the association was formed. He has watched the course of the organization closely and has noted its growth and its development with no little pride. His address was received with marked attention. He referred to the difficulties Morse encountered in securing recognition for his wonderful invention, and said young inventors of to-day were having the same experience—they too were looked upon with suspicion or toleration, and were often considered knaves or fools. Mr. Bowen said: "I expect to live to see the day when all these little towns all over the country shall be illuminated with electric light, and we shall not have to grope about in darkness as much as we have heretofore." The association conferred the distinction upon Mr. Bowen of making him an honorary member.

(*Continued from page* 111)

them—have been so much lower than any commercial company has ever produced their lights under anything like similar circumstances, that that thing is not at all necessary; there is no use of doing it. A commercial company who has stockholders to serve and who is under certain confidential obligations, which are generally recognized, are not in the habit of publishing that sort of statement. So that I presume when the commercial lighting comes down to a point where it can produce the lights at a less cost than the municipal plants are now costing, we shall hear just what they cost; and they can very well afford to wait until that time.

MR. DUNCAN: While my friend DeCamp thinks that every man who has ever had any connection with a municipal body must naturally become dishonest, I differ with him. I believe that the same percentage of honesty will prevail in municipalities as in the Electric Light association. But, sir, the information that the gentleman from New Jersey had to put before his man was meager. What we want to do at the present time is to place the statistical information which has been prepared by Mr. Francisco with a great deal of labor and care, in such shape that members of this association can use it when this question arises in their own cities or towns.

MR. DE CAMP: In the statement that lamps in Chicago cost 16 cents does that include interest, salary and depreciation.

MR. FRANCISCO: I can answer that for Mr. Barrett. I have a letter from Prof. Barrett in which he states point blank that he does not include it.

MR HAMMER: I have a suggestion which I think is very pertinent to this subject, which comes from across the water I lived in the city of Paris last year and I became acquainted with some of the gentlemen connected with the municipal government there, and among them the chief engineer of the city, who has charge of the municipal lighting affairs. As is probably known by every gentleman in the room, the city of Paris some time ago offered a prize for the best electric meter that was brought to the attention of the expert. Tests were conducted and there is to be I believe a second series of tests. It may also be known by many of the gentlemen here that the city of Paris at a very considerable expense has placed in one of the sections of Paris a large plant on the direct current system, and also a large plant, a similar plant, on the alternating system. The city of Paris, a great many people have supposed, was going into municipal lighting, and that these experiments were intended as leading up to the installation of enormous municipal central stations for doing the general lighting of the city. I asked the engineer if he would give me an expression of his opinion of just the status of the government in regard to this matter, and he said it was this: The municipality of Paris appreciated that electric lighting had come to stay, and it was an enormous industry, one of great importance to them, and one in which the French people were backward in taking hold of and pushing forward; and that they desired, as has always been characteristic of the French people, to encourage the arts and sciences, and in this particular case they wanted to encourage and enforce this industry which seemed to be in the background in their country. With that end in view they took a representative of the direct current system and a representative of the alternating current system and placed them in one of the sections of the city and said, "Now when we are through with the test the system which has given us the greatest satisfaction and which we can indorse as being the best for the city of Paris will be applied, and the municipal lighting will be done by that system." And I asked him about the relation of the meter tests, and he said they were very similar; he said the meters were to be tested, prizes awarded, and the city of Paris would retain the privilege of utilizing any meter which they decided upon as being the best, but that utilization would be only very limited, to be used in those experimental stations, and that the city of Paris did not propose to go into the manufacture of electric light any more than they were going into the manufacture of any other commodity; that they did it entirely to foster the industry.

THE PRESIDENT: Mr. De Camp, Prof. Barrett has now returned to the room and you will now have an opportunity to ask him the question.

MR. DE CAMP: I asked, whether the published statement of the cost of sixteen cents per night per lamp included interest, his own salary and depreciation.

MR. BARRETT: It doesn't include interest; it doesn't include water taxes, rent or—yes, it includes depreciation. We don't have any depreciation We buy a class of goods that will last. I will say that sixty-two miles of wire last year cost me $16 for maintenance underground.

MR. DE CAMP: How many lamps did you have on?

MR. BARRETT: I will not attempt to answer it; I don't know. I don't know the amount of wire that we have in that district. But there is another consideration that I want to mention. By the action of the council the gas and oil and the electric light fund is one fund, and the electrician has charge of all, and of course it would cost less.

T. CARPENTER SMITH: There is one point on this question that I think we should look at fairly There is no doubt that a municipality under certain conditions can, and under all conditions ought to be able to run its plant cheaper than any corporation. On the other hand, I think there is very little doubt that it seldom does. The remark that Mr. Garratt made about dealing with conditions and not theories, I think is a very pertinent one; and I think if you will examine into the administration of a good many of the larger European cities you will find that a good many of those cities do own their own gas works and water works and do furnish gas and water as cheaply as a corporation would; but on the other hand you will find a very large number of cities, and especially the very large ones, who do not own the gas works or water works, and yet water and gas are supplied at a far less rate than when the cities do own them. Another thing you have to take into consideration is what is meant when you speak of the cost of running gas works in the city, or an electric light plant.

In Philadelphia they have as good a chance to supply gas as cheaply as anybody; they can get cheap transportation for coal; they have an excellent market for coke and all waste products, and they charge $1.50 for about the meanest gas I ever used. Not only that, but the city pays $150,000 for gasoline lamps. I think the $150,000 should be charged right into the gas works, for the city is supposed to do its lighting and yet it pays an outside corporation that money. I think there are a good many things that we want to look at very carefully and I think the more this thing is probed the more baseless you will find the claim to be that the city does run the lights cheaper; and I think Mr. Francisco's paper ought to be published as widely as possible, because when you go into any average council chamber and listen to the talk you will find very soon that it is not facts that are taken into consideration but talk; and if you have good solid facts that you can put to these people that cannot be controverted it will have more weight with the public than anything else. I have seen these statements of the cost of lights in the various cities, that have been sent around, and some of them are very wonderful as Mr. Francisco has shown them to be.

MR DE CAMP: The city of Philadelphia has owned its gas works for a great many years. In the annual statement of the board of gas trustees they always showed an enormous profit, but under the new charter it was taken out of the hands of the board of trustees, and for all moral purposes it is generally conceded for the better. It is a matter of history that the gas trust in the city of Philadelphia politically was one of the greatest sinks of corruption in the whole city, and on moral grounds if on no other it was taken from the board of trustees and placed in the department of public works, which in point of honesty has the confidence of the whole community, unpopular as it may be personally. They found that the capacity of the present established plant was not sufficient to supply the needs of the city for public purposes and for private purposes too—because they furnished light to private parties. There was no money to build an additional plant. The next thing was to contract with a new company to furnish three million feet of gas a day to make up the deficiency. They contracted for that at 37½ cents per thousand feet delivered in the holder. They sell it for $1.50 a thousand and the official reports published for last year show a profit. With all the increased effort and with the prestige of an honest, businesslike administration of those affairs, the gas department of the city of Philadelphia would have shown a very heavy loss for the year 1889 even with gas at $1.50 a thousand, had it not made the profit on the gas it bought at 37½ cents. Now it is done by private corporations The city of Philadelphia had the proposition made to it to lease those gas works under guarantee that gas would be furnished for both public and private purposes for $1. a thousand feet which is just 50 cents less than had been paid for it.

MR. ALEXANDER: I do not believe in municipal plants, but I hope the statements that are made here to go out as printed will be fair to all parties. Thirty-seven and one-half cents is the price of gas in the holder—not including the cost of distribution and leakage in the pipes, which will diminish the profits of the city of Philadelphia on that three million feet considerably.

MR. FABEN: The buying of this three million feet at 37½ cents and selling it at $1.50 ought to give them a profit of the difference between those two prices; but they did not realize the difference between the cost of three million feet at 37½ cents and the sale at $1 50, which would show that their business before they bought this three million feet at 37½ cents was not self-sustaining.

MR. ALEXANDER: That is exactly what I am getting at, that the difference between 37½ cents and $1.50 is not the profit, but they realized a profit beyond the cost of distribution.

MR. DUNCAN: I should like to ask one question of this committee. While this is a very gratifying report it does not seem exactly fair that we should make a statement in regard to a company which is furnishing lights to a city, on a bid, unless we ask whether they take into account or not their other business in connection with it; whether they make a separate item of that alone, which the municipality does. You have got to get them on the same basis to make a fair statement.

MR. DE CAMP: The city lighting in the city of Philadelphia I think averages about eleven hours and some few minutes. Now the general average of the whole business, including commercial, is practically the same thing, eleven hours. But a large portion of the commercial business would not average probably more than six hours. If you were to eliminate all commercial business, and take city business, whatever difference there is would be against the city because you would have nothing to off-set in the way of short hours. I am perfectly safe in saying that our general average is a fair one.

MR. BOWEN: In this statement regarding the lighting of the city of Dunkirk it is said that after using their machinery for a year and eight months their lines are in a better and more perfect condition than when they first started, that differs from my experience because about the first of the year after I put in my plant I had to build it all over again, and I have heard of others that had to do the same thing; and that is why I suggest to you that whenever you do a thing do it well. On that point I want to say one thing: Professor Barrett enjoys the confidence of every man in Chicago, whether he is a democrat or republican. They all refer to him as an absolute authority, and he has absolute authority to carry on the electric light business and his bills are paid. There is the great advantage that he possesses. I happen to know of a city where a while ago they wanted a few brushes and they sent the city clerk to the nearest seaport town, and that happened to be Chicago, to buy a couple of pairs of brushes. That cost the city some fares, etc. and gave the man a chance to go to Chicago. There cannot be a thing done unless a committee passes upon it. If a man wants to sell a few carbons they call the committee together; and all of you know, who have had anything to do with selling carbons, what you have to do when you meet a committee.

A motion that the association print a certain number of copies of Mr Francisco's paper, was adopted.

REPORTS OF THE COMMITTEE ON RESOLUTIONS.

THE PRESIDENT: Next in order is the report of the committee on resolutions.

MR. MASON: To your committee on resolutions have been referred only two. I will read the first:

"That a committee of five be appointed, of which number, the president of the association shall be ex-officio one, the other four members to be appointed by the president, who shall offer their services to the authorities of the Columbian Exposition with a view to securing suitable facilities for the proper exhibition of electrical manufactures and appliances, and in general to work for the advancement of electrical interests and to offer the authorities of the Columbian Exposition the co-operation of the National Electric Light association to aid in making the Exposition a success."

Your committee recomend that this resolution be passed. I will read the other.

"That the committee request the selection by the authorities of the Columbian Exposition of John P. Barrett to have practical charge and control of the electrical department of the World's Columbian Exposition."

Your committee recognizing the fact that, while before the present gathering probably the larger part of the members of this association had personally recommended the appointment of John P. Barrett by the authorities of the Columbian Exposition to the charge of the electrical department of the World's Columbian Exposition, yet that, on the floor of the convention members have expressed the opinion that it is outside the province of this association to offer such recommendation. Your committee, therefore, return this resolution to the association, suggesting that it act upon the same without suggestion from its committee.

The resolution providing for the appointment of a committee of five to co-operate with the authorities of the World's Columbian Exposition, was adopted; that relating to the recommendation that Mr. Barrett have charge of the electrical department, was tabled by a vote 26 to 17. This determination was reached by a call of the roll, after a discussion of an hour or more of rules of order and constitutional rights.

The convention adjourned to 4 P. M.

AFTERNOON SESSION.

At the afternoon session A J. De Camp of Philadelphia, made an address on the value of details in electric light stations.

VALUE OF DETAILS IN ELECTRIC LIGHT STATIONS.

MR. DE CAMP: It certainly is a fact apparent to any one who has had the handling of electric light stations, that it is essentially a business of detail. The larger items about the business are very easily handled. They will take care of themselves if they are put in the right direction; but there is an infinite number of small things which very materially affect the successfull operation of an electric light station. As an illustration of what I mean I will say that after considerable reflection and dividing the items worthy of care and attention in the management of the business under fifty heads, all of which have to be kept track of and all of which are a positive and a direct item of expense or income, I find in looking over it for this purpose, one, two, three, four, five items which I ha hadto to class as miscellaneous expenses. These have a bearing on the business in general and are not chargeable to any one of the particular heads, under which I have seen fit to group cellaneous items year, in one county, was about business. Now, in going further in that, in looking as mis-$15,000; going further in looking into the records to see what they consist of, the space occupied on the book of the company to cover these small items was very nearly twice as much; in other words, it covered twice as many pages as the whole of the other part of the business. The items there reached from one cent up. There is no doubt but that detail may be carried to such an extent that it becomes burdensome. It may become unprofitable on some particular item, but we can only treat this matter as a whole.

By the instance upon a detail and consequently a check upon waste, there is a supervision, and consequently a greater care on part of the employe. I will have to illustrate somewhat, and I will say that in one item of carbons alone, the reduction in the expense of the carbons caused, after a sytem was adopted by which they were accounted for on the basis of inches, was a saving of nearly 50 per cent.

That is proved to be correct, because it has been in practice for the last five years. Another important thing is the matter of discipline, for you cannot have details thoroughly looked after without discipline.

The most important item in the whole operation of an electric light station in point of dollars and cents is that of labor and I do not see but what it will always be the case. It is a most unsatisfactory thing to deal with. I remember there was a time when we thought that sixty lamps on an ordinary circuit was a day's work for a man. Now they trim a hundred lamps more, easily than they used to trim sixty, and my own judgment is that in the course of time we will work up, so that 150 will be no harder than 100. But it takes patience and great care to bring that about without a temporary effect upon your business and the perfection of your service. A custom of dealing with labor, I think, which requires the counting of every minute of time for which a man is employed has a very beneficial effect. I think that plan alone can be credited with a reduction in the pay-roll in the course of

take months, in which it is getting into shape of some 25 per cent. Now it takes a little time to do that and you can count that time lost, and when you get ten, or fifteen or twenty men they are scattered all over a great city in groups of two, or three, or a single man. He gets outside of your control and you have no means of checking him. He makes a half day's work in a day, if the foreman is settled at the end of the week or at payday. A custom adopted for the men of having a slip furnished to them on which they account for every hour of their time gives the man who has charge of them an opportunity of judgment for himself whether they have employed their time properly during that ten hours. The adoption and the rigid enforcement of the thing in our station did not grow out of any idea of accomplishing the the object which it has accomplished. In the early history of the business it was the custom of my company to do a great deal of work without charge. That was done for policy sake. The question arose as to the enormous expense at our labor and the number of employes we had on our pay-roll, what they did and how they could employ their time. The balance was on the wrong side of the sheet and it received very careful attention. The number of men apparently required for the operation of the station was very far in excess of what anybody ever supposed it would be. In looking into it we found that there were two or three men working here, and two or three there and three or four somewhere else. What were they doing? Well, they were making changes; they were shifting the position of lamps; they were doing this, that and the other thing. Well, we were going to be through with that—that would all be done with, and we could let sell these men go, we thought. But the fact is they never did go.

That work was all being done without any charge, and the shortest way of getting at it was to say, "Here now, that is all right, we must attend to the demands of our customers. If they have anything that they want done, it must be done and there is nobody who is better qualified do it than we are. We do not want to leave it to somebody else to do." So we closed that month and started in the next on the basis of charging for that work. The basis of that charge was mainly for the labor. The labor was charged at thirty cents an hour and all waste materials. We did not charge for anything that would be incorporated into our own property, but we did charge for wires and screws and things of that kind that would probably never be of any use, except for that particular purpose. At that time, I think, we were running about 350 lights, and when, at the end of the month, we charged that up and footed it up to see what it amounted to, it amounted to eight hundred and some odd dollars. We tried to collect it, but I presume we did not collect more then $200. People demurred and would not pay it. But it brought the thing to an understanding. Now, no work is done after the first installation, unless it is to be paid for by our customer, and we get an order from our customers, in which they order the work to be done and to be charged to their account. That brought the next month's charges down and all we had occasion to charge them, was something less than $200. There could be no better proof in the world than that very fact that, as long as people did not have to pay for a thing they ware very free to indulge their fancies.

Another point. We sent a man out to do a job and he comes in and charges three, four, five, six, ten hours' time. The man for whom that work is done cannot account for more than an hour or two. Then comes your dismission on the payment of that account, and it is a great trouble. We know nothing. We charge a man time from the time he leaves the station, till he gets back and reports to us, and whether he has put in that amount of time, less the time of coming and going, of course, we have no means of knowing, at least we did not; we get nearer to it now. A man goes on duty at seven o'clock and is employed for ten hours. He has got to account for these ten hours through the day, where he has been. Now your superintendent can follow and he can come to some conclusion. If the man says I was there two hours, and, in the superintendent's judgment, it is a one hour's job, you put a check on that man; but under the old system he could not tell, where that man went to, he might have been on two or three jobs.

The electric lighting business is not in such condition that you can take the ordinary stand and say to the public, "You will take just what we can give you, and just as we want to give it to you, or nothing." We make our contracts as specific as we can; but we have not got a contract under which we have not given more service than we agreed to give. The service rendered is never below the standard. We have lights running on the twelve o'clock service plan; and our contracts for that service cover seven hours of maximum burning. That would mean strictly that at no time was the service rendered by those lights to exceed seven hours, which, in the winter months, is from five to twelve. But that does not do, because five o'clock is not early enough during three or four months of the year, when the lamps are sometimes lighted as early as three o'clock. It means more than seven hours in point of fact. It means rather an average of seven hours than it does a maximum of seven hours. In any city the restrictions on the running of wires may make it necessary that you put half-night lights on all-night circuits with the object and purpose of switching them off, individually perhaps, at twelve o'clock. A customer can hardly be relied upon to do that. He may do it, or he may not do it. The only safe way to do it, is to have them switched off by your own employes. It is the same way with all-night lights, which might be run, and sometimes are run, for fifteen, sixteen and seventeen hours, starting a portion of the lights at three or four o'clock. You must give the people what they want, or you will finally lose your business. Now, those are small things, but I have held to the opinion that, to go into all those details of the means of which you rent your lights, and employ people to switch them off, or any other means, that can be devised to do it, is an item of expense that does not pay. That is, it does not pay for what you get in return.

I do not think that there is a very general or a high appreciation put upon the methods of arriving at just what your product cost you. I think that this is recognized in the incandescent work, but not in the arc work. As long as I have been connected with this association, and as large an acquaintance as I have among electric light central station men, I never have found any one yet who seemed to have any appreciation, or any interest in knowing just exactly what his product cost him on the same basis on which he sold it. To get at the cost of a light, or of any particular part of it, it is very generally figured up as a horse power. But the point that I have always contended for, is this: I rent a light for a given length of time, for a year, if you choose, which is the most favorable contract that I consider that we can make, because it gives us the longest service; and in doing that, if you figure it on the basis of exepting Sundays', you rent your lamps to furnish 312 lights, which you sell at so much per light. Now, you really want to know not what the 312 lights cost you, and how much you get for them, and take the difference, and let that be profit or loss, just as happens to be, but you want to know just what each one of those lights costs you, and you want to know it as a whole; you do not want to know whether it takes one horse power, or two horse-power, or a half a horse power; as there are a great many other things besides horse power that enters into this question.

Another thing that I find is a very common practice is to have a uniform price for a light of a certain character, whether the contract is for furnishing light for six months or for a year. The same rate for the longer and the shorter term is unjust to your long contract customers. It is a very easy thing to rent lights during six months of the year, commencing the 1st of September, October or November, and it is a very easy thing to keep such customers becaure they want the lights most at that time. But in the summer time people discontinue the use along about the first of March, April, May or June, and so you have an idle lamp during the summer, in which you have your money invested, waiting until the fall season comes around again in all probability. I contend that the user of that lamp has no right to expect to get that light at the same price per diem as the man who pays you for a service of 312 nights in the year. But that is almost universally done. I contend that if we could run our arc light machines from the time of starting up in the morning, continuously, as we run the incandescent machines, and make contracts to run from time to time at certain hours of the day and charge by the hour, or at least by a group of hours, we would meet a very great demand and do justice to customers and popularize the business.

Discussion.

C. R. Price: I did not get Mr. De Camp's idea with regard to the charges for electric light service; whether he would change the rate for small customers, or whether he would fix one rate right straight through the year.

Mr. De Camp: I have only referred to the graduation or scheduling of prices in accordance with the service required.

Mr. Price: You would make a charge at so much per hour?

Mr. De Camp: No. What I say that we are doing now is that if we make a contract for a year, for a lamp which renders us an income for 312 nights in the year, we fix a rate for that. Now, if a person wants precisely the same lamp to burn the same number of hours per day, but says "I will contract to give you service for that lamp only for six months of the year," then I contend that that man should be charged a very much higher price per diem.

Mr. Price: Whether it is a summer or winter lamp?

Mr. De Camp: I base the charge on the all-winter scale. If a person was to come in and say, "I want to give you a contract, or an order, for a light to burn six months in the summer," then that would be an entirely different thing, and that man would be entitled to a very low price because he is going to rent from you your product when you are over-stocked with it.

We do not have any three months' customers. We do not make any contracts for anything less than six months. It is sometimes the case that we have lights that burn for two or three months, but we make the price without any reference at all to our schedule price.

The price for a twelve months' contract (and that covers the distinction between seven night light and a six-night light) is 65; for eleven months, 62½; for ten months 70; for nine months 75; for eight months 80; for seven months 85; for six months 95. That is for half night lights. For all night lights we add fifteen cents to each one of these prices.

Mr. Wilmerding: Is there any discount from those prices?

Mr De Camp: Yes; there is a discount. We render bills on the first of the month, and stamp each bill, "Ten per cent. off if paid before the 10th of the month"; but the contracts are made without reference to the ten per cent. deduction.

Mr. Wilmerding: I would like to ask Mr. De Camp if he has been running on those rates for any length of time, and if so what his experience has been in making six months' contracts.

Mr. De Camp: On these particular rates we have been running for a year, but the same principle prevailed for the three years previous. We started on the basis of having a uniform and graduated schedule of prices. I have had one or two cases where I have had trouble, and where I had to bring suit in order to get a settlement with parties, and I had found that we did not have any foundation for a suit except a contract by word of mouth. It occurred to me that there was a great necessity of having a binding and substantial contract so that there would be no question about it when we had to resort to a suit to collect a bill. I determined to make out a contract or lease; and so I drew up a lease, had it approved by a competent attorney. I think that in the effort to have those contracts signed, I lost about five lights on the six months' basis. We would rent a great many more lights if the difference between our prices for twelve months' and for six months' contracts was not so great. But I think the difference is quite fair. It is certainly a great loss to any one to have a part of a plant idle a part of the time.

Mr. Price: I understand those are for full arcs. Did you have any half arcs?

Mr. De Camp: Mine are six-tenths, or nominally 2,000.

Mr. Price: Did you have any 1,200?

Mr. De Camp: No.

Mr. Wilmerding: Do you wire those lamps free?

Mr. De Camp: Yes; we charge nothing for insulation either on the six months' or on the twelve months' contracts.

Mr. Wilmerding: In Chicago, on the twelve months' contracts we charge 65 cents, with 15 cents discount, per lamp per night. But I am speaking of the arc light only. Where the wire is paid for by the customer it lets us out on the short contracts. If a customer does not want it for more than three months we have got to have some rule established by which we can give it to him; and they are willing to pay for what time they use the lamp. In that case it is the same to us whether the customer uses the lamp for three months or for a year, so long as he pays for the actual cost of construction, and we are getting our regular rates out of him.

Mr. De Camp: I do not think you are getting enough for it.

Mr. Wilmerding: But you must be in the position to accommodate the public more or less, and so you cannot make an absolute rule which will suit all classes of people.

E. R. Weeks: Mr. Wilmerding has the advantage of being placed in a city where the interest amounts to nothing, and where the depreciation is nil.

Mr. De Camp: That shows a disposition on the part of the public to be fair to the company, but still they are not paying near enough. If your year's service will render you $100, and your six months' service would render you only $50, and the man pays you for the cost of putting the light in, which would be $5 or $10, he would not be paying enough.

Mr Wilmerding: That is all right; but the electric light companies are competing more or less with gas; and a man can use gas at his house, turning it on when he wants it, and paying for it only as he uses it. If he is compelled to pay for an electric light service whether he uses the light or not, he will be dissatisfied. He wants something more in proportion to his actual requirements, and he only wants to pay for what he uses. I think that we have made a pretty good step in advance in inducing men to pay for the electric lamp from dusk to midnight. That is what quite a large number of our customers do. They must pay for the light whether they use it all night or not. But if he wants the service and wants us to charge for only the summer, then we have got to let him have it, or else he will use something else. I think we must accommodate ourselves, more or less, to the public demand.

Mr. De Camp: As for competing with gas I may say that I do not think we have any arc light in service to-day that is burdened with any reference to the cost of gas.

Mr. Wilmerding: My experience has been just the reverse. I find that they will figure exactly just what their gas is costing, and then see whether they can get the electric light at a sufficiently small advance over that cost of gas to warrant them in paying for it. Six or seven hundred of our arc lamps are day lamps, which are burned in large dry goods stores where they have got to use artificial lights; and they would use gas if they could not get the electric light for what they consider a reasonable price. Those people do not care whether it is the arc light, or the Lungren burner, so long as they get a good light; and with them it is merely the question whether they can get a better light with the arc light than with gas for a price which they consider sufficiently reasonable; if so they will take it; otherwise they will not. The night lighting is quite another matter, for a man who puts an arc light outside of his store at night is doing it for advertising purposes, and not for any other use. I think the question in the mind of the customer is whether he gets an advantage which is proportioned to the difference in price.

S. J. Hart: It seems to me that this is a question which can be regulated by the different companies. It can only be regulated by the managers of the different companies for the reason that the conditions are different.

A. M. Renshaw: I will state that our experience in Washington has been substantially the same as it has been in Philadelphia. We found that we had a large demand for lighting in the fall months, commencing along in October, November or December, and generally ceasing about the first of the year. We found that it would be impossible to supply that demand without doubling, or perhaps trebling our capacity. We found, furthermore, that we could not charge a price that would warrant us in doing that kind of a business. The result was that for several years we had to have two terms for the electric light, one for six months, and one for twelve months. We rented no lights for a less term than six months; and we have very few lights rented for six months. We encourage our customers to take their lights by the year, and we make as low a rate as is consistent with the business; but we do not attempt to compete with gas. The price of gas is only $1.25 in Washington, and we can not compete upon that basis. We make a large difference in our price between the term for six months and the term for twelve months—a difference nearly as great as the gentleman has indicated exists in Philadelphia.

Motor Rates.

The President: The next paper on "The Proper Basis for Determining Electric Motor Rates," by H. L. Lufkin, of New York, will be read by Joseph Wetzler.

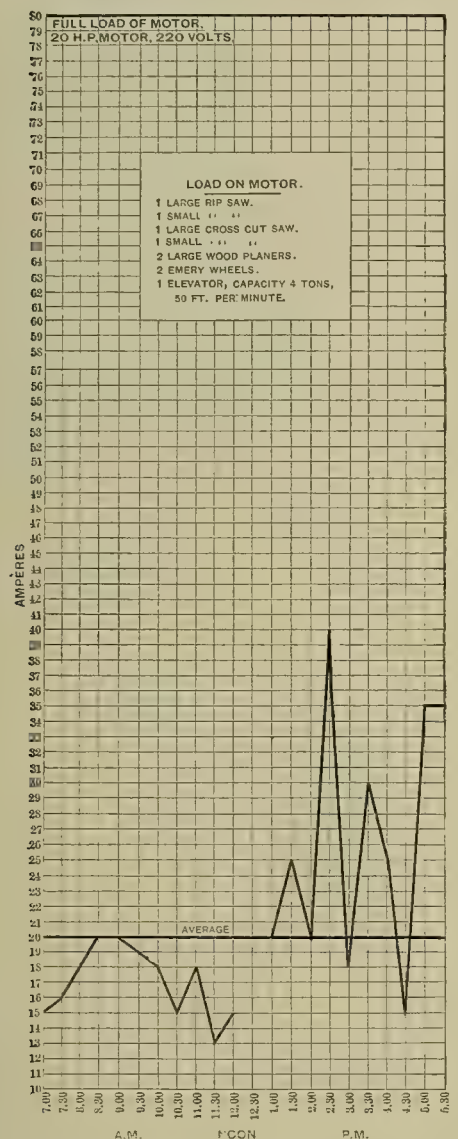
Mr. Wetzler: A short while ago in discussing with Mr. Lufkin the charges paid for electric motor service he pointed out what seemed to me a number of anomlaies in this matter; and when I expressed my opinion on the matter also he brought out a large number of diagrams in sup-

port of his opinion. A small number of these—although they may appear large in the aggregate—have been embodied in the diagrams which have been distributed here, and which will elucidate the paper which I am about to read.

A Proper Basis for Determining Electric Motor Rates.

BY H. L. LUFKIN.

The equitable adjustment of motor rates, or rather the rates per month, or year, for the supply of current for the operation of electric motors, has long been a matter of considerable annoyance to companies supplying electric power. It is obvious that to invariably charge the motor user an arbitrary rate per horse power for the motor which he uses, based on its rated capacity, and regardless of the work it is doing, is not satisfactory, for the reason that the manufacturer usually prefers to buy a motor somewhat more powerful than his work really requires, and thus avoid the possible damage to his motor from overload, or the strain to which any piece of machinery is subjected when constantly operated above its normal working capacity. Again, the manufacturer may contemplate an increase in his plant in the near future, and in buying a motor, may provide one of sufficient capacity to operate his prospective increase.



Average Load.....25 per cent. of R...
Maximum Load.....50 per cent. of F...
Average Load.....50 per cent. ...
Shafting.....75 per ce...

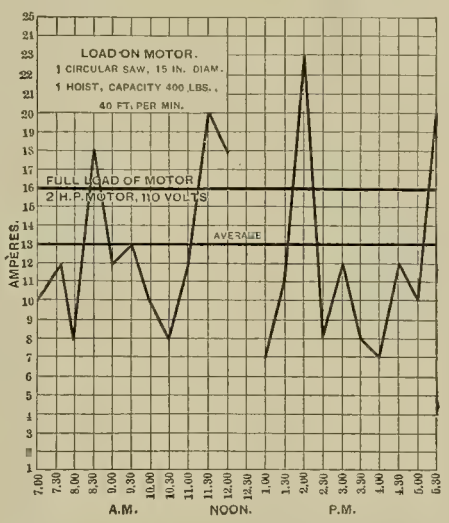
No. 1.

To illustrate graphically the practical operations of motors under load, I have taken a large number of records of motors in actual service and from these records have laid out ampere curves or daily load diagrams which will illustrate very clearly the fluctuations in the current supplied to motors in actual practice. Other interesting features of these curves are the maximum, minimum and average readings as related to each other; the current consumed in driving the shafting as related to the average current consumed, and the peculiarity of the records of motors operating elevators.

Copies of these load records are illustrated in the accompanying diagrams. The vertical lines of these charts, you will notice, represent hours of the day, and the horizontal lines, amperes. In making these records an ampere meter was placed in the circuit in series with the motor and each reading taken was dotted on the chart where the ampere line, corresponding with the reading taken, intersected the hour line corresponding with the time at which the reading was taken. By connecting these dots together with a continuous line we, of course, obtain the diagrams or curves shown.

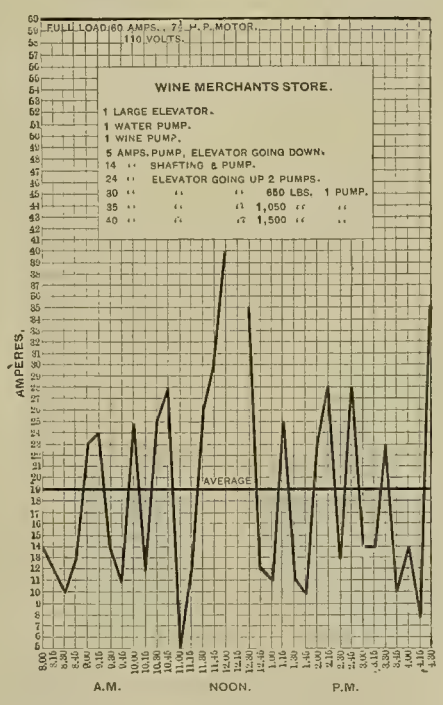
The highest average use shown in any of these records is in diagram number 2, with an average use of 81% of the capacity of the motor; this record also shows an overload of 44% at the 2 P. M. reading. Diagram number 16 shows the lowest average, it being in this case but 24% of the capacity of the motor. A composite average of all these records shows that the average use of an electric motor is but 43.57% of its rated capacity.

It is a fact that many central stations which still use a "maximum or motor capacity system" of charges have adopted a schedule with the fact in view that where the motor is used for the usual run of intermittent work its average use is much below its capacity. The circumstances of motor use are, however, so varied that a system of rates or charges for power which shall better adapt itself to this wide range of conditions has already been adopted by many central stations, especially those operating constant potential power circuits. This system of charges I will call the "maximum reading system," which is based on the maximum reading of an ampere meter in series with the motor. The station supplying the power reserves the right in its contract with the customer to change or modify the charge for power from time to time as any increase is shown by these readings.



Average Load .....81 per cent. of Rated Capacity.
Maximum Load..... 44 per cent. in excess of Rated Capacity.
Average Load.....51 per cent. of Maximum Load.
Shafting..... 55 per cent. of Average Load.

No. 2.



Average Load.....32 per cent. of Rated Capacity.
Maximum Load..... 67 per cent. of Rated Capacity.
Average Load.....47½ per cent. of Maximum Load.

No. 3.

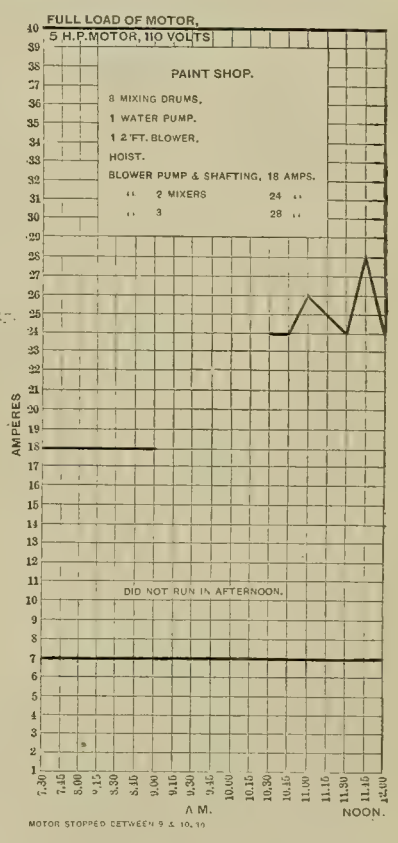
A PROPER BASIS FOR DETERMINING ELECTRIC MOTOR RATES—LOAD DIAGRAMS.

To illustrate more clearly this "maximum reading system" I would refer to diagram number 23, which is a fair average record. This represents the record of a 15-horse-power motor operating lithograph presses, etc., the maximum reading in this case being 75 amperes, or, approximately, 10-horse power. The user is given a 10-horse power rate, which in this case happens to be $60 per month, or a rate of $6 per month per horse power based on maximum readings. As the average power delivered to this user is but 67% of the maximum reading, the station actually receives at this nominal rate of $6 per horse power an actual rate of $9 per month per horse power for the power actually delivered.

The central station supplying this particular motor has adopted the "maximum reading system," and this rate of $6 per month per horse power is their standard charge for motors showing a reading of 5-horse power and over up to 15-horse power. From 15-horse power up their charge is $5 per month per horse power. Their monthly bills are also subject to a discount of 5%, I believe, if paid promptly on the first of each month.

To return again to the diagrams. The records, twenty-nine in number, are of so varied a character that an average taken from all the records will, I think, show within 1% or 2% of the general average conditions found in electric motor practice. The conditions as shown by these records are as follows: Average load on motor, 43.57% of its capacity. Maximum load on motor, 68.24% of its capacity. Average load on motor, 64% of maximum load.

Reducing these averages to dollars and cents we have the following results: A "maximum capacity" rate of $6 per month per horse power pays the station $13.80 per month per horse power for the power actually delivered.



Average Load.....17½ per cent. of Rated Capacity.
Maximum Load.....70 per cent. of Rated Capacity.
Average Load .....25 per cent. of Maximum Load.
Shafting.....— per cent. of Average Load.

No. 4.

A "maximum reading" rate of $6 per month per horse power pays the station $9.37 per month per horse power for the power actually delivered.

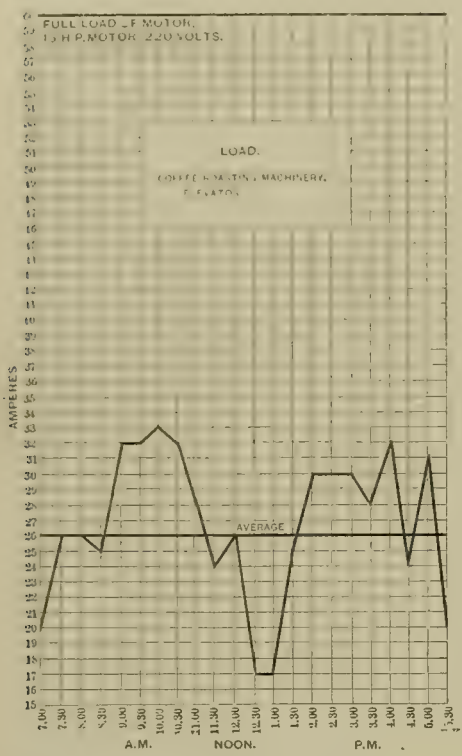
This rate, $13.80 per month per horse power, is certainly a tempting price for power, but it is open to some serious objections. In the first place, at this price the electric motor, even with its much higher efficiency, cannot compete with the gas engine. A good gas engine uses about 20 feet of gas per hour per horse power, or about 5,200 cubic feet per month. Giving gas at $1.50 per thousand (and in many places it is much lower than this), the gas engine will deliver power at a cost of $7.80 per month per horse power. We can, without much trouble, obtain the $9.37 rate per month for a motor in competition with the gas engine on account of its many and obvious advantages, but we can seldom obtain the $13.80 rate. This maximum capacity rate also very much hampers the user in a selection of a motor, and the motor salesman, in order surely to effect a sale, is very apt to underrate the prospective load on the motor, as the customer is governed in his purchase of a machine much more by the monthly charge than by the first cost of the motor.

Another feature which must not be lost sight of is the fact that a motor user who has bought and paid for his machine becomes your permanent customer, his income being entirely derived from the product of the work of his motor. His bills for power you are also sure of collecting, for the moment his power is shut off his earning capacity ceases. The motor becomes to him an absolute necessity instead of

a seasonable luxury, as is the case with many electric lights. Another very remarkable feature brought out by these diagrams is the fact that the average power consumed in doing serviceable work is but three-eighths of the total and thus acts as a brake to retard the too rapid descent of the elevator.

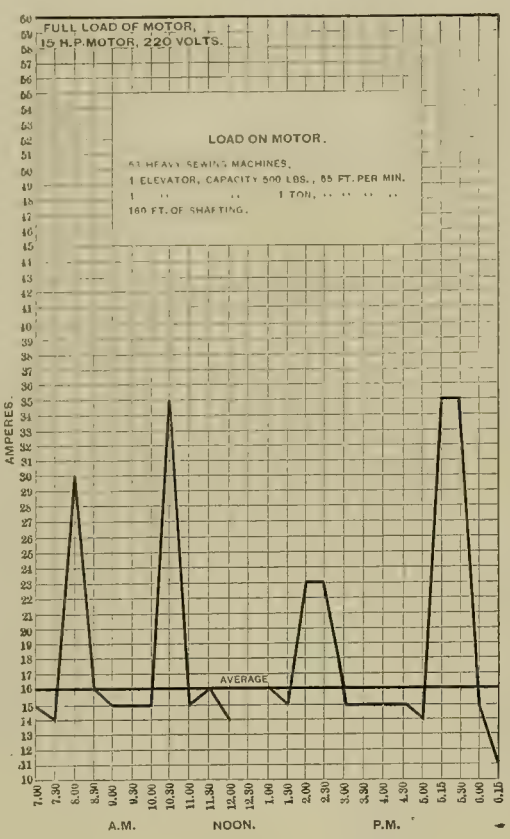
As a concluding reference to these diagrams, let me call your attention to diagram number 3, in which a condition presents itself with which you are familiar in theory, but which has, I believe, never before been practically illustrated, namely, the counter e. m. f. in the armature of a shunt wound motor driving a spur gear elevator. When the elevator is coming down with a load the counter e. m. f. runs above the e m. f. of the supplying circuit, and therefore the motor becomes a producer instead of a consumer,

Diagram number 3 represents the record of a 7½-horse power motor in a wine merchant's store operating an elevator, a small piston water pump and wine pump. The water pump is in continuous operation, the wine pump and elevator being only used intermittently. The current consumed in the shafting and water pump, which constitute the continuous load, is 14 amperes. The difference be-



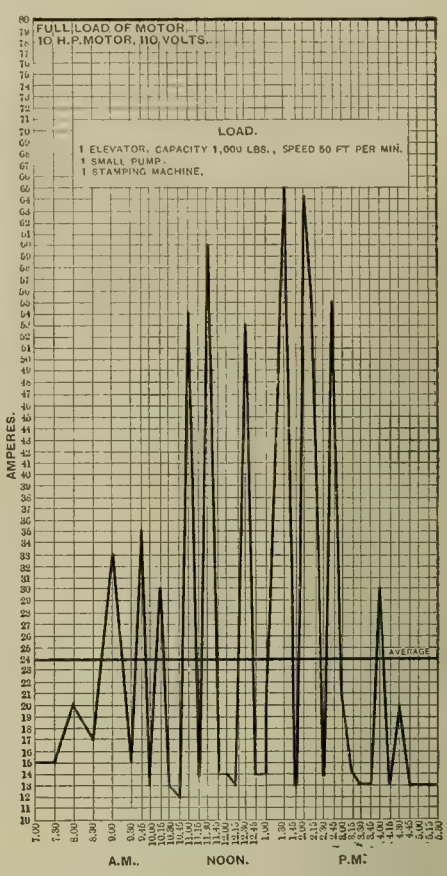
Average Load ..... 43¼ per cent. of Rated Capacity.
Maximum Load..... 55 per cent. of Rated Capacity.
Average Load..... 78 per cent. of Maximum Load.
Shafting..... 65 per cent. of Average Load.

No. 5.



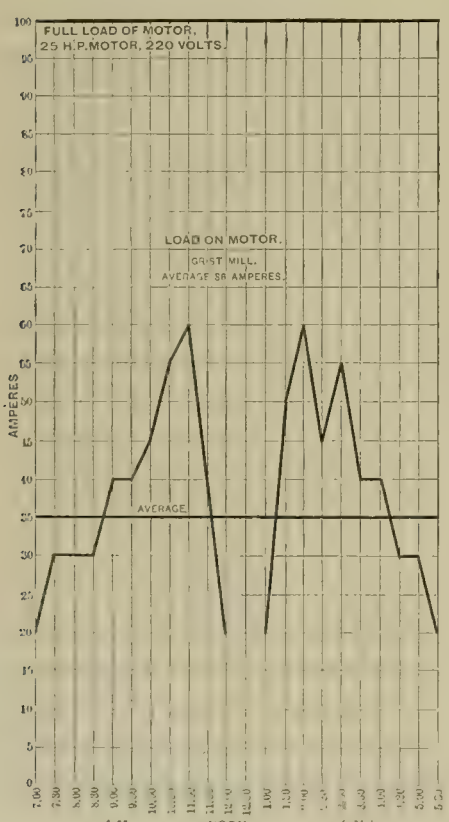
Average Load.....26 per cent. of Rated Capacity.
Maximum Load.....58 per cent. of Rated Capacity.
Average Load.....46 per cent. of Maximum Load.
Shafting.....71 per cent. of Average Load.

No. 7.



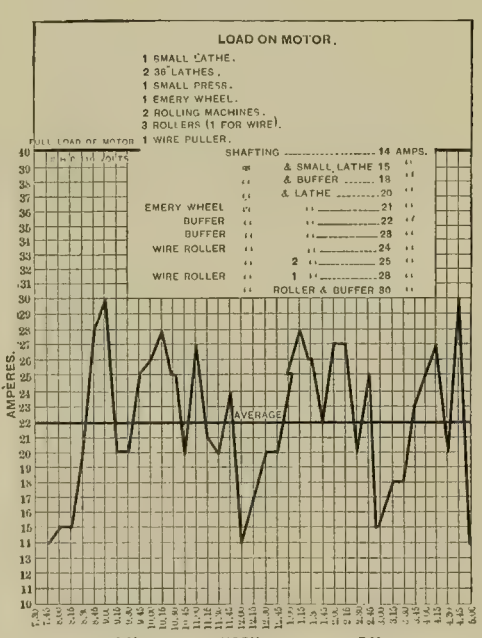
Average Load.....30 per cent. of Rated Capacity.
Maximum Load.....81 per cent. of Rated Capacity.
Average Load.....37 per cent. of Maximum Load

No. 6.



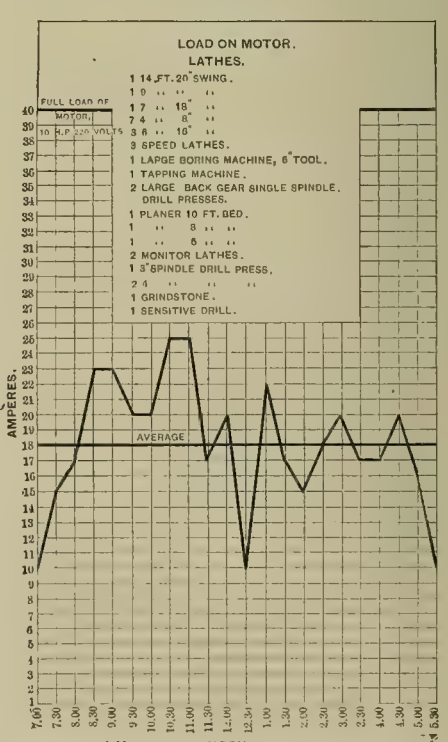
Average Load.....35 per cent. of Rated Capacity.
Maximum Load.....60 per cent. of Rated Capacity.
Average Load.....58 per cent. of Maximum Load.
Shafting.....58 per cent. of Average Load.

No. 8.



Average Load.....55 per cent. of Rated Capacity.
Maximum Load.....75 per cent. of Rated Capacity.
Average Load.....74 per cent. of Maximum Load.
Shafting.....64 per cent. of Average Load.

No. 19.



Average Load.....45 per cent. of Rated Capacity.
Maximum Load.....62½ per cent. of Rated Capacity.
Average Load.....72 per cent. of Maximum Load.
Shafting.....56 per cent. of Average Load.

No. 20.

A PROPER BASIS FOR DETERMINING ELECTRIC MOTOR RATES—LOAD DIRGAAMS.

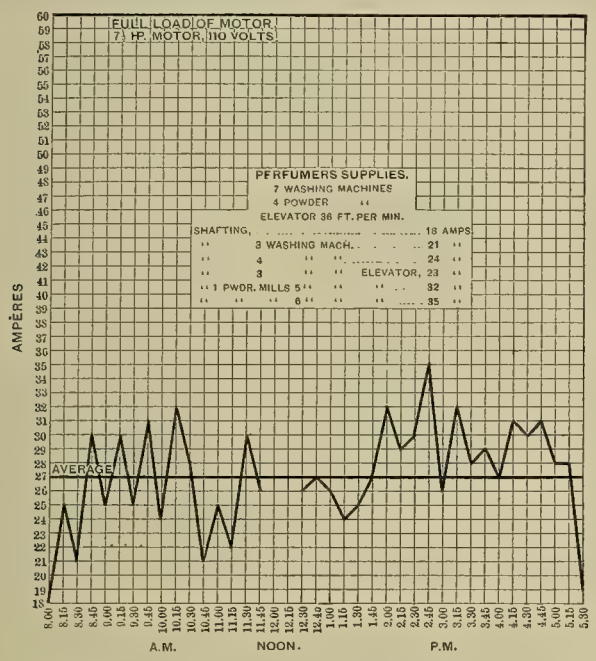
power used, and the remaining five-eighths (68%) is consumed in driving shafting. This enormous loss in shafting would indicate that the day may be not far distant when each machine will be equipped with its own direct-geared motor, and the days of shafting and belting are numbered.

tween this 14 amperes and the several readings below that amount, shows the amount of current generated by the motor when the elevator is coming down. As this class of elevator is largely used, this peculiar fact becomes an item of considerable importance to the central station, and is here submitted, and thereby illustrate graphically the advantages of the constant potential circuit for power distribution. Want of time has, however, prevented this.

In conclusion, let me read you some extracts from a letter received in March last from a prominent manufacturing corporation using 75 or 80-horse power in motors in their workshops:

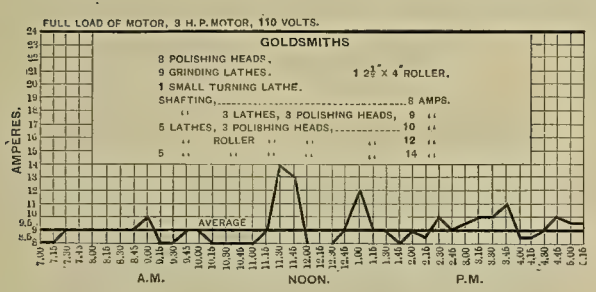
"We are running with one motor a large 4-ton Graves' elevator, and several wood-working machines, such as planers, crosscut saws, etc. In our machine department the several motors run several lines of shafting, independent of each other. In this department we run heavy planers, lathes, drill presses, shapers, slotters, gear-cutters and other machinery necessary to a complete machine shop. A motor in our department for fine wood work furnishes power for the various machines necessary to the manufacture of articles needing turning lathes, gig-saws, rip saws, etc.

"In our experimental department and show room we use a smaller motor, set with the necessary speed reducing pulleys and belts upon a movable frame. This we roll from



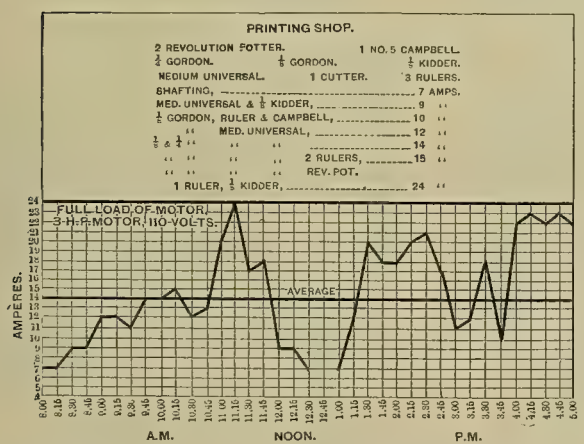
Average Load .....45 per cent. of Rated Capacity.
Maximum Load.....58 per cent. of Rated Capacity.
Average Load.....77 per cent. of Maximum Load.
Shafting .....66 per cent. of Average Load.

No. 9.



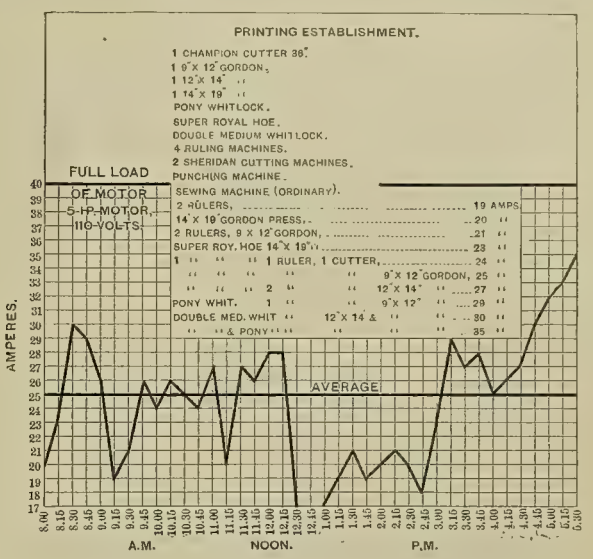
Average Load .....37½ per cent. of Rated Capacity.
Maximum Load.....59 per cent. of Rated Capacity.
Average Load.....64 per cent. of Maximum Load.
Shafting.....89 per cent. of Average Load.

No. 13.



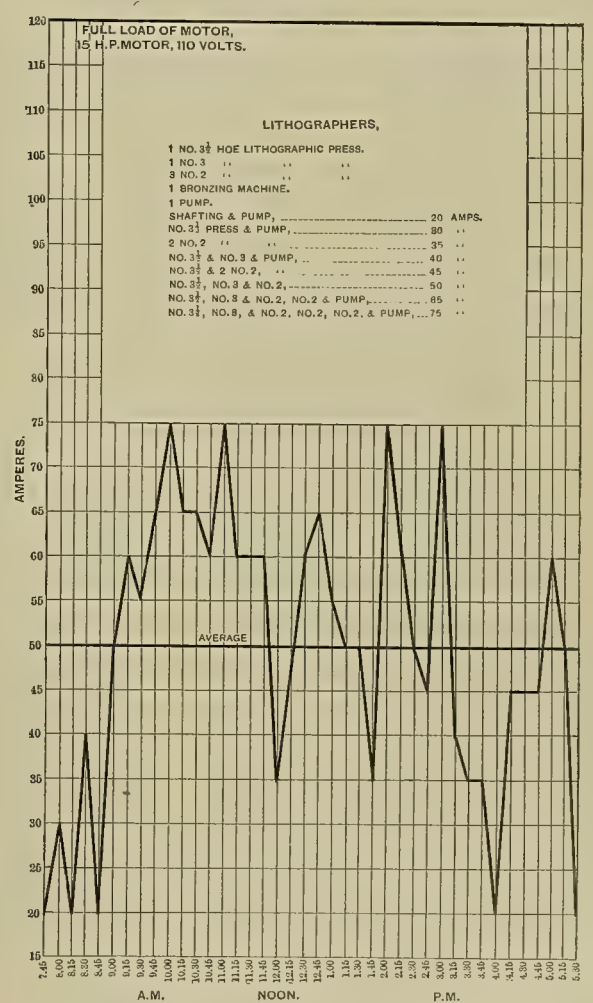
Average Load.....58 per cent. of Rated Capacity.
Maximum Load.....100 per cent. of Rated Capacity.
Average Load.....60 per cent. of Maximum Load.
Shafting.....50 per cent. of Average Load.

No. 24.



Average Load.....63 per cent. of Rated Capacity.
Maximum Load.....75 per cent. of Rated Capacity.
Average Load.....83 per cent. of Maximum Load.
Shafting.....71 per cent. of Average Load.

No. 29.



Average Load.....42 per cent. of Rated Capacity.
Maximum Load.....62½ per cent. of Rated Capacity.
Average Load.....67 per cent. of Maximum Load.
Shafting.....40 per cent. of Average Load.

No. 23.

A PROPER BASIS OF DETERMINING ELECTRIC MOTOR RATES—LOAD DIAGRAM.

also a strong argument in favor of a constant potential power circuit, as only on this circuit can these conditions be obtained.

I had hoped to prepare some diagrams of motors on series or arc light circuits for comparison with the records

place to place, as convenience dictates. All of these motors are giving us unqualified satisfaction, and we would not willingly return to direct steam engine power."

This company is being supplied with power by the local electric light company on a basis of $50 per year per horse power based on maximum readings. The user is apparently delighted with his service and perfectly satisfied with the cost of his power, and I have the assurance of the electric light company supplying the power, that they will load their plant under the same terms given this customer.

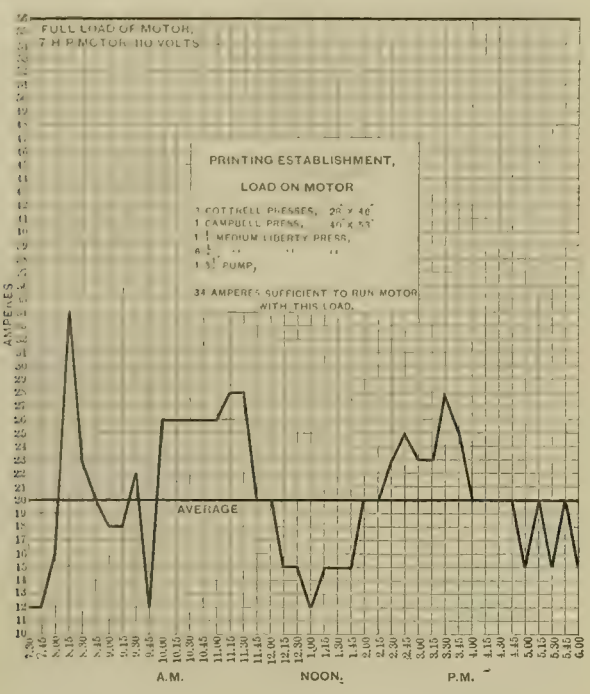
DISCUSSION.

MR. WORTH: I think the writer of this paper is a little bit too fair to the gas engine. I am not very familiar with those figures at present—not as familiar with them as I was at one time; but I think it would be a very large gas engine—a very good gas engine to give a horse power for twenty feet. I was talking a little to a gas expert and he told me that with some kind of gas it would burn as high as fifty feet—that was fuel gas.

MR. GARRATT: May the apparent discrepancy not be this—that the figure of twenty feet for horse power of gas engine meant on an intermittent load?

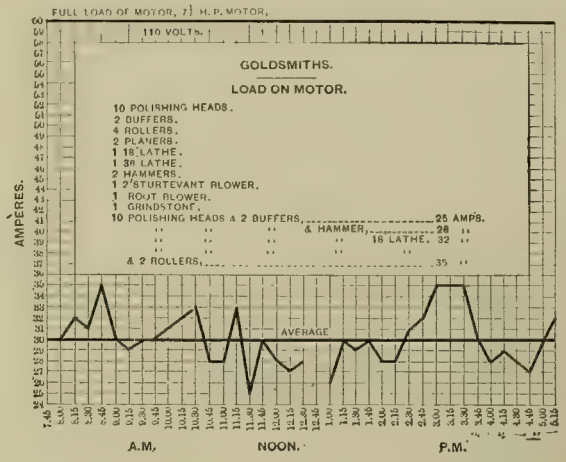
MR. FABEN: The Otto Gas engine people of Philadelphia who make the gas engine will warrant that the engine will not consume to exceed twenty-two and a half feet per hour per horse power with an average commercial illuminating gas. Experiments were made in New York by the *Popular Science Monthly* in testing domestic motors. They cited that fact of twenty-two and a half feet; but the experience had merely shown that that quantity was consumed. It ran less than that. I have the observations of a number of engines running with ten horse power and less which ran with about twelve hundred feet of gas per ten hours. That was on the basis of a ten-horse engine.

DR. LOUIS BELL: I have some little interest in this question of the gas engine for the reason that the gas engine seems to be the principal opponent of the electric motor for light work. In all of the tests that I have ever seen which were at all of an authoritative character, I should



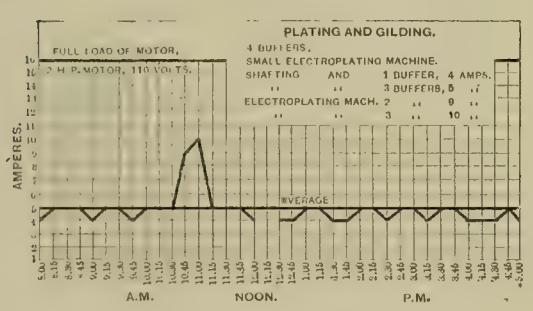
Average Load.....36 per cent. of Rated Capacity.
Maximum Load.....61 per cent. of Rated Capacity.
Average Load.....58 per cent. of Maximum Load.
Shafting.....60 per cent. of Average Load.

No. 27.



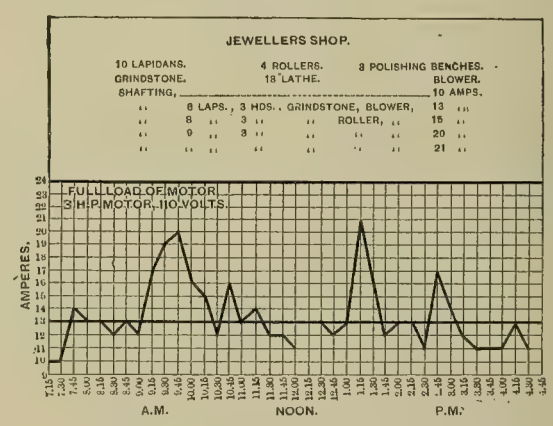
Average Load.....50 per cent. of Rated Capacity.
Maximum Load.....58 per cent. of Rated Capacity.
Average Load.....76 per cent. of Maximum Load.

No. 10.



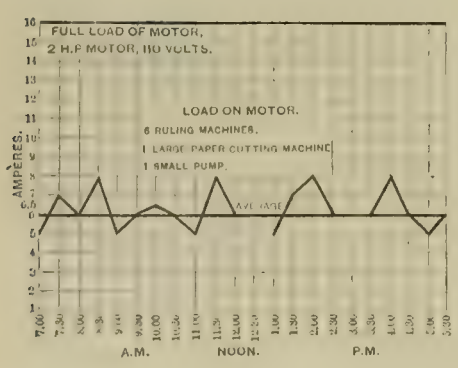
Average Load.....31 per cent. of Rated Capacity.
Maximum Load.....63 per cent. of Rated Capacity.
Average Load.....50 per cent. of Maximum Load.
Shafting.....80 per cent. of Average Load.

No. 11.



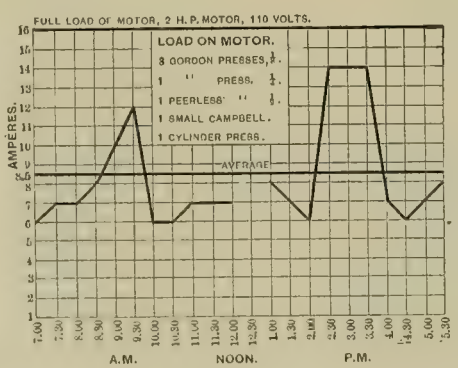
Average Load.....54 per cent. of Rated Capacity.
Maximum Load.....87½ per cent. of Rated Capacity.
Average Load.....62 per cent. of Maximum Load.
Shafting.....78 per cent. of Average Load.

No. 12.



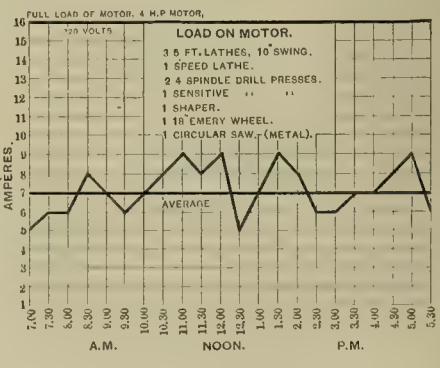
Average Load.....31 per cent. of Rated Capacity.
Maximum Load.....50 per cent. of Rated Capacity.
Average Load.....75 per cent. of Maximum Load.
Shafting.....85 per cent. of Average Load.

No. 15.



Average Load.....53 per cent. of Rated Capacity.
Maximum Load.....88 per cent. of Rated Capacity.
Average Load.....60 per cent. of Maximum Load.
Shafting.....70 per cent. of Average Load.

No. 25.



Average Load.....45 per cent. of Rated Capacity.
Maximum Load.....56 per cent. of Rated Capacity.
Average Load.....77 per cent. of Maximum Load.
Shafting.....70 per cent. of Average Load.

No. 21.

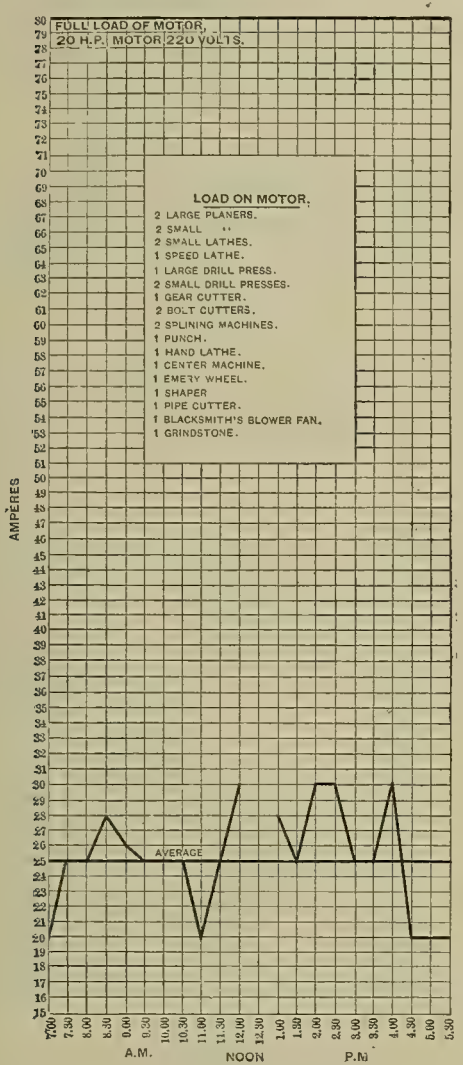
A PROPER BASIS FOR DETERMINING ELECTRIC MOTOR RATES—LOAD DIAGRAMS.

say that 20 feet per hour—per horse power hour—was a minimum figure, and not only a minimum figure but one considerably below the usual minimum. I have had occasion to handle, in the last year and a half, a large number of tests, both in this country and in Europe, and very few of them showed less than 23 or 24 feet of gas, although this figure was sometimes slightly better. A very considerable number of tests of small engines have been made, and although the lowest possible figures approximate somewhat nearly to those given, the average is very much higher—frequently nearer 30 feet than 20.

MR. WORTH: The gas engine uses water in considerable quantity. In some cases this expense would be well worth taking into account. Another matter with the gas engine is providing for the exhaust—there must be a large free exhaust, and this exhaust can be loaded to a point which makes it dangerous in regard to fire, and which makes it necessary to protect it thoroughly.

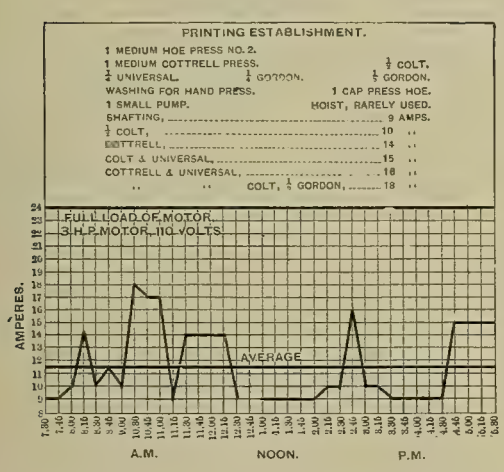
MR. EDGAR: I have listened with a great deal of interest to the article of Mr. Lufkin, because I have talked the matter over with him to a great extent and I know that a great many of his curves were made from motors running from our station. Our efforts in the last year and a half to two years have been to sell motors entirely by meter—selling it by the absolute horse power hour, and of the latest 400 horse power which have been used in Boston I should think that 250 are now paying for their current entirely by meter at so much a horse power hour. We make a nominal charge of 10 cents an hour per horse power, making discounts from this down to 40 per cent. so that the minimum rate is 6 cents per hour, the average being between 7 and 8. This is irrespective of the size of the motor. It depends entirely on the number of horse power hours per day as compared with the maximum which that motor can generate. In other words, a one horse power motor might get just as good a rate as a 30-horse power motor provided it used as much as its maximum, as if it were a larger motor. Charging by the nominal capacity of the motor is something I never heard of. Our station has never tried to charge in that way. It has always charged by the maximum load of the motor. In other words a man could put in any motor he pleased; he would simply be charged, when he was charged by contract, the maximum power which that motor used at any time by means of the ampere meter. If a person was going to use 5-horse power and he was inclined to put in a 10-horse power motor we were very glad to have him do so and we would only charge for the 5-horse power if he used only 5-horse power. I never heard of a case where a person was charged for 10 merely because he happened to put in 10-horse power rather than a 5-horse power.

THE PRESIDENT: The next paper will be on standards of economy in the generation of power and steam under the best conditions. It will be presented by the author, H. H. Swetland, editor of *Power and Steam*, New York.



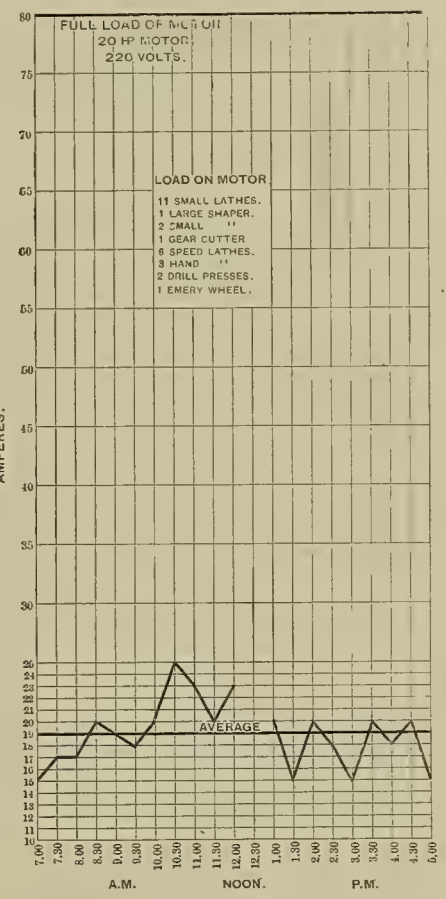
Average Load.....32¼ per cent. of Rated Capacity.
Maximum Load.....37½ per cent. of Rated Capacity.
Average Load.....83 per cent. of Maximum Load.
Shafting.....80 per cent. of Average Load.

No. 17.



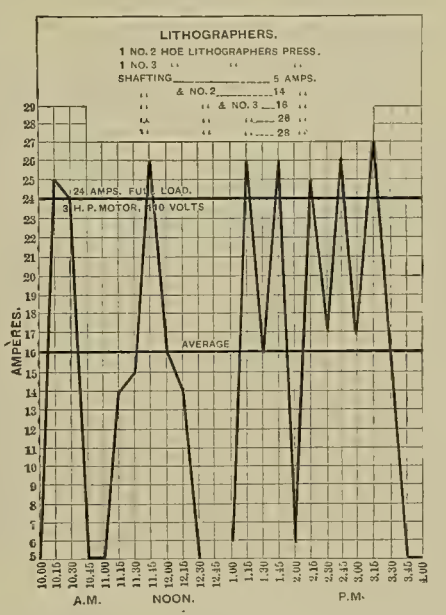
Average Load.....48 per cent. of Rated Capacity.
Maximum Load.....75 per cent. of Rated Capacity.
Average Load.....64¼ per cent. of Maximum Load.
Shafting.....79 per cent. of Average Load.

No. 26.



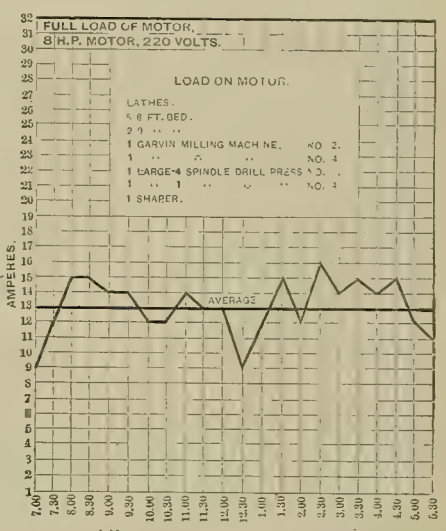
Average Load.....24 per cent. of Rated Capacity.
Maximum Load.....31 per cent. of Rated Capacity.
Average Load.....76 per cent. of Maximum Load.
Shafting.....79 per cent. of Average Load.

No. 16.



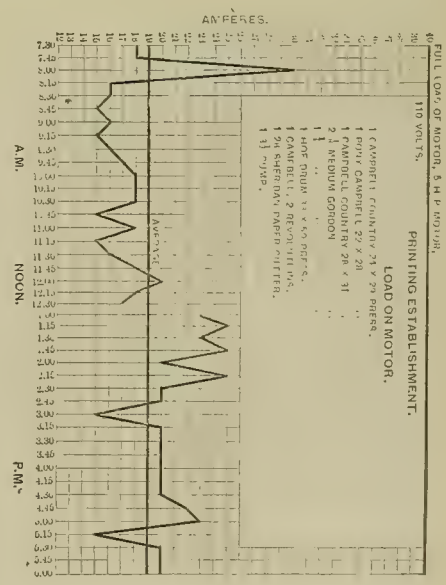
Average Load.....67 per cent. of Rated Capacity.
Maximum Overload.....12½ per cent. of Rated Capacity.
Average Load.....59 per cent. of Maximum Load.
Shafting.....89 per cent. of Average Load.

No. 22.



Average Load.....40 per cent. of Rated Capacity.
Maximum Load.....50 per cent. of Rated Capacity.
Average Load.....81 per cent. of Maximum Load.
Shafting.....70 per cent. of Average Load.

No. 18.



Average Load.....18 per cent of Rated Capacity.
Maximum Load.....75 per cent of Rated Capacity.
Average Load.....63 per cent of Maximum Load
Shafting.....80 per cent. of Average Load.

No. 28.

[illegible] OF [illegible] GENERATION

[illegible] POWER.

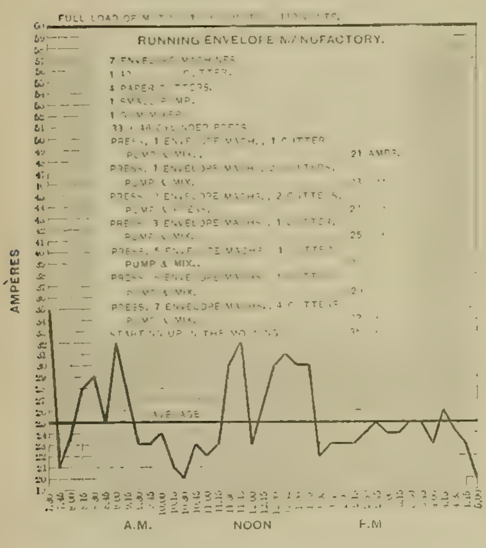
[illegible]

In suggesting to our secretary the subject for this paper as one which would be of vital interest to the members of this association, I had no idea that I should be called upon to prepare and present it, nor do I feel the fitness of my being chosen to instruct the gentlemen of this convention, whose knowledge upon these matters is the epitome of the best and highest accomplishment of the times.

The above title scarcely represents my treatment of the subject. I should prefer rather to call it "A Plea for the Collection and Recording of Data for Standards of Economy." In old and long established lines of work such would naturally be unnecessary. In the electric light business where so much is new and development is so constant and rapid, it is essential that there should be established some authentic form of comparison of operations with the view of reaching the greatest economy in the shortest possible space of time. Further, in view of the rapidly changing conditions under which the steam-engine is being operated, the concentration of small and individual plants into larger centers, etc., it becomes of the utmost importance that a careful and detailed system of standards shall be inaugurated and maintained.

Although far more able representatives than myself have heretofore approached this topic, there has been in the convention a noticeable lack of definite, reliable, uncontrovertible information in this special direction.

The subject of economy in general has received the attention of our best thinkers, but this attention has been



Average Load .... 41 per cent. of Rated Capacity.
Maximum Load . .. . 58 per cent. of Rated Capacity.
Average Load .. .. 71 per cent. of Maximum Load.
Shafting . . .. .80 per cent. of Average Load.

No. 14.

A PROPER BASIS FOR DETERMINING ELECTRIC MOTOR RATES —LOAD DIAGRAMS.

directed to the operation of the complete system. Too often details of definite expenses are overlooked by the superintendent whose imperative duty is the running of the plant and not its most economical operation. He is obliged to keep a station in smooth running order, to furnish good steady reliable lights under pressure of constant demand. So in this case economy is not the first consideration.

At the last convention the admirable paper read by T. Carpenter Smith of Philadelphia, entitled "A System of Central Station Accounts," touched upon and almost comprehended this necessity, but he still further included the maintenance of outside equipment. My paper is confined to the question of first cost of power expressed in pounds of fuel per H. P. per hour.

The data for standards of economy should naturally be the practical results of actual operations compiled in tables from the results obtained by different managers. To what end? They would interest and benefit all desirous of investing in electric light and power enterprises which are becoming such an attractive feature in the financial world. They would be useful to prevent the establishment of unnecessary and injurious competition frequently induced by statements of facts and figures showing an utterly false and unattainable economy.

But to the superintendent of the station more than any other person, these tables would be of paramount importance. They would enable him at a glance to learn what others are actually accomplishing under certain named conditions, and readily to institute comparisons with his own records. By their use he would not only gain enlightenment on many points, but be stimulated to the highest possible degree of efficiency and economy. He thus would be furnished also with unimpeachable authority to offer a doubting stockholder or a too exacting president who, while perhaps not being initiated in the details of practical workings, is always glad to be reassured by accurate information.

These tables would not, however, be found elastic enough to suit the purpose of the energetic boomer whose object in building a station is sale and not operation; for they will be found to show the necessity of the best modern appliances for the most economical production of power. Neither would they be particularly interesting reading to men who trade in inferior appliances.

A standard of economy is attainable only by a combination of mechanism best adapted to the conditions and attendance which can secure from this mechanism the best possible results. A plant may be equipped with the most improved devices, and their excellence may be practically nullified by neglect of well-known duties, by ignorance or by mismanagement. A poor gun in the hands of a good soldier is a better combination than a good gun in the hands of a poor soldier. It is not the machine alone, but its combination with the skillful man behind it that works out the best results.

This point was splendidly taken by Geo H. Babcock in his most valuable paper on "Boiler Economy" read before us in Kansas City. We all remember his allusion to "boilers and brains or the co-efficient of common sense."

It is perhaps superfluous to mention that results obtained with different existing equipment and attendance vary fully as 1 to 5, with a possibility of the still further lowering of the proportion by investment in better equipment.

Of course, no absolute standard or unit of economy can be established by a vote of convention or fiat of association. A yard stick is a yard stick, an inch an inch, but a standard of economy must always vary in greater or less degree according to conditions and equipment. Yet a sufficient similarity exists to enable us to prepare tables covering the main types of equipment, and the recorded performance of any special type would be relied upon and regarded as a standard.

Human ingenuity, talent, patience, skill and incessant labor are being exerted every day and hour in the direction of lowering the records. The ambition of the day is to produce the maximum of results with the minimum of expenditure. Standing in comparison with the fifteen minutes of the ocean racer, the second clipped from the tables of the turf, or the extra grain yielded by the refractory ore, is the ounce of fuel.

My plea is for the most minute and detailed system of tabulation as the means of reaching the best results. It is by the comparison of coal with coal, boiler with boiler, engine with engine, type with type, appliance with appliance, that these results may be obtained. Those who have had experience in collecting data of the kind required will comprehend at once the difficulties encountered in the process of getting information which shall fully cover the many important points in the case. Not only should there be no objection on the part of the companies, their managers or superintendents, to giving information that is reliable in character, accurate in detail, and comprehensive in scope, but there ought to be most cheerful acquiescence.

We are organized for purposes of free interchange of thought and experience, with a view to mutual advancement and benefit. In these tables each one is liable to discover information upon some important point which should be of great value to him. Naturally the broad ground of justice, fairness and liberality of felling is expected to be our starting point.

If I have succeeded in interesting the gentlemen in the importance of collecting data for these standards, I will feel justified in having consumed the time of the convention. If carried out we will reap the benefit in having on record the facts and figures which have been so often called for; and the answer to the three great questions, What is your equipment? How many lights do you furnish? How much coal do you burn?

DISCUSSION.

E. F. WILLIAMS, of Beloit, Wis.: I had hoped to get enough accurate data concerning the performance of triple engines to bring before you and to make the subject the basis of a paper, but circumstances have been such that the engine I attempted experimenting on has been so situated that I could not get it rigged up for making the tests, and there ore I cannot give you any accurate data in regard to high speed triple expansion engines for central station work. The main point to be considered in the matter is, first, the matter of regulation Perhaps that is of the highest importance and is a matter that is most frequently asked about. It is asked whether there will be a momentary variation in the speed of the triple engines when the load is suddenly increased or decreased that would not occur in single cylinder engine practice. Now that matter depends mainly on the weight of the wheel, and the intermediate spaces or clearances, and will be modified more or less by the accuracy or quickness of the governor; and as to whether this can be done or not, I will say yes, it can be done. The weight of wheel can be made sufficient, the clearances can be mad sufficiently small and the governor can be made sufficiently quick, and it is done so that the engine will not vary materially under sudden changes of load. Of course the smaller the clearances the heavier the wheel, and the quicker the governor the less will be the momentary variation. As to the matter of cost, taking the entire plant considered as a whole, boilers engines, and all, the triple expansion engine will cost, I presume, approximately 20 per cent more than the compound. The economy of triple expansion is unquestionably considerably in excess of the compound on the evidence taken from marine practice. It is a fact that compound engines, compound plants under ordinary circumstances where coal is say at an average price of $3 per ton, will consume their entire first cost in about five years' work in coal bills Assuming that the triple will save 20 per cent. over the compound the tri e would save the excess of cost over the compound in the first year's service.

There is another matter to be considered, namely, the reliability of the machine, and the smoothness of action. The triple has advantages over the compound in that respect, theoretically, which, as far as we know so far, practice has sustained. It appears, as far as the evidence goes, and as far as we know of their action, that the triple engines are much easier to care for than the compound. The compound is much easier to care for, ordinarily, than the single for reasons which are accounted for in theory and I think the practice will sustain the theory.

MR. GARRATT: I will move that the subject of Mr. Swetland's paper be referred to the committee on data with the suggestion that if it is not going to make a specific report upon that subject that either a sub-committee or a new committee be appointed to report six months from now on the point touched upon in Mr. Swetland's paper.

The motion was carried.

The report of the committee on revision of the constitution was read by Mr. Francisco.

The report was made a special order for Thursday at 11 A. M. The convention adjourned to Thursday at 10 A. M.

Thursday's Proceedings.

The convention met at 1 o'clock Thursday morning. Prof. Barrett rose for information, stating that he desired to ascertain where Mr. Francisco secured for his paper on muncipal lighting figures in regard to the Chicago city electric light plant. President Perry stated that the question was out of order at that time.

The special order of the day, the constitution as presented by the committee, was as follows:

PROPOSED CONSTITUTION.

ARTICLE I.—NAME.

This association shall be entitled the National Electric Light Association.

ARTICLE II.—OBJECT.

The object of this association shall be to foster and protect the interests of those engaged in the commercial production of electricity, for conversion into light, heat or power.

ARTICLE III.—MEMBERSHIP.

SECTION I.—Members shall be divided into three classes—active, associate and honorary. Active members only shall be entitled to vote, and take part in the deliberations of the convention, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use.

SECTION II.—In the case of a corporation, the membership may stand in the name of the company, and such company shall have the right to be represented at any meeting of the association by any of its officers or directors, or by its regularly employed manager or superintendent.

SECTION III.—Associate members shall be electricians, electrical or mechanical engineers, manufacturers and individuals who are otherwise directly or indirectly interested in advancing the use of electricity, and shall have the right of attending all meetings of the association except executive sessions.

SECTION IV.—Honorary members shall include those already elected as such, and such other persons as may be elected upon the unanimous recommendation of the executive committee and approved by a two-thirds vote of the association.

ARTICLE IV.—OFFICERS AND EXECUTIVE COMMITTEE.

SECTION I.—The officers of the association shall be a president, two vice-presidents, an executive committee of nine members and a secretary and a treasurer, who shall be elected as specified in this constitution.

SECTION II.—The president and vice-presidents shall be elected to serve one year from the first of the month following the date of their election, and shall be active members. The president shall act as chairman of the executive committee during his term of office. He shall not be eligible to re election for two years after his first term has expired.

SECTION III.—The executive committee shall be chosen from among the active members. The first executive committee elected after the adoption of this constitution shall be divided into three classes. Class one shall serve for the period covered by three conventions, class two for two conventions, and class three for one convention from the first of the month following their election, after which three members of the committee shall be elected at each convention to serve for three succeeding conventions from the first of the month following their election.

SECTION IV.—The offices of secretary and treasurer may be filled by the same person. He shall not serve as a member of any committee; shall be eligible for re appointment and election without limit; shall give a security bond in such sum and with such qualifications as the executive committee may determine from time to time, and shall perform such duties as said committee may direct subject to their approval.

SECTION V.—The secretary and treasurer shall be nominated by the president and ratified by the executive committee. He shall serve for one year from the first of the month following the date of the president's election. He may be an active or associate member.

SECTION VI.—The executive committee shall be the governing body of the association, and shall manage its affairs, pass upon all applications for membership subject to this constitution and such special rules or regulations as may be adopted by the association from time to time, and five members of the committee shall constitute a quorum.

ARTICLE V.—MEETINGS.

The annual meeting of this association shall be held in February, and a semi-annual meeting may be held in August of each year, at such places as the association shall determine, and on such dates as may be determined by the executive committee.

ARTICLE VI.—QUORUM.

Fifteen active members of the association shall constitute a quorum for the transaction of business.

ARTICLE VII.—DUES.

The annual dues of active members shall be twenty-

five dollars, and associate members twenty dollars, payable in advance, and shall cover the calendar year. Members in arrears for dues shall not exercise the privileges of membership. Any member in arrears for one year's dues shall be dropped from the rolls, and if he is reinstated he will be required to pay his dues for the year in which his membership lapsed.

ARTICLE VIII.—ELECTION OF OFFICERS.

All officers shall be elected by ballot at the annual meeting of the association. Vacancies in office may be filled by the executive committee to cover the term until the next annual meeting of the association.

ARTICLE IX.—PERMANENT OFFICE.

A permanent office of the association shall be established in the city of New York, and shall be located, furnished and governed in such a manner as the executive committee may from time to time determine.

ARTICLE X.—PARLIAMENTARY RULES.

Roberts' Rules of Order shall be the governing parliamentary law of the association in all cases not definitely provided for by this constitution.

ARTICLE XI.—VOTING AND PROXIES.

SECTION I.—The roll call shall be ordered on the demand of ten members on any question before the association. Unless ordered otherwise as specified in this constitution, all voting shall be by voice.

SECTION II.—Voting by proxy shall not be allowed at any meeting of the association or any of its committees.

ARTICLE XII.—AMENDMENTS.

SECTION I.—Amendments to this constitution shall be presented in writing, and shall be referred to a committee to be elected by the association before being acted upon. A two-thirds vote of all members present, entitled to vote, shall be necessary for their adoption.

SECTION II.—No amendment shall be voted upon by the convention at which it is introduced.

THE DISCUSSION.

DR. MASON moved that section 1 of article 3 be amended to be read as follows: "Members shall be divided into two classes—active and honorary. Active members only shall be entitled to vote, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use."

A long and tedious debate followed. Dr. Mason's amendment was finally lost by a unanimous vote, and the associate membership was retained.

Mr. Alexander moved that the words in section 1 of article 3 "and take part in the deliberations of the convention" be stricken out. This amendment was adopted.

At the suggestion of Mr. Duncan section 3 was ordered to precede section 2 in the arrangement of article 3.

Section 3 as it appears in the report of the committee was amended so as to read as follows:

"Associate members shall be electricians, electrical or mechanical engineers, manufacturers, corporations and individuals who are otherwise directly or indirectly interested in advancing the use of electricity, and shall have the right of attending all meetings of the association, except executive sessions, and shall have the right to discuss papers before the conventions."

Section II of article III as printed above was amended on motion of Mr. Whipple so that after the last word "superintendent" these words were added "or by a properly accredited representative." Section 6 of article II was, upon motion of Mr. De Camp, amended to read as follows:

"The executive committee shall be the governing body of the association, and shall manage its affairs, pass upon all applications for membership and the eligibility of their representatives, subject to this constitution and such special rules or regulations as may be adopted by the association from time to time, and five members of the committee shall constitute a quorum."

Article VIII was amended by inserting in the first line after the word "officer" the words "except the secretary and the treasurer."

Mr. Garratt presented the following new article:

"Article V. No individual actively associated with a corporation holding active membership shall become an active member individually unless he shall own or operate a central station plant individually."

The article was adopted and the articles following it were renumbered.

The constitution as amended was unanimously adopted.

The amendments which have been noticed above were adopted after several hours of debate. Several additional amendments were proposed, but as they were not adopted they are not mentioned in the report.

DISCUSSION OF MR. FRANCISCO'S PAPER.

MR. BARRETT: I want to ask Mr. Francisco where he secured the figures with regard to the expenditures in Chicago.

MR. FRANCISCO: In answer to Mr. Barrett's question I will say that Mr. Barrett is too good a politician, and understands the working of these matters too well, to expect that I would disclose the name of the party in Chicago who gave that information. The information was given to me from parties who are perfectly reliable.

MR. BARRETT: Is not the matter of expenditures in any department of the city government a matter of public record?

MR. FRANCISCO: Is this a matter of public record in Chicago?

MR. BARRETT: Certainly.

MR. FRANCISCO: Then can you tell me just where the expenses of the electric light business in Chicago is charged?

MR. BARRETT: I expected to accord an honest answer to any question asked me, and I expected to receive the same thing in return. Let me ask you what were those figures—for what year?

MR. FRANCISCO: Those figures were given me for last year.

MR. BARRETT: It is just the expenditure to maintain the 275 lights.

MR. FRANCISCO: If Mr. Barrett can read the English language he can see exactly what it shows. It gives the wages paid the different men, and the amount charged up for depreciation; and that depreciation I figured myself. The other figures are actual figures as given me as paid for those items. There they are in plain language. There is no chance for misconstruing or evading them.

MR. BARRETT: I want to say for the benefit of the association that there are only two items throughout that statement that are correct—one is the salary of the engineer, and the second is the number of lights. Between the total expenditure as charged by you and the actual expenditure, there is the slight difference of $35,190. I do not believe that you want to do the city of Chicago, or any one else, an injustice. I am free to say that I have not got such poor faith in humanity as to believe that.

MR. FRANCISCO: I did not intend to reflect in any way upon the city of Chicago or upon Mr. Barrett; but it has gone broadcast over the country that it only cost nineteen cents per thousand to furnish light in Chicago.

MR. BARRETT: I tell you now that it does not cost that much.

MR. FRANCISCO: The statement that it does not cost so much is a question that we will not enter into now. It is just the question of controversy between us.

MR. BARRETT: I want to make a suggestion, if you will permit me. I just want to say this: That if the balance of that document is no more accurate than the statements made for Chicago, then it is the greatest tissue of falsehood that I ever saw published in my life—with all due respect to the association. I want to ask if you desire to send broadcast the truth about municipal lighting, and if you do, that you will appoint a committee composed of such persons as you please, except this gentleman here, and I will pledge you my word of honor that they shall see every document and if their findings sustain that statement I will pay the expenses of this committee.

MR ARMSTRONG: If Mr. Barrett will allow me I will make a suggestion. We cannot come here and undertake to weigh as between statements made, so as to prove their truth or falsity. Mr. Francisco has presented here a document which is clear and unmistakable in its statement. If Mr. Francisco is wrong, then Mr. Barrett can by the facts and figures refute the statement, without our sending any committee and we will accord him just exactly what we have accorded to Mr. Francisco—no more and no less. He can send a statement of just exactly what his expenses are; and can answer the questions that have been asked; and he can prove his statement just as well as any committeee can do. Such a statement we would be glad to receive; it will be just the information that we want; and if he would send it to the secretary I have no doubt that the president, or the executive committee, will order it sent to each member of the association.

MR. BARRETT: This association has never asked me for any figures on anything. I have been overwhelmed with questions, so that within the last three or four months I have refused to answer them at all, as to the expenditures for maintenance of lights in the city of Chicago. I had no reason to cover up any expenditures there. I have more at stake than anybody else. I know what that light costs. Any citizen of Chicago, or any visitor has a perfect right to inquire into the expenditure. All that I want, all that I ask is honest and square treatment. I want it at the hands of this association. I want your treatment to be as liberal as your criticism is.

MR. ARMSTRONG: I move the adoption of this resolution:

"After hearing the statement made by Professor John P. Barrett in relation to the municipal lighting of Chicago,

"*Resolved*, That Professor Barrett be requested to communicate to this association a statement showing the cost of producing and maintaining electric lights in the city of Chicago."

MR. BARRETT: Let me suggest that it include the cost of construction also.

MR. GARRETT: Now I would suggest that you go further than this resolution does, and when you get that information over an official signature that you direct or authorize it to be published broadcast in connection with the document that this association has put out, and you will have the two statements before the public; and then you will be in position of doing equal justice to all parties, otherwise you will not be.

MR. DE CAMP: I do not think that there will be any objection to withholding the paper until your statement is ready to go out with it.

MR. BARRETT. If you will do that I am satisfied. I will give you that paper inside of one month from to-day.

The resolution was adopted.

The convention took a recess until afternoon.

AFTERNOON SESSION.

The convention was called to order at 3:30.

THE PRESIDENT: The chair will appoint on the committee on the Columbian Exposition, P. H. Alexander, Oldtown Electric Light company, Oldtown, Maine; George H. Rose, San Francisco Electric Light company, San Francisco; S. J. Hart, Louisiana Electric Light company, New Orleans, and Mr. Edwards of the Charleston Electric Light & Power company, Charleston, S. C. I thought, as it was a committee whose work would interest the whole country, I would make it cover all sections. We will now listen to the report of the secretary and treasurer.

Secretary Foote read the report of the secretary and treasurer, as follows:

REPORT OF SECRETARY.

Membership.

Active members, dues paid	79
Active members, dues unpaid	28
Total active members	107
Associate members, dues paid	128
Associate members, dues unpaid	34
Total associate members	162
Total membership, July 1, 1890	269
Total membership, January 1, 1890	259
Gain in membership for the six months	10

Report of Treasurer.

Balance January 1, 1890	$ 610 1
Received from January 1 to July 1,	3 020 00
Total to be accounted for	$3 630 17
Expended from January 1 to July 1, per approved vouchers on file	2 396 57
Balance in bank, July 1, 1890	1 233 50
Total accounted for	$3 630 17

The report was adopted

Mr. Garratt read the report of the committee to take action on the death of deceased members, as follows:

"The special committee, composed of the following undersigned members, appointed at the Kansas City convention of this association, in February of this year, unanimously recommend the adoption of the following preamble and resolutions, to wit:

"WHEREAS, In the course of Divine Providence our fellow member has been taken from our midst by death, and

"WHEREAS, It is our heartfelt desire to express individually and collectively, our sorrow, and to extend to those who are endeared to him by the ties of kindred, our sympathy. Be it therefore

"*Resolved*, That in the death of our fellow member, Miles W. Goodyear, this association has sustained the loss of one whose integrity of character and many noble qualities have endeared his memory to us; and whose well directed efforts in the arts and sciences pertaining to electrical industries, as well as his long and honorable connection with this association have earned our esteem; and be it further

"*Resolved*, That we hereby extend to the members of his family our deepest sympathy and condolence; and be it

"*Finally Resolved*, That the secretary is hereby instructed to spread these resolutions upon the minutes of this association and to transmit a true copy thereof to his family.

"F. E. Degenhardt, William D. Candee, Allan V. Garratt, Chairman."

A resolution expressed in the same terms, referring to the death of C. McIntire was also presented.

The report of the committee was adopted by a rising vote

THE PRESIDENT: The chair will announce as committee on nominations for executive committee, Messrs. T. C. Smith, De Camp, Armstrong, Long and Alexander.

John A. Seely, chairman of the finance committee, read the report of the committee as follows:

REPORT OF FINANCE COMMITTEE.

The books of accounts have been audited to July 1, 1890, and have been found to be correct. The financial statement is as follows:

Balance December 31, 1889	$ 610 17
Receipts	3,020 00
Disbursements	2,396 57
Balance June 30, 1890	1 233 60

During the six months covered by this report $725.02 of bills contracted previous to December 31, 1889, have been audited and paid. This shows the disbursements for bills contracted from December 31, 1889, to June 30, 1890, $1,671 55.

Two volumes of reports of the tenth and eleventh conventions have been published and are now ready for delivery. By resolution of the executive committee, the secretary, Mr. Garratt, was authorized to contract for advertisements to be printed in each volume. Under this arrangement the cost of publishing these two volumes, Vol. VII and Vol. VIII, 500 copies of each bound in cloth, is as follows:

Printing	$1 039 80
Binding	140 00
Wrapping, for mailing and sundries	10 00
	$1,189 80
Income from advertising	976 60
Balance, net expense to association	213 20

In looking over the accounts the committee has noted one change in the business methods of the association that in his opinion can be made with advantage. It relates to the payment of expenses incurred by the committees. Your committee recommends that hereafter, whenever a committee is appointed, the executive committee shall fix the maximum amount it will allow for the expenses of such committee and notify its chairman that vouchers for the expenses of his committe will be allowed within the limit specified, and no more.

The committee find that the accounts of the association are being kept in single entry, and without a ledger of accounts. Your committee recommends that the

secretary be directed to open a new set of books of date of July 1, 1890 to be kept in double entry system, and that the following be among the ledger accounts to be kept:

Receipts: Active members' dues, associate members' dues, sale of proceedings, advertising in proceedings, donations, sundry sources.

Disbursements: Rent, salaries, postage and telegrams, printing and stationery, publishing proceedings, committees (an account for each), furniture, sundries.

The portion of the executive committee's report was received and filed and the recommendations were ordered carried into effect.

THE PRESIDENT: The report of the committee on underground conduits and conductors. Joseph E. Lockwood, Chairman. Mr. Wilmerding of Chicago will present the report. Mr. Wilmerding read the report as follows:

UNDERGROUND CONDUITS AND CONDUCTORS.

At the Kansas City convention, held last February, the following members were appointed a committee on underground conduits and conductors, viz. J. E. Lockwood, of Detroit, Mich.; C. R. Wilmerding, of Chicago, Ill.; S. S. Wheeler, of New York; T. C. Smith, of Philadelphia, Pa.; D. E. Evans, of Baltimore Md.

Your committee now desire to report that they have perfected a plan of work, but before carrying out same desire the opinion of the association, and any suggestion that members especially interested, may desire to make.

The plan of work adopted is, first to secure from each electric light or power company, operating any high tension, underground conductors, a full description of the conduit and conductors in use, the character of the current used, and how long the same has been in use, which information, when classified and tabulated, will indicate plainly the condition of the subject at the present date, and will give us a starting point to work from. We then intend to secure the co-operation of these companies in our next step, which will be to have each company keep account of the cost of maintenance and repairs, to the conduits and conductors, and of all changes and additions thereto, and also of the average hours per day the system is operated; this information when classified and tabulated will show the cost of operating underground conductors, and if regularly reported to the committee, will show whether or not progress is being made in this direction, and whether the systems in use are likely to prove permanently successful or to finally fail.

It is also designed to include in these reports, a list of all grounds, burn-outs, etc, and their causes, with suggestions looking to the removing of said causes.

The committee would of course keep private the names of all companies furnishing such information, simply reporting same in tabulated form. These reports would be invaluable to companies operating such conductors, as they would have, not only their own experience to improve upon but also that of all other companies operating underground conductors.

In regard to the details of the plan of work proposed we have decided on first obtaining the following information, viz:

Conduits. 1st. A full description of the conduit used, kind of man or hand holes, provisions for taking off service, etc. 2d. Mileage of conduits laid and in use. 3d. Mileage of duct laid and in use. 4th. Number of man holes. 5th. Number of hand holes. 6th. Length of time in use.

Conductors. 1st. Description of the conductor in use, stating size of conductor, kind and thickness of insulation, and if insulation is covered, in what manner. 2d. How long has same been laid and in use. 3d. Mileage of conductors laid and in use. 4th. Average hours per diem same is operated. 5th. Electromotive, force and character of current used.

The above information would give us a good basis to work on; we would then endeavor to have each company operating high tension underground conductors, keep the following records, and report same regularly to the committee, just before each convention, so that same could be properly classified, tabulated and reported.

Records of Conduits. Mileage of conduit laid and in use; mileage of duct laid and in use; number of man holes; number of hand holes; number of services taken direct from conduit; cost of maintenance per month; cost of repairs per month; description of any new work done since last report; troubles with conduit man or hand holes and suggestions as to how same can be remedied.

Records of Conductors. Mileage of conductors laid and in use, number of circuits and mileage of each; cost of maintenance per month; cost of repairs per month; number of burn-outs and causes; troubles of other kinds and causes; suggestions as to how troubles can be remedied; average hours per diem circuits are operated; voltage and character of current used.

Changes or new work. Mileage of conduit or conductors abandoned; mileage of conduit of conductors added since last report.

The above reports would of course be separately classified for different kinds of conduits, conductors and currents.

Your committee think that these records should be kept continuously and reported regularly, until the question of operating high tension underground conductors is solved or effectually disposed of, and to do this we recommend that the committee be made permanent, and that members be elected annually at the February convention.

The committee should report at each convention: The number of companies operating high tension underground conductors; the mileage of conduits, ducts and conductors in use; the cost per mile per month of conduits, maintenance and repairs; the cost per mile per month of conductor maintenance and repairs; the average number of burn-outs and grounds per mile of conductors used and the causes; and also should report all conduits, conductors, etc., that had proved failures and were abandoned.

In this manner the association would keep thoroughly posted regarding the progress of the subject and would be supplied with the actual records made by the different systems; the members of the association could then judge for themselves of the success of the different systems, and thus be able to act intelligently, in case they desired to do any work in this line.

As this plan is intended to extend beyond the time for which this committee was selected, we have recommended that same be adopted by the association and that provision be made for the annual appointing of members to the committee.

If this meets the approval of the convention we would appreciate any suggestion from members who are especially interested in this subject, looking to the perfection of the plan of work.

E A. Armstrong read the report of the committee on the relation of manufacturing and central section companies as follows.

RELATION BETWEEN MANUFACTURING AND CENTRAL STATION COMPANIES.

The vast sums of money invested now as capital in the United States in the various electric light and power companies makes the subject with which this committee has to deal more than ordinarily important.

From every point of view the policy that has been more or less surreptitiously pursued by parent companies in *permitting* their agencies for the sake of a present sale of apparatus to foster and encourage improper and hurtful competition with present central station companies, cannot in our judgment be too strongly condemned by this association.

Capital has been induced in spite of its proverbial timidity, to invest in what has been an unexplored field. Often this investment has been brought about by the parent companies themselves. Then when it has seemed as if the stormy days of doubtful experiment were about over, and there was some little possibility that this investment might begin to make returns, along comes the agent of some parent company and by specious representations induces other citizens of the same place to start a new plant, always forgetting to tell of the weary journey of the pioneer company, and pointing always to present position. The only province of this new plant is to damage and destroy what did give some promise of life and fruit; and incidentally to make a market for a little new apparatus, effectually closing, however, a profitable avenue of steady continuing business in sales to the original companies.

It is rumored very strongly, and indeed stated as a fact, as strange as it may seem, that parent companies not satisfied with permitting, have gone so far as to actually organize central station companies in competition with others which are abundantly able to supply all demand, strengthening, supporting and sustaining them in their unholy warfare against legitimate enterprise.

Such being the case your committee would earnestly recommend either its continuance or the appointment of a new committee with power to confer and advise with any companies against whom such warfare is waged, and that through such committee the members of this association as central station companies, pledge sympathy, assistance and protection to any company so being fought; and that such committee be instructed to represent to the various parent companies that the conduct we have above deprecated is something so fatally injurious to us and to our stockholders as to make our investment uncertain and undesirable, and that therefore we will as one association feel not only justified in, but required to take the strongest possible means of remedy and prevention within our power, whenever we find a parent company engaging in or permitting such a course of conduct. When it has already been started any such company so minded can readily stop it.

The report was adopted and the committee was continued.

THE PRESIDENT: Top'c—How the National Electric Light association can best serve the interests of central station companies; C. R. Huntley.

MR. HUNTLEY: I think that the paper or the topic might be discussed upon another heading and better still—How can the central station men best serve the National Electric Light association? As we look about us today here we see perhaps thirty-five or forty central station people; in fact they are in the minority. We find a great many supply men here taking an active part in it; but conspicuously the central station men are not as active in their membership or in respect to their pocketbook to aid the National Electric Light association as they might be. I think, to put the whole matter in a nutshell, that the National Electric Light association should be purely a business association and in being that, it will best serve the central station men.

PLACE OF MEETING.

T. CARPENTER SMITH: The nominating committee have met and they unanimously recommend as the next place of meeting, Providence, R. I., the time to be announced hereafter by the executive committee. They have also unanimously concluded that it is only due to the executive committee and to the work which they have so thoroughly done, to continue that committee. the only change being made being the substitution of A. J. De Camp for Mr. Thurber, by request.

The report of the committee was accepted and the committee discharged.

The secretary cast the ballot for the nominees as follows: C R. Huntley, Chairman; E. R. Weeks, C. H. Wilmerding, J. J. Burleigh, M. J. Francisco, J. A. Seely, James English, A. F. Mason, A. J. De Camp.

The recommendation of the committee as to the place of meeting was adopted.

The convention adjourned *sine die.*

Exhibits and Convention Notes.

It was not expected that exhibits would be made at the convention, but the display of electrical apparatus proved highly interesting, although the number of exhibitors was not large.

Charles E. Gregory of the Sperry Electric company of Chicago, exhibited his company's new triple carbon arc lamp. The exhibit was made out of doors. Mr. Gregory secured a pair of climbing spurs and put up his lamp on an electric light pole in front of the hotel. Photographs illustrating other apparatus manufactured by the Sperry company were tacked to the pole. Altogether the exhibit was unique. Mr. Gregory was kept busy during the day explaining the triple carbon lamp, which, it may be stated, was illustrated and described in the last number of the WESTERN ELECTRICIAN.

The Sawyer-Man Electric company made an exhibit of incandescent lamps of from 10 to 150 candle power in one of the parlors. The globes were colored in red, white, blue, green, frosted and opal. The company also showed a new series lamp for arc circuits. The new socket for the lamp contains a fusible plug. An assortment of all-porcelain 5-ampere switches was shown. An exhibit was made of cut-outs, rosettes, branch blocks, with and without covers. The most attractive portion of the exhibit consisted in a display of the new compound alexite which, it is claimed, is fire-proof, water-proof and acid-proof. It is made in imitation of all kinds of marble and wood. The compound is of such a character that it can be colored so as to match wall paper, if necessary. A number of push buttons and switches, made of this material, were shown in connection with the natural woods and marble. It is stated that alexite is not more expensive than porcelain. An interesting feature of the exhibit was a new mercury cut-out, which has just been introduced. The representatives of the company were P. H. Alexander, general manager, and Gen. C. H. Barney, treasurer.

The Crocker Wheeler Motor company of New York, made an exhibit of its motors. Three sizes were shown practically identical in design, 6 horse power, 1 horse power, and ½ horse power. The company exhibited two motors for operating pumps—one motor was connected by gearing and the other by a belt. A fan motor with a new form of guard was exhibited.

The Crosby Electric company of New York exhibited its new dry battery, the latest invention of its electrician, Mr. Van Gestel. The capacity of the cells is 50 amperes at 1¼ volts on a short circuit. The battery was supplying current for a C. & C. fan motor. Mr. Van Gestel on Tuesday gave a practical and successful demonstration of the use of the battery in operating the fire alarm service of Cape May.

The Norwich Insulated Wire company exhibited a line of its wires. The insulation is composed of chemically treated manilla paper wound spirally around the conductors, lapping half. The paper is wound so tightly that when it is compressed it takes a metallic luster. The wire with its insulation is subjected to a baking process, which makes the covering tend to absorb moisture. This tendency is overcome by saturating the insulation with a heavy resinous oil. The core is then encased in lead. It is claimed that the insulation is proving extremely effective. The company was represented by L. D. Beck, president, and J. A. Wetmore.

The New York Insulated Wire company's exhibit consisted of a full line of the well known Grimshaw wire. The company was represented by R. E. Gallagher, treasurer, and J. W. Godfrey, secretary.

The Eureka Tempered Copper company of North East, Pennsylvania, exhibited a line of commutators, segments, finished and unfinished brushes, wire, journal bearings and castings of absolutely pure copper. The company claims as the tensile strength of the copper 64 480 pounds to the square inch, and as the load of compression upward of 110,000 pounds. The company also claims to cast pure copper without a blow-hole. The metal sold by the company is, it states, 99.961 per cent. pure, as shown by chemical analysis. A. L. Daniels represented the company.

Queen & Co of Philadelphia, exhibited three electrical testing instruments, comprising ammeters, voltmeters, etc. The electrician of the firm, E. G. Willyoung, was in charge of the exhibit.

The Connecticut Motor company of Plantsville, Conn., exhibited a half horse power constant potential motor of handsome design. A feature of the machine is the fireproof resistance box, which is made of slate and cast iron. The adjustment of the brushes with a spring gives perfect contact, and at the same time prevents any cutting of the commutator. The frame is constructed of soft cast iron without magnetic joints. Very high efficiency is claimed for the machine. J. R. Stagg, secretary, represented the company.

The Consolidated Electric Storage company of New York and Philadelphia displayed twelve accumulators shown in a cabinet-finished oak case. The batteries were charged at the factory and furnished current for the only electric lights in the Stockton during the convention. The battery also operated a C. & C. fan motor. The company was represented by the president, William Bracken, and Pedro G. Salom.

The Washburn & Moen company, of Worcester, Mass., displayed a case containing a full line of three wires.

The Moore & White company, of Philadelphia, exhibited a model of its friction-clutch pulley. W. H. Shoemaker was the representative of the company.

The Main Belting company, of Philadelphia, had on

exhibition samples of its Leviathan belting. W. H. Shoemaker represented the company.

During the convention A. B. Lawrence, the New York representative of the Schultz Belting company, took an order for 4,500 feet of belting for an electric light plant.

The New York Belting and Packing company displayed a full line of the Okonite brand of wires, and a sample of its latest cable for underground work. The company also exhibited samples of the Seely moulding, of which it has the exclusive manufacture. The Okonite company was represented by Willard L. Candee, the treasurer.

The Great Western Electric Supply company, of Chicago, distributed from its headquarters an immense amount of reading matter relating to electric supplies.

The Abendroth & Root Manufacturing company, New York, distributed its new catalogue, which contains many interesting descriptions of steam plants.

H. C. Eddy, who was present at the convention, has been appointed agent for the Consolidated Electric Storage company at Chicago, with headquarters on La Salle street.

The Seely & Taylor Manufacturing company of New York displayed samples of the "S. & T." compound. This material is used in the manufacture of switch-boxes cut-outs, rosettes, and other electrical appliances for insulation. John A. Seely, president, represented the company.

The Empire City Electric company of New York exhibited three grades of the "O. E. Brand" weather-proof wire, the E. T. grade of tape wire and the F. C grade of rubber covered wire. A few orders were received by C. I. Hague, general manager of the wire department, who was in charge of the exhibit. O. E. Madden, president, represented the company.

The Standard Electric Time company of New Haven exhibited electric gauges for testing batteries, arc light circuits, etc. Its electric time clock, used in the time system, was displayed. Its latest installation of the electric time system is in the Auditorium, Chicago. C. D. Warner, president, represented the company.

The Evans Friction Cone company of Boston displayed some handsome photographs of its system of driving dynamos. Its special catalogue, just issued, contains a list of companies who are using the system to the extent of 4,000-horse power. Five blue prints of its latest installations attracted much attention. They represented a 4,000 light plant of the American Waltham Watch company, a 350-horse power plant of the Waltham Gas company, a 275-horse power plant of the Leavenworth Electric Light company and a 170-horse power plant of the Juniata shops, Pennsylvania railroad, at Altoona; also a 400 light plant of the steamship Portland. The company was represented by A. N. Burbank, treasurer, and H. J. Conant.

The American Electrical Works of Providence displayed a full line of samples of wire and cables. P. C. Ackerman, agent, represented the company.

The Jewell Belting company of Hartford exhibited samples of its fine leather belts. C. L. Tolles represented the company.

The Edison General company of New York was represented by Jas. F. Kelly, manager of the wire department, who displayed samples of the new "E. M. W." wire. H. Ward Leonard and W. H. Fleming, of the company, were also present.

The National Carbon company of Cleveland distributed its comprehensive directory of arc light plants of North America. B. F. Miles, vice-president, and C. D. Smith represented the company.

H. A. Cleverly of Philadelphia was present and kept his promise "I'm with you, 'tis true, 'tis pity.'"

Geo. B. Prescott, Jr. displayed samples of the Kerite wires and cables.

The Western Electric company of Chicago was represented by C. A. Brown, manager, and John Young.

The electrical specialties of H. T. Paiste of Philadelphia were displayed by Wm. R. Hood.

Lewisohn Bros. of New York were represented by S. Rosentamm, who reported a recent sale of tamarack copper to a European company. It is said that this copper a year ago was entirely unknown abroad and that a demand for it is springing up for certain kind of manufactures.

The Chalmers-Spence company of New York distributed a new catalogue descriptive of its asbestos manufactures.

Dr. Allan V. Garratt, who was present at the convention, reported the incorporation of the National Electric Construction company under the laws of Maine. He has been elected general manager of the electrical and engineering departments. General Benjamin F. Butler is president, A. H. Sawtell, vice-president, Hon. S. M. Childs, general manager, and T. H. Pearse, treasurer. The capital stock of the company is $2,000,000, and F. Z. Maguire, 18 Wall street, New York, is financial agent, and handles the securities of the company. The main office is 620 Atlantic avenue, Boston.

The "C. & C." Motor company of New York was represented by H. L. Lufkin and A. M. Hall.

Wm. E. Cunningham of Philadelphia showed some samples of a new insulating material which he calls "Cunninghamite."

Partrick & Carter of Philadelphia were represented by E. Ward Wilkins.

The Consolidated Fruit Jar company of New Brunswick, N. J., was represented by F. P. Wisner.

The Bryant Electric company of Bridgeport, Conn., exhibited the Bryant double-pole switch, a new rosette, a a new style socket and the Orford pendant. The company was represented by W. C. Bryant, treasurer and general manager, and J. M. Orford

C. G. Young of New York, inventor of the automatic safety cut-out, was present at the convention.

The Wenstrom Consolidated Dynamo & Motor company, Philadelphia, was represented by Wm. Hazelton, and W. A. Stadelman. The exhibits of the Wenstrom motor, street car gearing, and model of the electrically actuated elevator were made by the United Electric Equipment company, which is the agent for the Wenstrom Consolidated Dynamo company.

The Eastern Electric Cable company of Boston was represented by H. H. Eustis, president.

The Standard Paint company of New York exhibited samples of the P. & B. conduits. The company was represented by W. W. Castle.

R. T. White of Boston was present at the convention.

The Electrical Supply company of Ansonia and Chicago was represented by Chas. Wirts and F. B. Platt.

One of the most interesting exhibits was that made by the Interior Conduit & Insulation company of New York. On a handsomely designed sample board was displayed a large variety of the company's interior conduits, cut-out boxes, covers of unique design for cut-out boxes etc. The development of the business of the company in a single year is almost unprecedented in the electrical world. About a year ago the company began to introduce a paper conduit; since that time a great variety of auxiliaries has been designed, which makes the system complete in every particular. During the last year the company has built a large factory, but finding its facilities still insufficient it acquired 7 floors of the factory of Bergmann & Co. of New York, and now is erecting a second factory. The demand for the conduits manufactured by the company has been so great that it has found it absolutely impossible for it to fill the orders on time. E. H. Johnson, the president of the company, says this about the concern: "It is the youngest and most gigantic industry in the whole electrical field." The company was represented by E H. Johnson, president; E. T. Greenfield, electrician; and E. W. Little.

The interests of the Standard Underground Cable company were looked after by F. E. Degenhardt of Chicago.

C. S. VanNuis, the manufacturer of New York of the Ajax switch for all heavy electric lighting, railway and power circuits, was present at the convention. The switches are simple in action and construction, and neat and compact in design.

The weather at Cape May was warm enough so that bathing was a most enjoyable pastime. From 12 to 1 every day most of the delegates and visitors were to be seen in bathing suits on the beach.

The music furnished by the orchestra at the Stockton was all that could have been desired.

President Harrison did not attend the convention as it had been hoped he would be prevailed upon to do. Tired out by the assiduous attention of office-seekers, the president of the United States was too much fatigued to visit the convention hall and address the delegates. A large number of the delegates drove to the famous cottage of the president at Cape May Point, and inspected the building to their satisfaction.

Every evening some informal entertainment was given in the assembly room under the direction of the reception committee, C. W. Price and W. H. Temple. On Tuesday evening C. M. Paine, of New York, sang several solos, accompanied on the piano by George M. Phelps. A hop was in order each evening. Willard L. Candee, of New York, was floor manager.

CORRESPONDENCE.

Kansas City, Mo

KANSAS CITY, Aug. 23.—At a directors' meeting of the Inter-state Water & Electric Power company last week John B. Colton, of the Kansas City Loan company of this city, was elected president; John G. Johns of Kansas City, Kan., was elected secretary, while the directory remains the same as before for the present.

D. B. Carlisle of Kansas City, Kan., has given out the information that work will be commenced upon the great dam across the Kaw within ten days. The point selected is one mile south from the South side city limits of Kansas City, Kan., in section 18, township 11, range 25. The plans of the company have been fully devised and the capital to carry out the project has been secured.

President Colton was conservative in his statements regarding the enterprise. He admitted that the company was preparing to go to work at an early date on the plant, but would not specify the time. Several New York capitalists were present at last week's meeting, and while they have not subscribed to the stock of the company, it is inferred that they will do so as soon as certain riparian rights have been secured, having confidence in the project.

The company proposes to accumulate 6,000-horse power from the dam across the Kaw. Every horse power can be let now, but the company will make no contracts until the plant is put in. Two large manufacturing concerns offered to enter into a lease for a term of twenty years yesterday, but they were denied a lease for the present. One point upon which the members of the company are silent is the rumored attempt on their part to purchase the Consolidated Electric Light & Power company's franchise of Kansas City, Kan. Rumors to this effect are neither affirmed nor denied, but the matter is in direct line with their enterprise. To control this franchise a large sum of money would necessarily be involved. President Colton has charge of the financial end of the concern, and it is understood that he has virtually placed all of the stock. The construction company is now being organized.

In behalf of the power company Nicholas McAlpine will probably receive this week from the Grinter syndicate its figures on the proposal of the company to buy the riparian rights of the syndicate's property on the Kaw river near Muncie. The Grinter syndicate is composed of Henry Swingley, Frank Hasson, J. B. Chapman, Charles Lovelace, W. H. Bridgens and O. D. Hurt, and owns a tract of land lying on the north side of the Kaw river and containing 502 acres. It has a frontage of one mile on the river and the right to the use of that is what the Inter-state company wants.

The members of the land syndicate were out yesterday looking over the ground and decided upon an offer. They seemed much impressed with the feasibility of the gigantic scheme of the Inter-state company.

Changes are contemplated in the Thomson-Houston agency here, Charles A. Rusling, the agent, going to Chicago about Oct. 1, to enter the company's railway department. C. A. Ross will still represent the company here.

W. R. Ross of St. Louis has secured the franchise for an electric light system at Maryville, Kan. It will have a capacity of 650 incandescent lights and 30 arc—alternating system. Thomson-Houston machinery will be used. The Western Engineering company of this city is preparing the plans and specifications.

Councilman Thomas has announced his intention of proposing an amendment to the charter which will give the city power to make a contract for lighting the city for a term of years. He said to-day: "As the charter now stands the city is unable to make such a contract. We deal with the electric light companies on a monthly basis, and it stands to reason that they cannot make a rate under such circumstances anything like as low as if they submitted bids under a contract for a term of years. This is one reason why we are now paying such excessive prices for our electric lights. If, after such an amendment was passed, the present companies wouldn't make a rate, there are plenty that are willing to enter the field on the basis, say, of a five-year contract.

"I don't believe I would be in favor of making an electric lighting contract for a longer term than five years. It is different in contracting for water for instance. Twenty years hence the water will be just the same, will flow by the city just as it does now, and the probable actual cost of supplying it will be about what it is now. With electric lights it is different. Improvements are always being made, and the cost may at any time be largely decreased by such improvements. For that reason I do not believe I would favor a contract for a much longer term than five years.

"Minneapolis is taking up the light question in dead earnest. A committee of the council recently made a trip through the eastern cities looking into their systems of government and their public improvements, and the committee will soon report in favor of the city owning its own electric lighting plant. Alderman Potter, of Minneapolis, estimates that $250,000 will pay for a plant large enough to light the city, and says that $40,000 a year will run it. He calculates the total cost, including plant and operating expenses for three years to be $370,000. Minneapolis is now paying $140,000 a year for light; three years' payments equal $420,000. In other words, the Minneapolis committee figures that in three years the city would have paid for its own plant and have $50,000 in the treasury; or, by simply paying interest on the plant and operating expenses, the committee says that the city would save $100,000 a year.

"We must be paying about what Minneapolis does every year, and as the city grows, of course the expense will be much heavier. I think the cost would be very materially reduced by making a five-year contract, and simply mention Minneapolis to show what other cities are doing. Under our charter, as it stands, we can't make a contract, and the amendment I will introduce will give the city power to do so if it is thought best."

The Consolidated City & Chelsea Park Railway company of Kansas City, Kan., which is now engaged in constructing the extension of the elevated road to the South side, has executed a deed of trust to the Metropolitan Trust company of New York to secure $100,000 in mortgage bonds issued for the purpose of carrying on the construction and equipment of the proposed line. The bonds are of the denomination of $1,000 each, running twenty years with 6 per cent. interest, payable semi-annually in New York. It is now stated that the construction of the new electric line will be pushed as rapidly as possible and that in a few weeks the line that will afford rapid transit between the North and South sides will be in operation. P.

Milwaukee, Wis.

MILWAUKEE, Aug. 23.—Henry Villard has invested heavily in Milwaukee street railroads and electric light plants, and he is at present involved in a war with Milwaukee capitalists. The dispute is over street railway franchises.

Mr. Villard, as the WESTERN ELECTRICIAN stated in its last number, has purchased outright the Cream City railroad, the second largest system in the city. The line runs from the extreme northeastern part of the city to the

extreme northwestern and southwestern corners. The Milwaukee & Whitefish Bay Railroad company, which at present operate dummies from the Cream City's northeastern terminus still farther north to Whitefish Bay, is preparing to build an electric railway which would practically parallel the Cream City lines. The company is composed of Milwaukee capitalists and Charles F. Pfister is its president. The northeastern part of the city is so platted that the only practicable route through it, in order to allow the Pfister company to connect its new down town lines with the dummy line, is by way of Warren avenue. Boylston street, Cambridge avenue and North avenue. On Monday, Aug. 10, the common council passed an ordinance giving the Pfister company the right to build on these streets and the other thoroughfares covered by the Hinsey east and south franchises, which had lapsed. On the same day the Villard syndicate, through Henry C. Payne, its local representative, placed gangs of men at work laying tracks on Warren avenue, Boylston street, Cambridge avenue and North avenue. At that time the Pfister company's franchise had not been approved by the mayor and the company was powerless to resist the Villard inroads upon what it considered its territory. But it soon found a way out of the difficulty. One of Mr. Pfister's friends is a Cambridge street property owner and he speedily secured an injunction, stopping work on that street.

It appears that in July, 1884, the common council granted the Cream City Railroad company the right to extend its Farwell avenue line to Bradford street, and to extend its North Water street line to the North avenue bridge by way of Warren avenue, Boylston street, Cambridge avenue and North avenue. The extension on Farwell avenue to Bradford street was built but nothing was done until the present time on the other lines, although the franchise was granted six years ago. The ordinance provided that the extension to Bradford street should be built within a year, otherwise the franchise would lapse. The Villard people claim that the company complied with the ordinance, while the Pfister company claims that the franchise lapsed long ago. On Tuesday the Cream City company secured an injunction restraining the Pfister people from building under their new ordinance. The Pfister company, in the meantime, had done enough work to protect the approach to North avenue bridge, across which it intends to build in order to reach the western city limits. The Cream City company, on the other hand, was the recipient of an injunction stopping work on Warren avenue. The company, however, put its men to work on Boylston street and North avenue.

On Wednesday morning the fight was renewed in the mayor's office. The Cream City company tried to prevent the mayor from signing the Pfister ordinances. Payne, Pfister and their attorneys were on hand. When arguments were made Mayor Peck said that he would be guided by the common council and the city attorney, and he accordingly approved the ordinance granting the franchise to the Pfister company.

On Thursday morning an injunction was served upon the Cream City Railway company restraining them from doing any more work on the disputed streets. They had done most of the track laying, however, and the workmen were put on the North Water street extension.

Judge Gilson, who presides over the court in which the Cream City company took out its injunction, is out of town, and the Pfister people cannot secure a dissolution of the order until he returns. Judge Johnson, from whom the Pfister people secured their injunction against the Cream City railroad, is in the city, but the Villard company does not seem to be in a hurry to break the deadlock.

Matters rested until Sunday, August 20. On that day, while the Pfister people were either fishing or at church, and when it was impossible for any injunctions to be obtained, the Villard people quietly began work in another part of the city—the North Side. They put down tracks on a portion of North avenue, to which the Pfister company had secured the right of way with the understanding that other companies were to be allowed to pass over the tracks. The Villard people had actually been granted the use of what tracks the Pfister people might build there, but hurried to the front themselves and laid their own rails. Mr. Pfister, however, felt secure in that quarter, and did not do anything to prevent the work or to have the rails taken up. The Milwaukee City Railroad company has built tracks under a non-exclusive franchise, on Broadway, between Martin and Michigan streets. The common council had granted the Pfister people the use of the other company's tracks on Broadway. The Milwaukee City Railroad management, however, had nothing except tracks on Broadway, and on Tuesday the Pfister company began to erect poles and string wires along the Villard tracks It was simply reversing the affair on North avenue. Mr. Payne lost no time getting out an injunction restraining the Pfister folks from doing any more work on Broadway, between Martin and Michigan streets. The Pfister people then started in on Broadway, between Michigan and Huron streets, where the Villard company has built tracks under a non-exclusive franchise. This was done on Thursday, the day of the Republican state convention, when Mr. Payne was so busy with politics and platforms that he had no time to devote to street car affairs.

The Pfister people next went to work putting up poles and stringing wires on Cambridge avenue, one of the streets covered by the injunctions of each company. Mr. Pfister claimed that the injunction against his company simply restrained it from laying tracks on Cambridge avenue, but the other side secured an order to show cause why the Pfister people should not be punished for contempt of court. The matter will be argued before Judge Gilson on September 1.

The Villard syndicate will expend about $1,600,000 in equipping the Cream City and Milwaukee City lines with the overhead system. Mr. Payne states that the roads will be entirely rebuilt. New rails will be laid and the roadbed rebuilt at a cost of $450 000. On the main line a 70-pound girder steel rail will be put down and on the branch lines a 60-pound rail. The electric equipment, consisting of power, motors, new cars, poles and wires, will cost from $1,100,000 to $1,200,000. The Sprague system will be used. Trussed poles have been adopted. The Milwaukee City lines on West Water street, and the Cream City lines on Huron, Martin and East Water streets will be converted into a belt line. All the street railway lines will strike the belt line at some point, so that passengers will be able to go to any part of the city without the least inconvenience.

The bids of the Badger Illuminating company and the Edison Electric Light & Power company for furnishing street lighting, the former at $112.50 per lamp and the latter at $113 per lamp, have been referred by the common council to the committee on street lights. There is a probability that new bids may be solicited. There is a good deal of talk about a combination of the big electric light companies to maintain prices.

The Wauwatosa Motor railway is nearing completion, and it is announced that the road will be in operation by Nov. 1. It is not yet decided whether electric motors will be used on the line. C.

Pittsburg, Pa.

PITTSBURG, Aug. 23.—The Duquesne Traction company is pushing with all possible speed the construction of its street car line between Pittsburg, East Liberty and Wilkinsburg. The suburb, of Wilkinsburg, the terminus of the line, is seven miles from Pittsburg, and it is likely that a 5-cent fare will prevail for the entire distance. The Pittsburg Traction company, which has a very good thing in its cable system between Pittsburg and East Liberty, is looking with envious eyes upon the Duquesne company, and there has been some talk of consolidation. The Pittsburg people have also been threatening to reduce to three cents the fare between the city and East Liberty as soon as their formidable rival shall be ready for business. The Duquesne company's line parallels that of the Pittsburg company for a portion of the way between Pittsburg and Liberty. Conservative observers are of the opinion that in view of the rapid growth of the east end districts of the city, there will be business enough for each of the companies, and that there is no necessity for their cutting each other's throats. Of course the public would be well pleased with a 3-cent fare.

A fine new incline railway has been put in operation from the South Side of Pittsburg to Mount Washington, a thickly populated hill. It is known as the Pittsburg Incline Railway. The equipment is of the very best. The engines are models of their kind, and the cars are fitted up in the most modern and convenient fashion. This incline is to be operated as an adjunct to the Pittsburg and Birmingham Traction company, which is earnestly at work on its line preparatory to changing from the motive power supplied by the mule to that afforded by electricity.

One of the most prosperous electric lighting companies in Pennsylvania is the East End Electric Light company of this city, which is obliged to add to its dynamo capacity every now and then, and to constantly extend its lines. These additions and improvements cost money and because of the necessity for them, the company has not been able to figure largely as a dividend paying corporation. But it has a great future before it, one which will beyond a doubt prove satisfying to the stockholders.

The Dravosburg, Mendelssohn & Elizabeth Electric Street Railway company is the latest Allegheny county street railway corporation to apply for a charter at the state capital. The charter has been granted and the company will set about the building of its line without delay. The line will be seven miles in length and will connect the towns of Dravosburg, Mendelssohn and Elizabeth. Forty-five thousand dollars is the capital of the company. The men who furnish it hail from McKeesport and their names are James E. White, John Haben, John K. Skelly, James L Devenny and Joseph A Skelly.

The city lighting system of Allegheny, which is run on the tower plan, is to be improved in the near future by the addition of 10 towers and 100 mast arms. It seems there has been complaint from some parts of the city that the illumination is not just what it should be, and the city fathers being anxious to please the whole populace are willing to remedy the defects.

The Squirrel Hill Railway company which, as was noted in this correspondence, recently fell into the hands of a receiver owing to lack of funds, is to have an opportunity to push its line to completion. The receiver has been granted permission by the court to borrow $5,000 to be devoted to the work. The city is now making objections to the proposed route of the Squirrel Hill railway, which touches Schenley park. It will probably be necessary to make a change in the running of the line to the end that the new pleasure resort may not be encroached upon. The residents of Squirrel Hill are anxious that the road be finished soon, as at present they are engaged in envying their fortunate neighbors who are enjoying rapid transit advantages. E H. H.

Nashville, Tenn.

NASHVILLE, Aug. 23.—All the local electric companies are pushing the work of construction of new plants and lines, or extending and improving those already established. The Nashville Electric Railway & Power company and the Citizens Rapid Transit company have arranged to connect their lines.

The United Electric Railway company's passenger and office building is progressing. When this building is completed every car of the entire system—about 60 in all—will pass through it one time on each trip, and in it all transfers will be made. It will contain the business offices of the company, passenger waiting rooms, etc. The company has just received four handsomely furnished cars from the Pullman Car company. They are marked "Woodland & Broad street," and will be run as through cars from the extreme east to the extreme western limits of the city without change, and for one fare. The company has its own shops and does all its repair work.

The Capitol Electric company is installing 100 arc lights for the city. The stationary motors furnished by this company are giving satisfaction. Electric lights for private houses are becoming so popular that new houses in this city are wired. This has necessitated a revision of the city building and inspection laws, and some rigid amendments have been adopted. B.

Slate Quarries in the United States.

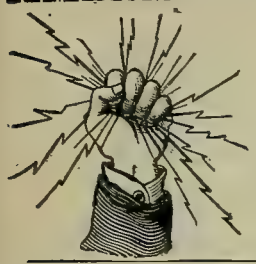
There are many interesting facts presented in the report of Dr. David T. Day, special census agent, on the question of mining slate. The greater part of the product of the American mines is used for roofing purposes, but of late the demand for slate for insulating purposes in the manufacture of electrical devices has rather stimulated the business. There are 206 slate quarries in the United States, of which 104 are in Pennsylvania. Vermont has 60 and New York 16. Maryland and New Jersey have 5 each, Georgia and Maine 4 each; Virginia, 3; California, 2; and Arkansas, Michigan and Utah, 1 each. That in Utah, however, was not operated last year. The total value of the production of 1889 was $3,444,863, the cost of the production $2,823,668 including wages of employes amounting to $2,209,344. Over $10,000,000 are invested in these enterprises, including land, buildings and fixtures, live stock, machinery and supplies on hand and the necessary money for operating expenses.

Some of the facts presented in this report are quite interesting. For instance the quarry at Arkansas represents a capital of $610, divided as follows: land $500; buildings and fixtures, $10; live stock, tools, machinery and supplies on hand, $25; cash $75. The employes number seven men—one foreman, two quarrymen and millmen, one mechanic and three laborers. The cost of operating the quarry last year is reported as $4,295 and the value of the productions $240. It might be interesting to note that the name of the company and the addresses of its officers are omitted from the list which is appended to the report. This may indicate that the owners did not find it advisable to continue the undertaking.

Although New York ranks third in the number of its quarries, it does not hold that position in the relative value of the property. Maine which has only 4 quarries, ¼ the number in New York, produced slate valued at $214,000 while the output of New Yorks was only $130,603. The Maine quarries represent an investment of $641,000 while those of the Empire State are rated at $296,180. The importance of this industry to Pennsylvania may be realized when it is shown that it represents a capital of $6,823,002, and gives employment to 3,567 hands. The wages of these employes amounted to $1,283,530 last year. The total operating expenses aggregated $1,729,163 while the output was valued at $2,011,776. What is known as the Bangor region in Northampton County, Pa., is the most important in the country, including quarries at Bangor, East Banger, and Mount Bethel. The only red slate produced in the country is found at Washington County, New York.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

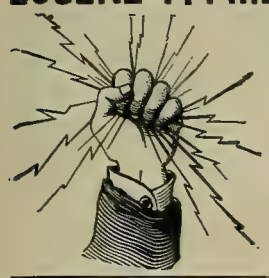
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union,** under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof,* and *will not deteriorate, oxidize* or *crack,* and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

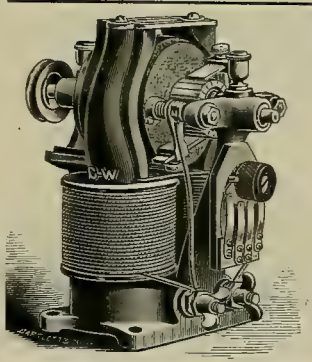
THE TURNER BRASS WORKS
MAKE ANYTHING IN BRASS.
4 LASALLE AVE CHICAGO.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE

Crocker-Wheeler

PERFECTED MOTORS

Develop Full Power at Half the Speed of other Makes and are, Therefore, Noiseless.

WORKS:

14th, Washington and 13th Streets,

NEW YORK.

THE SUNBEAM

MAINTAINS ITS RATED CANDLE POWER.

SEND FOR PRICE LIST.

SUNBEAM INCANDESCENT LAMP CO.,

Corner Randolph and Canal Sts., CHICAGO, ILL.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Belt Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

INSULATED WIRES AND CABLES,

OKONITE TRADE MARK.

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

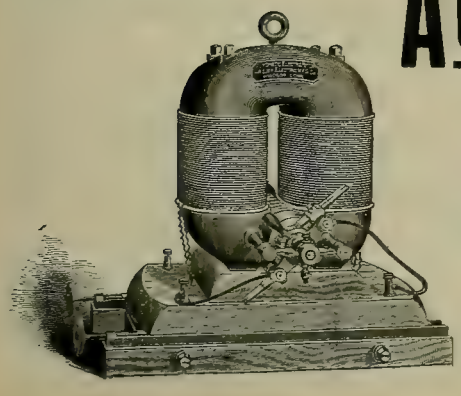
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 508 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 101 Camp St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 19c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FRANK T. BROWN, Late
PRINCIPAL EXAMINER ELECTRICITY,
U. S. PATENT OFFICE, NOW OF
Butterworth, Hall, Brown & Smith,
Patent Attorneys,
25-26 HONORE BUILDING, - - CHICAGO.
Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,
FITCHBURG, MASS.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

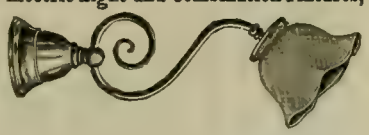
Special and Experimental
MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

BLECKERT & NELSON,

MANUFACTURERS OF
Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:
85 and 87 FIFTH AVENUE, CHICAGO, ILL.
Send for New Descriptive Circulars.

Binders FOR THE Western Electrician **$1.00.**

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

Standard and Special Devices for use on all roads
IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

PURDUE SCHOOL OF ELECTRICITY.

New laboratory, fitted with best appliances, dynamos, storage batteries, and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue.

PURDUE UNIVERSITY, La Fayette, Ind.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

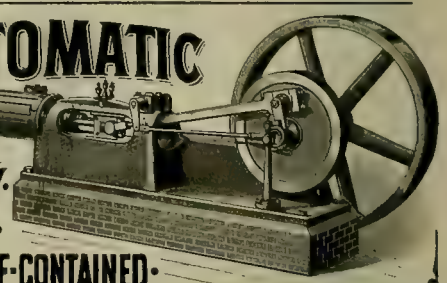
S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

THE RICE AUTOMATIC



GUARANTEED ECONOMY.

REGULATION · DURABILITY ·

8 TO 300 H.P. SIMPLICITY · SELF-CONTAINED ·

PAIR & TANDEM · COMPOUNDS. THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

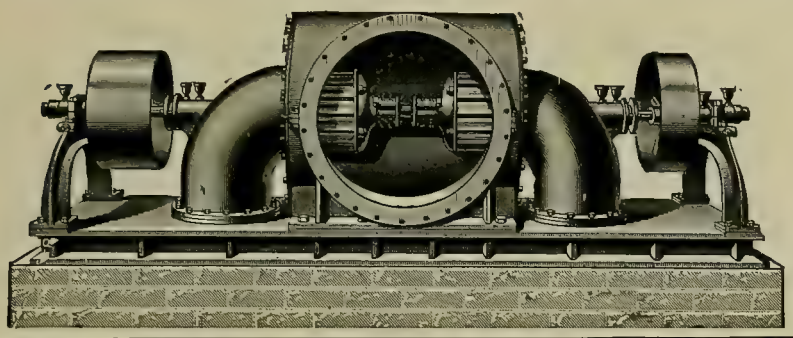
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its diameter, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

Bell Hangers' Hand-Book,
BADT, $1.00.

Dynamo Tenders' Hand-Book,
BADT, $1.00.

ELEMENTS of ELECTRIC LIGHTING.
ATKINSON, $1.50.

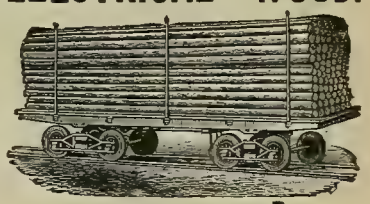
All three Books, to one address, cash with order, $3.00.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, CHICAGO.

ENGINES CORLISS OR HIGH SPEED WITH BOILERS, Etc.
For Driving Dynamos.
Complete Steam Plants Furnished and Erected.
ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.
WOODBRIDGE & TURNER,
Electrical Engineers and Contractors.
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.
Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.
Designs and Estimates Submitted.
74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS POLES ARMS
C. H. HOLMES & CO.,
Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,
180 Summer St., Boston, Mass.

COLUMBIA
Incandescent Lamp Co.,
1912--1914 Olive Street, St. Louis, Mo.,
MANUFACTURERS OF
INCANDESCENT LAMPS.
Lamps Made to Fit any Socket.
Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,
Only Manufacturers of Pure Copper Tempered for
Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.
Eastern Office: 35 Broadway. General Western Office: 225 Dearborn St., Chicago, Ill. Factory; North East, Pa.

HOLMES, BOOTH & HAYDENS,
FACTORIES: WATERBURY, CONN.
MANUFACTURERS OF
BARE AND INSULATED WIRE.
Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.
AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.
THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

WESTERN ELECTRIC CO.,

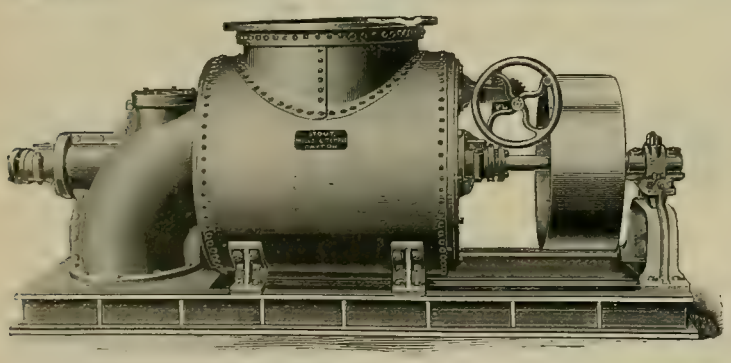
WE ARE THE EXCLUSIVE WESTERN AGENTS FOR THE SALE OF

A. G. DAY'S KERITE WIRES FOR TELEGRAPH, TELEPHONE, AND ELECTRIC LIGHT USE.

PRICES ON APPLICATION.

CHICAGO. NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

THE MONON ROUTE

Affords choice of Four (4) Fast Trains each way, commencing June 1, 1890,

EVERY DAY AND SUNDAY, TOO

In Pullman's Patent Perfected Safety Vestibuled Buffet Sleepers and Chair Cars between

CHICAGO and the OHIO RIVER.

These are all solid Pullman trains of latest design and improvements, consisting of Elegant Day Coaches, Chair Cars, Composite Cars, Dining Cars and the very finest of Buffet Sleeping Cars, equipped with Pullman's Perfected Safety Vestibules.

Trains from Cincinnati and the Southeast, and from Louisville and the South, arrive at Chicago in ample time to connect with the morning and evening fast trains for Milwaukee, Minneapolis, St. Paul, Omaha and all points in the Northwest.

Morning and evening connections made both at Louisville and Cincinnati with the Fast Express Trains of connecting lines for Memphis, Knoxville, New Orleans, Jacksonville and all points South.

At Indianapolis connections are made with all diverging lines.

Special Features: Steam Heat, Electric Light, Perfected Safety Vestibules.

For rates, through and local schedules, address any Ticket Agent of the Monon Route.

Wm. F. Black, General Manager.
W. H. McDoel, Traffic Manager.
James Barker, General Passenger Agent.

C., M. & ST. P. R. R.

The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
21, 23 and 25 Ann St. New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

WHIPPLE'S

Electric, Gas & Street Railway

FINANCIAL REFERENCE DIRECTORY

FOR 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

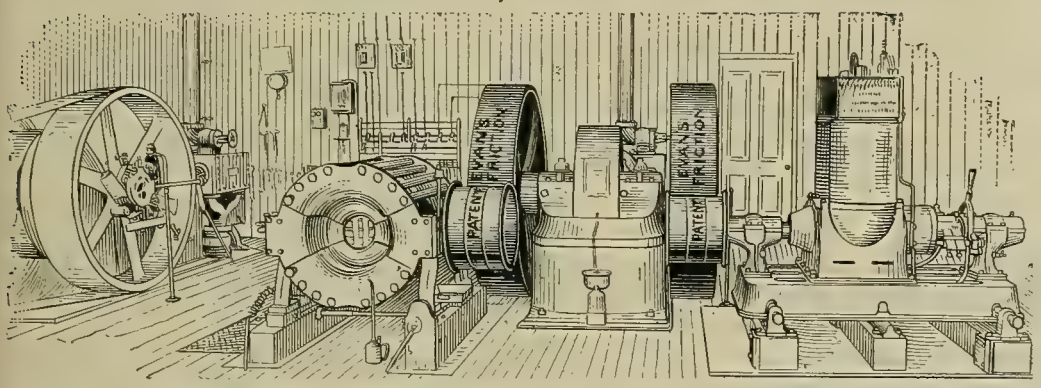
Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

The EVANS SYSTEM OF DRIVING DYNAMOS.

HUTCHINSON WATER, LIGHT AND POWER CO.



Thomson-Houston "M. D." and Edison No. 16.
Running constantly since January, 1890.

This cut of a portion of the Hutchinson (Kansas) Water, Light and Power Co.'s station is introduced to illustrate still another way in which two dynamos may be driven directly from an engine. There are many places where, owing to the shape of the space allotted to the engine and dynamos, this arrangement is most desirable. In cases where the location permits, however, room can be saved by using the arrangement shown in the blue print of the plant on board the Steamship "Portland." This arrangement has also a further advantage in that when both dynamos are in gear the pressure of one dynamo pulley on the engine bearings is counterbalanced by the pressure of the other, and is not all in one direction as is usually the case in common practice.

The plant in the new Shoe and Leather Exchange Building in Boston, is of the same type as that shown in this cut. Two 650 light Mather dynamos are driven, one from the fly-wheel, and the other from the governor wheel of a McIntosh & Seymour Engine.

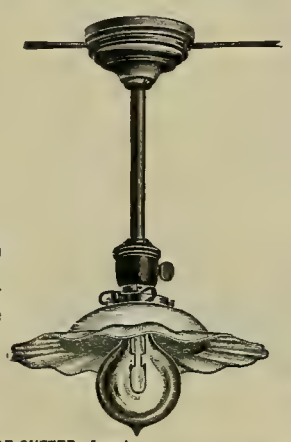
These two plants are instances where the advantages of our system are unusually apparent. In the case of the station at Hutchinson where the arc machine furnishes the current for street lamps, and the incandescent machine for commercial lights, it is a great advantage to stop and start either machine as the requirements of the service may require.

This is equally true of the plant in the Shoe and Leather Exchange Building. For a portion of the day one machine will furnish all the current necessary to supply what few lamps may be in use; but later in the day, or in cloudy weather, the demand for lights may be in excess of the capacity of one dynamo, and it will then become necessary to throw in the reserve machine. This can be done without even slowing the speed of the engine.

EVANS FRICTION CONE CO., 85 Water St., BOSTON.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.



SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.

CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

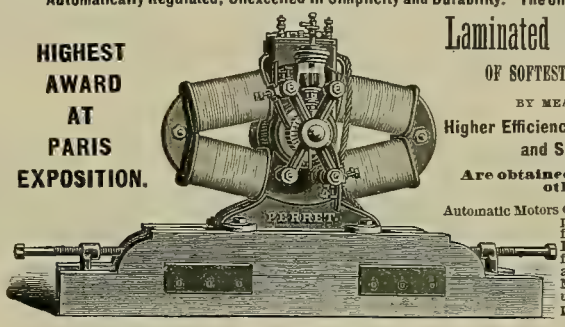
79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

INTERIOR CONDUIT AND INSULATION CO.
GENERAL OFFICES. 16 & 18 BROAD STREET
NEW YORK May 29/90

FACTORY. 154-156 WEST 27TH ST

Thomas A. Edison Esq
My Dr Edison
Are you to rewire your House today What system of wiring would you employ?
Yours Truly
Edw. H. Johnson

The asphaltic paper tubes of the "Interior" Conduit Co
Thomas A Edison
orange NJ May 30/90

H A PEVEAR President
C A COFFIN Vice Pres't & Treas.
S A BARTON Genl. Mang'r & Ass't Treas.

E I GARFIELD Secretary
E THOMSON Electrician
E.W. RICE JR Sup't & Con. Elec.

Lynn, Mass. June 6, 1890. 189

Interior Conduit and Insulation Co.,
154 West 27th St., New York, N. Y.

Mr. Edw. H. Johnson,

Dear Sir:-

In reply to your letter of May 29th inquiring in relation to the system employed for introducing the wiring into my house, I take pleasure in saying that I consider the system the most perfect ever devised for interior wiring, and that it has been worked out practically in a very successful manner by your Company. The features of flexibility and security together with ease of repair are not the least of the points in its favor.

Yours very truly,
Elihu Thomson

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD W LKINS
—TRADING AS—

PARTRICK & CARTER,

Manufacturers of and Dealers In Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE
NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,
114 S. Second St., - Philadelphia, Pa.
ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS
FOR THE SALE OF
PARTRICK & CARTER'S
Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO., - San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO., - Seattle, Wash.
WOLFE ELECTRICAL CO., - Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO., - Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

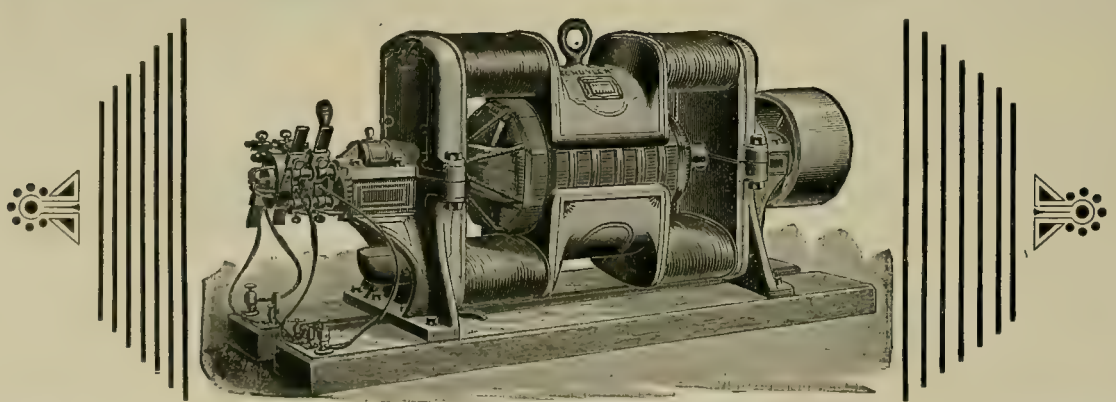
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

HOGGSON'S
IMPROVED
DOUBLE
WINDOW SPRING
THE BEST.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

HOGGSON'S
PATAPPLED FOR
OVAL
Fibre Wire-Cleats.
SAVES BATTERY AND WIRES.

Southern Electrical Supply Co.,
ELECTRICAL SUPPLIES
Of Every Description at Bottom Prices. Prompt Shipments and Intelligent Execution of Orders Our Specialties.
823 LOCUST STREET,
ST. LOUIS, - MISSOURI.

OKONITE
TRADE MARK.
WIRES, CABLES, TAPE and CORD
FOR
PROMPT SHIPMENT.

HOGGSON'S
IMPROVED
Door Spring.
Has Shield to Protect the Pin.
THE ONLY SPRING MADE HAVING SCREW AND WASHER FOR EACH WIRE.

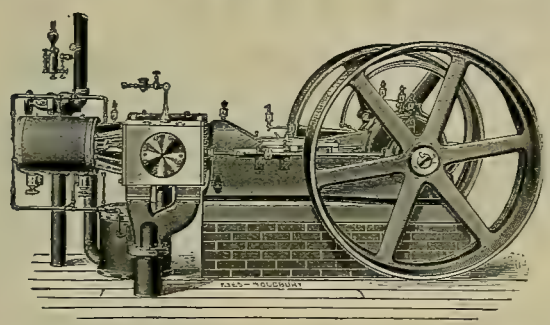
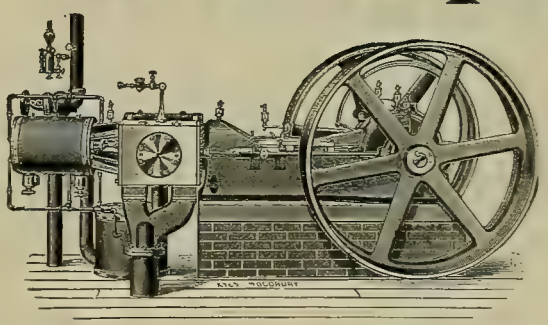
JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
FOR
ELECTRIC MOTORS

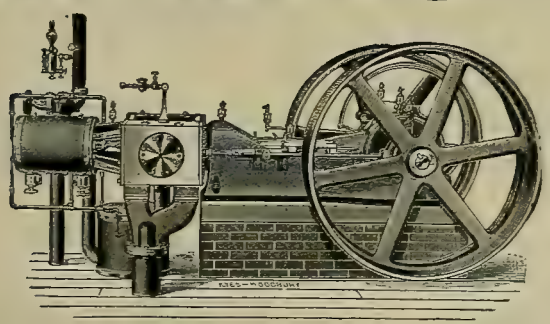
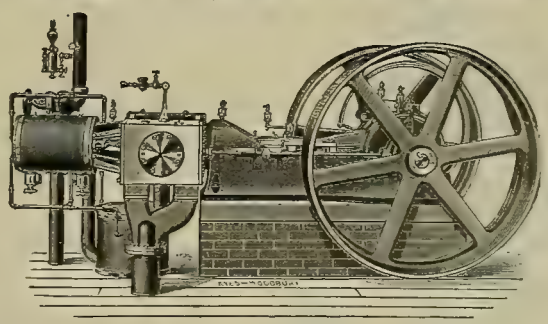
CARS ADAPTED TO ALL SYSTEMS.

WE ARE HEADQUARTERS IN THE WEST
FOR ELECTRICAL BOOKS.
SEND FOR OUR NEW AND COMPLETE CATALOGUE,
Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

None so Good, None to Equal.


TANDEM


McINTOSH & SEYMOUR.


COMPOUND


WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

LEWISOHN BROS.,

81 and 83 Fulton St, NEW YORK.

SOLE AGENTS
Tamarack Osceola Copper Manufacturing Company,
DOLLAR BAY, MICH.

BARE COPPER WIRE

Guaranteed made from Best Lake Superior Copper.

HARD DRAWN WIRE

For Telephone and Electric Railway Use a Specialty.

Soft Annealed Wire for Electrical Purposes.

C. B. HOLMES, Prest. & Genl. Mgr. G. W. GRIFFIN, Superintendent of Construction. WM. C. NICHOLS, Secretary & Treasurer.

The Hazelton Tripod Boiler

Is the quickest generator of steam,
Needs less repairs than any other, and
Is the most economical boiler in use.

ADDRESS
HAZELTON TRIPOD BOILER CO.,
170 TWENTY SECOND ST., CHICAGO, ILL.

OHIO STATE UNIVERSITY,

COLUMBUS, OHIO.
Civil, Mechanical, Mining and Electrical Engineering. SEND FOR INFORMATION.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

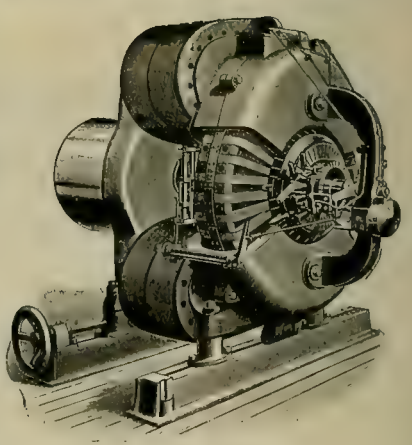
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

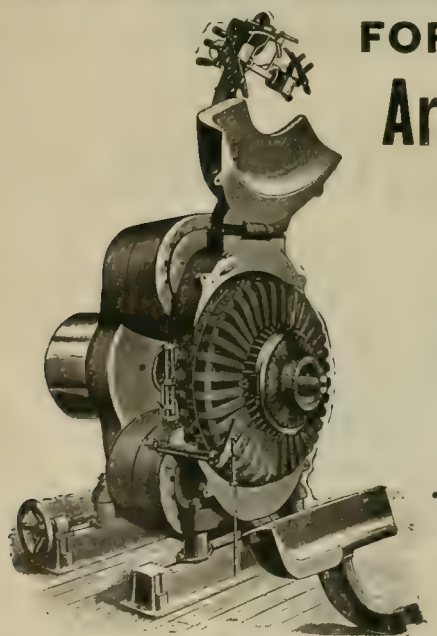
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

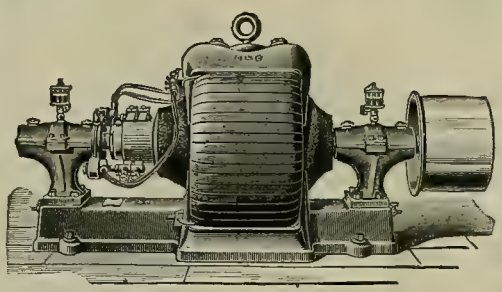
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

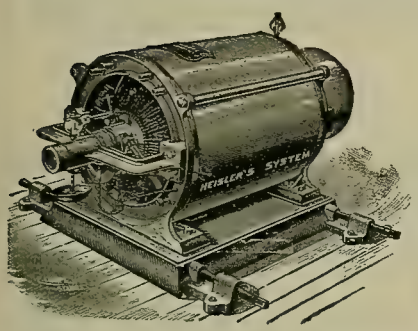
Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.



UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.

"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS

EDW. P. ALLIS & CO.,

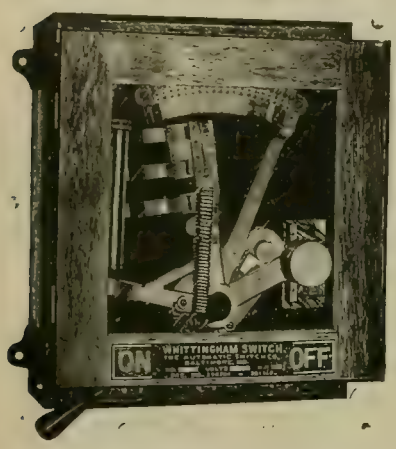
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

WHEN YOU BUY A MOTOR



From ANY Manufacturer or Dealer,

State that you WANT IT SUPPLIED WITH the

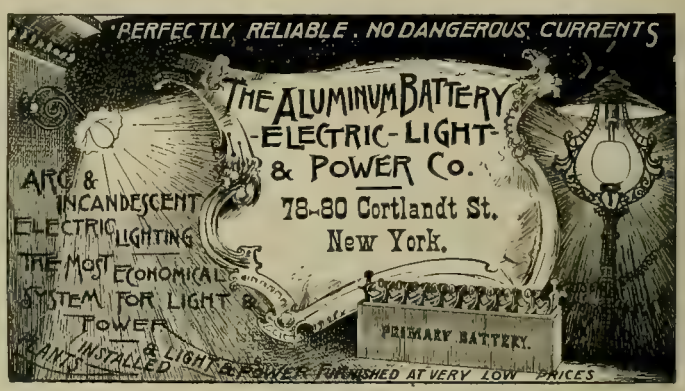
Whittingham Automatic Switch.

Send for Catalogue.

Automatic Switch Co.,

No. 8 Keyser Building,

BALTIMORE, MD.



COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt

ALL LEATHER

NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.

BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER.

BRANCHES: 161 Summer St., Boston, Mass.; 225 Pearl St., New York City; 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago.

St. Louis, Mo.

DR. GASSNER'S

DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3½ in.
17.	"	7⅛ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,

111 Chambers St., New York.

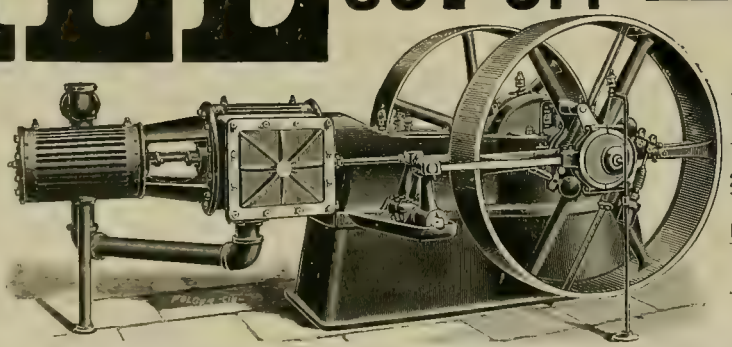
BALL AUTOMATIC CUT OFF ENGINE

Standard.

Cross Compound.

Triple Expansion.

Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER,
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Build'g, CHICAGO, ILL.

OMAHA ENGINEERING COMPANY,
Sheeley Building, OMAHA, NEB.

KANSAS CITY ENGINEERING CO.
KANSAS CITY, MO.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

CINCINNATI HEADQUARTERS

ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.

WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE · FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·

THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.

The JONES-BROS-ELECTRIC CO. 28 30 & 32 West Court St.

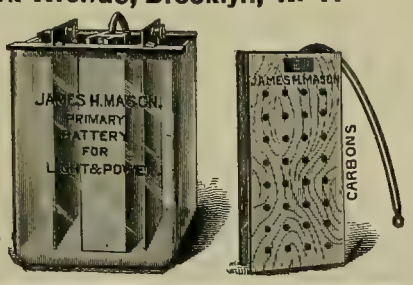
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

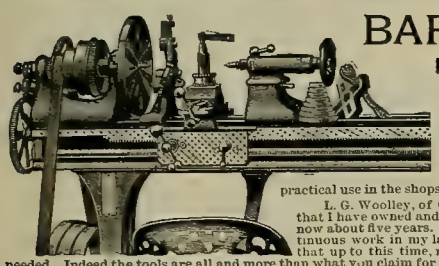
JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.





BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

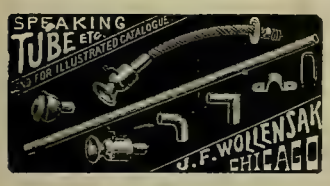
There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

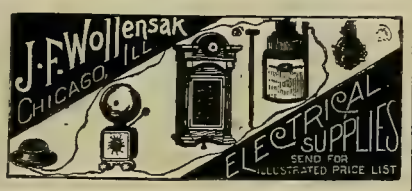
L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.





UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

Over 105 Roads operated under Our System, and that Successfully, both financially and electrically.

EDISON
GENERAL ELECTRIC
COMPANY,

Edison Building, 44 BROAD STREET,
NEW YORK CITY.

ELECTRIC STREET RAILWAYS.

Our Electric system for Street Railways has been found to be the most durable, reliable, economical and convenient.

New roads in course of construction going on in all parts of the country.

Railroad Managers and Others interested in this business are earnestly requested to correspond with us, to *get facts* and *data* showing the advantages and possibilities to be obtained by Electric Traction over any other existing methods.

DISTRICT OFFICES:

NEW YORK, Edison Building. CHICAGO, Rialto Building.
SAN FRANCISCO, Chronicle Building. NEW ORLEANS, Cotton Exchange.
PORTLAND, ORE., Washington Bldg. DENVER, Masonic Building.
TORONTO, CAN., Bank of Com. Building.

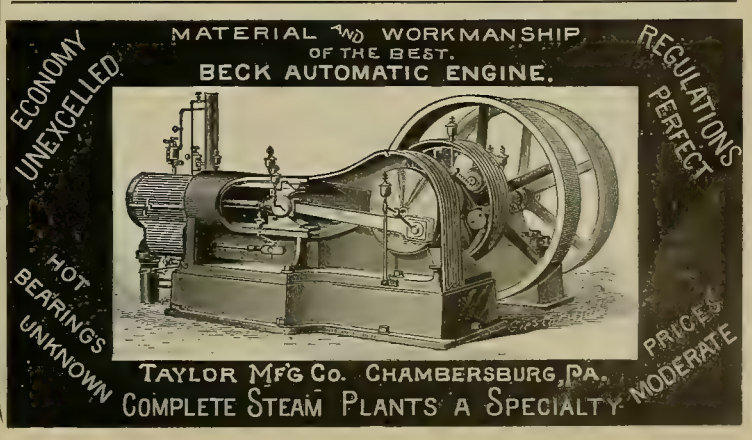
C. H. & D. R. R.

BEST ROUTE

From CINCINNATI to the North and North West.

C., B. & Q. R. R.

—IS THE—
Best Appointed Line
—FOR REACHING THE—
West, Northwest and Southwest.



NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2000	"
" " " "	3d " (Just ready.)	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition (Just ready.)	2,500	Copies
Bell Hangers' " "	1st "	2,500	"
" " " "	2d "	1,000	"
Total within Eighteen months		15,000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1.00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane-Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, NEW YORK.

Possess Superior Advantages in the Manufacture of

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture *HARD RUBBER* under the valuable Patents granted to WILLIAM KIEL.

All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING

Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT

HARD RUBBER CELLS

FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

Hard Rubber Goods of Every Description Manufactured.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

o

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. THE THOMSON-HOUSTON RAILWAY SYSTEM only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

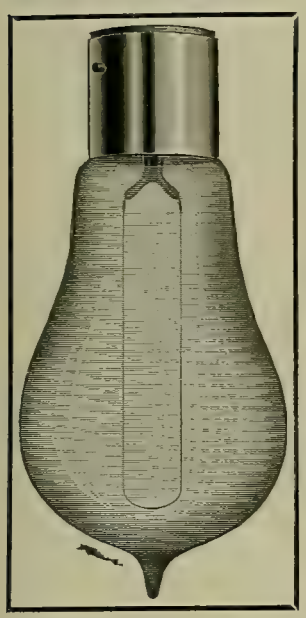
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

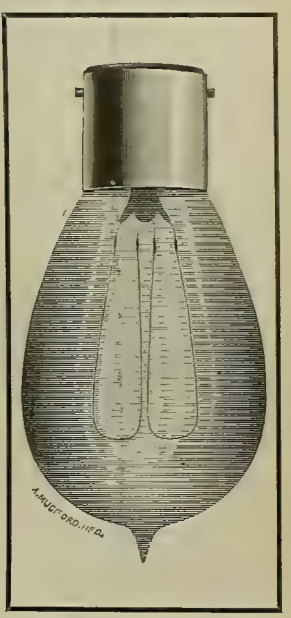
—— THE ——

Perkins Electric Lamp Co.

ALL CANDLE POWERS.

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

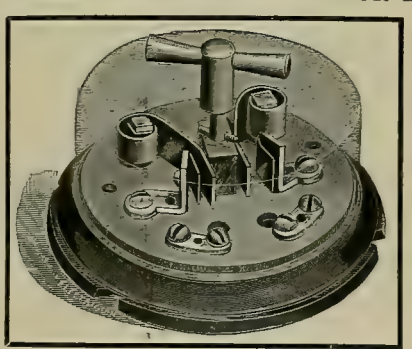
TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

—— WE CALL SPECIAL ATTENTION TO ——

THE DIAMOND
"K"
SWITCH AND FUSE BOX.



DOUBLE POLE
— FOR —
ICNANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

"ALWAYS ROOM AT THE TOP"

HABIRSHAW INSULATED WIRES, CABLES AND CORES

Too high up to be crowded by inferior insulations struggling for second place.

OUR CLAIM OF SUPERIORITY IS BASED ON PURITY OF MATERIALS AND SUPERIOR METHODS OF MANUFACTURING.

Scientific and practical tests unite in awarding Habirshaw insulation FIRST PLACE.

Read the Following:

ELECTRICAL TESTING BUREAU,

JOHNS HOPKINS UNIVERSITY.

REPORT OF A SERIES OF TESTS OF THE INSULATION RESISTANCE, CAPACITY AND CONDUCTIVITY OF A SAMPLE OF

Habirshaw Rubber overed Wire.

The sample submitted for measurement was 2027 feet in length.
Thickness of insulation was .281 c. m.
Diameter of wire .1632 c. m.

The wire was extremely flexible, and was coiled and uncoiled several times befo e measurements were made.

The insulation consisted of several layers of India Rubber, with an external cotton braiding.

The coil was immersed in water on December 16, at 8:30 P. M., and tests were begun the following morning. Both the Direct and Loss of Charge methods were employed. The following are the results:

CAPACITY IN MICROFARADS PER KNOT.	INULATION RESISTANCE IN MEGOHMS PER KNOT.	TEMPERATURE CENTIGRADE, DEGREES.	DATE.
.453	11240	8.5	Dec. 17
.441	9558	13.3	Dec. 18
.456	10080	13.0	Dec. 19
.441	10183	11.0	Dec. 20
.450	9620	10.8	Dec. 21
.450	10000	12.0	Dec. 27

Direct deflection 7200 megohms per knot at 12° C. on December 27th. Conductivity was obtained by making a number of measurements of the diameter of the wire, and a determination of the resistance of the entire length of the sample at a definite temperature.

The conductivity was 98 5 per cent. that of pure copper as given by Matthiessen.

For the eleven days that the wire was in water the insulation resistance remained practically unchanged, and the slight variation which occurred can be accounted for by the difference in temperature, etc.

The insulation seems to be less affected by changes in temperature than that of other samples which we have tested at various times,

Very respectfully,

(Signed) LOUIS DUNCAN,
G. A. LIEBIG, JR.

January 5, 1889.

THOS. FRENCH Jr., City Electrician, CINCINNATI, OHIO, writes:

"My test of the Habirshaw Wire was perfectly satisfactory as to insulation resistance under water. I commended the insulation as of high grade—adding that I did not have the facilities for testing how the wire would withstand the special conditions prevailing in a soap and candle factory."

A gentleman formerly connected with the Leonard & Izard Company stated that he made tests to determine best insulation to use in soap and candle factories, and found Habirshaw the only insulation that could stand the service.

This gentleman stands high in electrical circles, and we are authorized to refer intending purchasers to him for further particulars.

BATEMAN & POLLARD,
CONTRACTORS FOR
Electric Light Wiring, Electric Light Plants, Railroad Installations,
And Every Description of Electrical Work.
Marine Work a Specialty.

No. 143½ EAST 23D STREET, NEW YORK, April 15, 1890.

W. M. HABIRSHAW, Esq., 159 Front Street, City.

DEAR SIR:—In response to yours of yesterday's date, regarding your Standard India Rubber Core Wires, would say we have used the same in various paper Mills throughout the State, which is about as severe a test on a wire both for moisture and acids as we know of, and as they have been using the wire for several (5 years probably) years with no complaints, we presume it is giving every satisfaction.

We have also used the wire in Russian Baths in the city for over a year where it has stood the test admirably. Yours respectfully, BATEMAN & POLLARD.

I. C. WALKER. H. G. KEPLER.

WALKER & KEPLER,
Agents and Contractors Edison System of Electric Lighting,
106 & 108 SOUTH FOURTH STREET,

PHILADELPHIA, February 21, 1889.

INDIA RUBBER AND GUTTA PERCHA INSULATING CO., 159 Front St., New York.

GENTLEMEN:—We have been using your Wire almost exclusively during the last year for our Incandescent Work. In this time we have wired the Drexel Building, 2,600 lights; Keystone Bank, 400 lights; Catholic High School, 600 lights, and a large number of other buildings. Total number of lights probably 10,000 to 12,000, and we are pleased to say that we have never had the least trouble with the Insulation, which we consider A1.

We might add that the local Edison Company in this city, have had their Inspectors examining and testing the work done, and they say that the Habirshaw Insulation shows up first-class and above all others. Yours very truly,

(Signed) WALKER & KEPLER.

ANOTHER PRACTICAL MAN WRITES:

Inclosed please find sample of Habirshaw Wire that I had in a dry kiln for (168) one hundred and sixty eight hours at temperature of (212) two hundred and twelve degrees, also a piece of ——— Wire No. 18 that was used the same.

NOTE—These samples are now in our possession. The Habirshaw samples, which is taped standard wire, is in good condition, showing no visible effect of any injury whatever to the covering or insulation. The ..... sample, which is braided insulation, is very much damaged, looking as though it had passed through a severe test of dynamite.

Letters and samples above referred to can be seen by calling at our office. **WE INVITE TESTS AND COMPARISONS**

CAN YOU AFFORD NOT TO USE THE BEST?

THE BRUSH ELECTRIC COMPANY

STILL CLAIMS THE EXCLUSIVE RIGHT TO MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

AGAIN SUCCESSFUL

THE BRUSH ELECTRIC COMPANY
vs.
THE WESTERN ELECTRIC LIGHT & POWER COMPANY, et al.
(Western Electric System.)

Opinion by Judges Brown and Ricks in the United States Circuit Court for the Northern District of Ohio, filed August 15, 1890:

"Any dissimultaneous arc forming separation by mechanism resulting in the suc-
"cessive burning of the carbons, is an infringement of the Brush patent."

So called double fixed carbon, three carbon or flat carbon lamps are crude and unsatisfactory.

The Court say:

"Defendants experts are constrained to admit, not only that Brush was the first to "invent the principle of substitution in his double carbon lamp, but that the Western "Electric Company could not successfully compete with the companies using his patent, "in furnishing all night electric lighting plants unless it could provide double carbon "lamps to its customers."

"We should have felt fully justified in disposing of this case by a simple reference to "the opinion of Judge Gresham in the Brush Electric Company vs. The Ft. Wayne Electric "Light Company, in which the same construction was placed upon the Brush patent, but "in view of the importance of the questions involved, and of the elaborate preparation of "counsel, we have deemed it proper to give it an independent consideration."

"We are clearly of opinion that complainant is entitled to relief in this case, and a "decree will, therefore, be entered for an injunction, and the usual reference to a Master "to assess and report its damages."

BRUSH APPARATUS ALWAYS RELIABLE.

ARC AND INCANDESCENT LIGHTING SYSTEMS, ELECTRIC MOTORS, GENERATORS, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

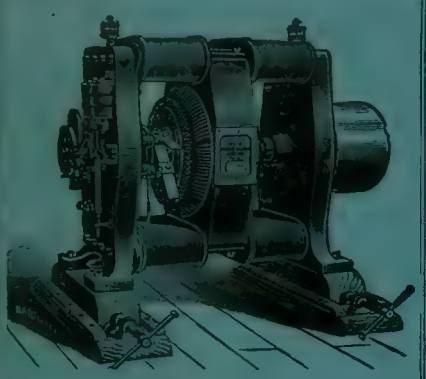
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



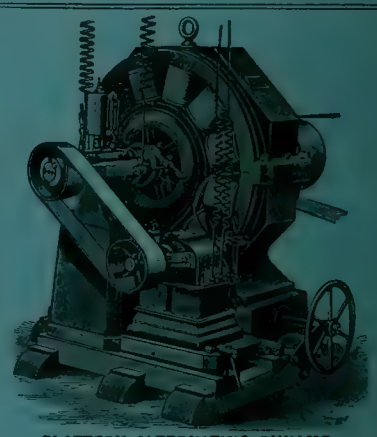
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK,	115 Broadway.
CHICAGO,	185 Dearborn St.
PHILADELPHIA,	907 Filbert St.
PITTSBURGH,	533 Wood St.
DETROIT, MICH.,	57 Gratiot Ave.
SAN FRANCISCO,	35 New Montgomery St.
TORONTO, CAN.,	138 King St. W.
DALLAS, TEX.,	McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

THE MITCHELL VANCE CO.,

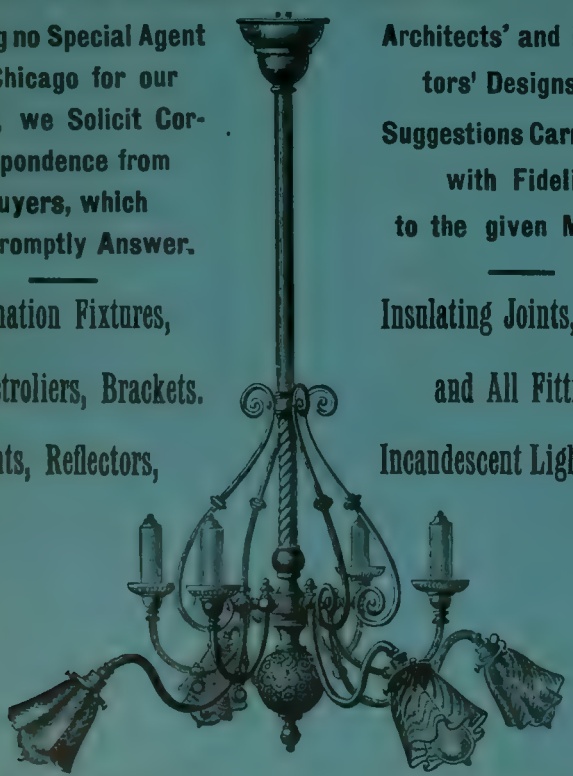
(Successors to MITCHELL, VANCE & CO.)

DESIGNERS AND MAKERS OF

ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.



Combination Fixtures,
Electroliers, Brackets.
Pendants, Reflectors,

Insulating Joints,
and All Fittings for
Incandescent Lighting.

MANUFACTORY,
24 and 25th St. and 10th Ave.,

SALESROOM,
836-38 Broadway and 13th St.,

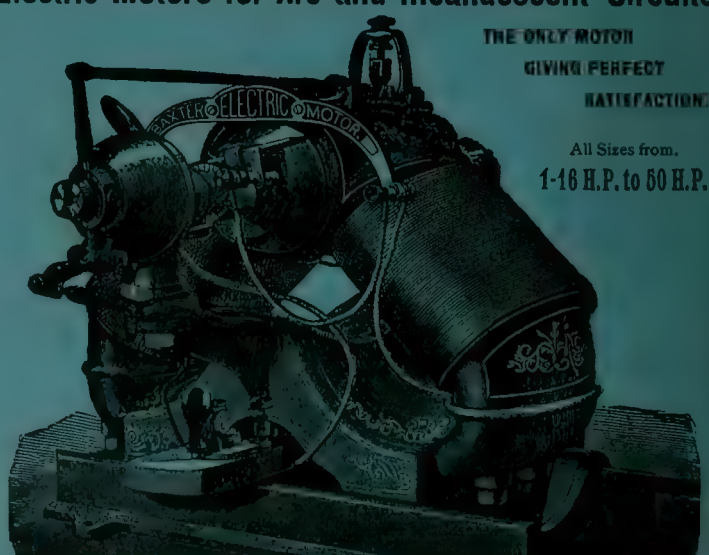
NEW YORK CITY.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

Every Motor is Guaranteed.

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, SEPTEMBER 6, 1890. No. 10.

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

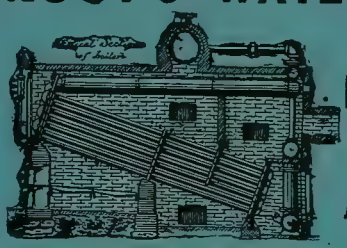
To Make YOUR TELEPHONES TALK

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

ROOT'S WATER-TUBE BOILER.



ROOT SECTIONAL SAFETY BOILER.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

ELECTRIC PLANT BOILER.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff Street, New York.

BRANCHES: BOSTON, PHILADELPHIA, NEW ORLEANS, DALLAS and CHICAGO.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York. / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

—— MANUFACTURERS OF ——

Weather Proof Wire, Annunciator Wire, Gas Fixture Wire,
Insulated Iron Wire, German Silver Wire, Arc Lamp Cords,
Magnet Wire, Office Wire, Tinsel Cords,
Rubber-Covered House Wire, Flexible Brush Holder Cable, Flexible Cords,

Telephone, Telegraph and Electric Light Cables.

PARAGON TAPE.

Please address all communications to the nearest District Office.

EDISON BUILDING, BROAD ST., NEW YORK.

MAIN DISTRICT OFFICES: EASTERN DISTRICT, EDISON BUILDING, NEW YORK. CENTRAL DISTRICT, "THE RIALTO" BUILDING, CHICAGO. MOUNTAIN DISTRICT, MASONIC BUILDING, DENVER. PACIFIC COAST DISTRICT, CHRONICLE BLDG., SAN FRANCISCO. NORTH WEST DIST., WASHINGTON BLDG., PORTLAND, ORE. SOUTHERN DIST., COTTON EXCHANGE BLDG., NEW ORLEANS. CANADIAN DIST., BANK OF COM. BLDG., TORONTO CAN.

WORKS: SCHENECTADY, N. Y.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave., CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment.
Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	285
Waterhouse	222	.....	222
Heisler	.....	500	500
Remington	159	300	459
Sperry	130	.....	130
Excelsior	90	.....	90
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	2,289
Westinghouse	321	49,067
Edison	..	10,862
American	1,537	175
United States	632	6,141
Schuyler	1,166	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,000
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	1,013
Remington	129	.....
Sperry	160	.....
Excelsior	205	30
Hochhausen	70	.....
Weston	138	.....
Fuller	10	.....
Reliance	30	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45.055
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%

	Arc.		Incandescent.	
	T. H. System.	All other Systems	T. H. System.	All other Systems.
Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Increase	5,843	4,402	36,229	40,652
Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Ansonia Brass & Copper Co.. i
Allis, E. P. & Co..... xxiv
American Electrical Works.. xvii
Abendroth & Root Mfg. Co.. i
Aluminum Battery, Electric Light & Power Co.... xii
Ball Engine Co..... xxv
Baggot, E..... xviii
Barton, Geo. P..... —
Bernstein Electric Co..... xxi
Brush Electric Co..... xxxi
Butler Hard Rubber Co..... xi
Bain Foree..... xviii
Brown, Frank T..... xviii
Barnes, W. F. & Jno..... xxv
Baxter Electric Motor Co..... xxiv
Bleckert & Nelson..... xix
Bunnell & Co., J. H..... xvi
C. B. & Q. R. R..... xxv
Cleverly Electrical Works... ix
Colburn & Co., I. W..... xviii
C. & C. Electric Motor Co... xxiii
Central Electric Co..... xiii
Continental Dynamo Co..... —
Columbia Incandescent Lamp Co xix
Connecticut Motor Co..... xxi
Consolidated Electric Storage Co..... xxii
Crocker-Wheeler Motor Co... xvii
Crosby Electric Co..... iv
Curtis Regulator Co..... xviii
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xx
Electrical Supply Co xxx
Empire City Electric Co..... xx
Eastern Electric Cable Co. xvii
Edison General Electric Co.,— Railway Dept... xxv
English, Morse & Co..... xix
Excelsior Electric Co..... ... xii
Elektron Mfg. Co..... xxi
Eddy Electric Mfg. Co..... xvi
Electric Construction & Sup. Co iv
Edison Mfg. Co..... xxiii
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co..... —
Eureka Tempered Copper Co.. xix
Easton Electric Co..... iv
Electric Merchandise Co..... xviii
Electrician Publishing Comp'y, xxvi, xxiv, xxi, xxii
Evans Friction Cone Co..... xxi
Empire China Works..... xviii
Fibrone Mfg. Co..... xvi
Fort Wayne Electric Co..... xxxii
Fletcher & Fletcher Electric Co xviii
Globe Carbon Co xix
Greeley & Co., E. S..... —
Gibson Gas Fixture Co..... xx
Giles Bros..... vi
Great Western Electric Sup. Co. v
Hazelton Tripod Boiler Co.... xii
Heisler Electric Light Co..... xxiii
Hill Clutch Works..... —
Holmes, Booth & Haydens..... xix
Harmount, G. A..... xviii
Hazazer & Stanley..... xvi
Holtzer-Cabot Electric Co..... i
Hawkeye Electric Mfg. Co.... iv
Holmes & Co., C. H..... xix
Humphrey, H. H..... xviii
Ireson, Chas. L.. i
Interior Conduit & Insulation Co. xvi
India Rubber & Gutta Percha Co. i
Ide & Son, A. L..... xvi
Illinois Electric Material Co.... xvi
Jewell Belting Co..... xvii
Jones Bros. Electric Co..... xxiv
Knapp Electrical Works..... xxix
Law Telephone Co..... xvii
Leclanche Battery Co..... vi
Laminar Fibre Goods Co..... xix
Mitchell Vance Co..... —
Monitor Electric Co..... xviii
Munsell & Co., Eug..... xvii
Munson Belting Co., Chas..... xviii
Mason, Jas. H..... xxv
Magnolia Anti-Friction Metal Co—
N. Y. Belting & Packing Co... xvi
National Carbon Co..... iv
National Electric Mfg. Co..... x
Noye Mfg. Co., Jno. T..... —
Northwest Thomson-Houston Co. vii
Ohio State University..... xvi
Ostrander & Co., W. R. xx
Okonite Co..... xvii
Partrick & Carter xi
Phoenix Glass Co..... vi
Paiste, H. T..... xvi
Pond Engineering Co..... xviii
Powell Co., Wm..... —
Pumpelly Storage Battery Co. xii
Phillips Electrical Works, E. F xvi
Page Belting Co..... xviii
Queen & Co..... xviii
River & Rail Elec. Light Co.. xxvii
Roeblings' Sons Co., Jno. A.... ix
Shultz Belting Co..... ..... —
Stilwell & Bierce Mfg. Co. xviii, xix
Standard Carbon Co..... xi
Stephenson & Co., Jno xxii
Schuyler Electric Co..... xi
Southern Electrical Supply Co. xxii
Sperry Electric Co..... xx
Sawyer-Man Electric Co..... xiv
Schoverling, A ..... —
Standard Paint Co..... xvi
Standard Underground Cable Co. i
St. Louis Electrical Supply Co... xii
Standard Electrical Works... xviii
Sunbeam Incandescen Lamp Co. xvii
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxviii
Taussig, S..... xviii
Taylor Mfg. Co..... xxv
Triumph Compound Engine Co..... xxiv
Turner Brass Works..... xvii
Union Hardware Co..... xvi
United Electric Traction Co.... xxv
United States Electric Lighting Co..... —
C. S. Van Nuis..... —
Woodbridge & Turner.. xix
Westinghouse Electric Co..... xv
Wollensak, Jno. S..... xxv
Western Electric Co..... xx
Weston Electrical Instrument Co..... —
Western Power Construction Co. xxii
Wanted..... xviii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co.
Pumpelly Storage Battery & Elec. Motor Co.
The River & Rail Electric Light Co.

Aluminum.
Aluminum Brass & Bronze Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Aluminum Battery Electric Light & Power Co.
Bunnell & Co., J. H
Central Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Hazazer & Stanley
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Weston Electrical Instrument Co.

Electric Railways.
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Mitchel-Vance Co.

Electroliers and Combination Fixtures.—Continued.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
American Electrical Works.
Ansonia Brass & Copper Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Mitchell-Vance Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.

Lamps, Incandescent—Contd.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

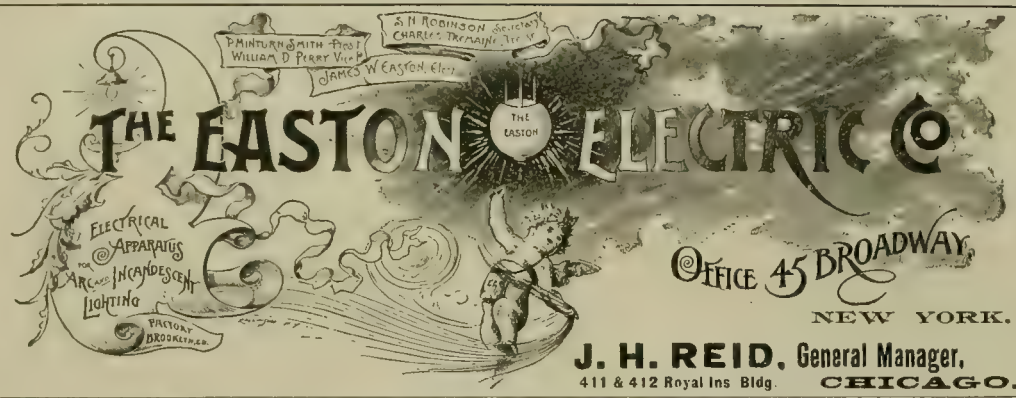
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

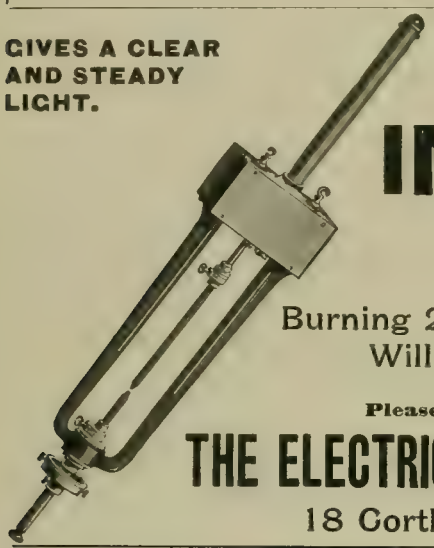
ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

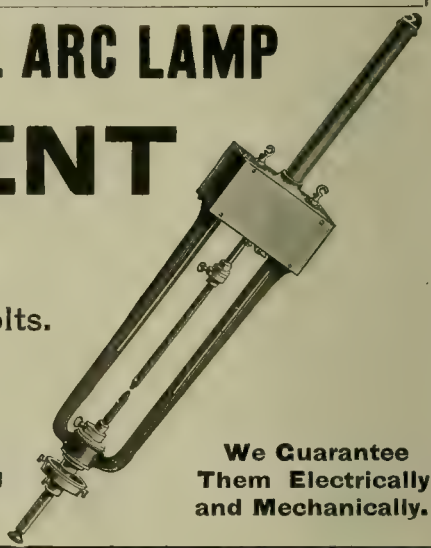


J. H. REID, General Manager,
411 & 412 Royal Ins. Bldg. CHICAGO.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.





Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE.

SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

—o(FOR)o— TELEPHONE ONE DOES THE WORK FOR LONG OR SHORT DISTANCE

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

THE HAWKEYE ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station AND ISOLATED PLANTS, ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the *Renowned Perkins Incandescent Lamps*, Famous for long life without discoloration.

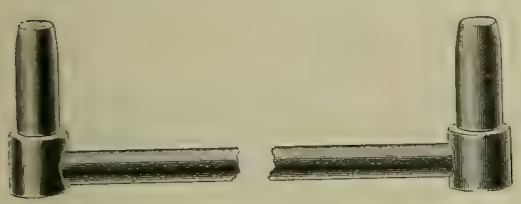
ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192 FIFTH AVE., CHICAGO.

Makers of the Choicest Electrical Supplies.

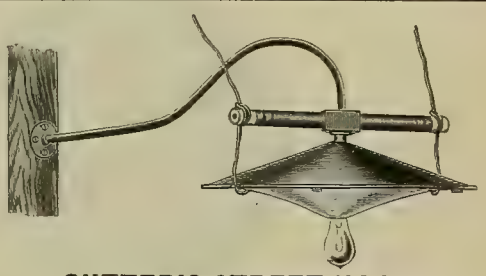


ALL COPPER RAIL BOND.

THE WIRE FOR
Thoroughly Weatherproof
CIRCUITS.

SIMPLEX

THE WIRE FOR
All Mining Work.



CUTTER'S STREET HOOD.

ELECTRIC HOUSE GOODS:

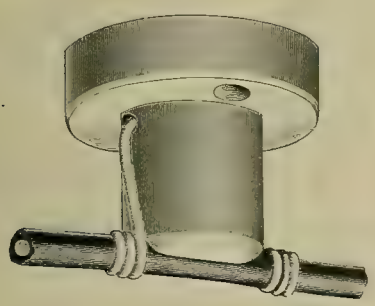
Full Line of Gas Lighting Apparatus.
New District Telegraph Apparatus.
New Designs of Push Buttons.

THE NEATEST AND MOST UNIQUE SWITCH MADE.

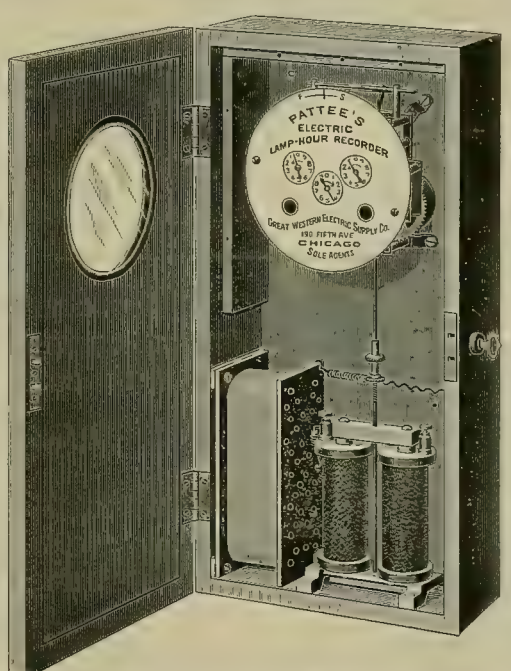
OUR ELECTRIC SPECIALTIES,

STEADILY GROWING IN NUMBER
AND IN PUBLIC FAVOR,
ARE DESCRIBED IN

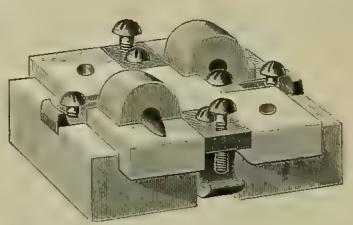
OUR SPECIAL CIRCULARS.



CUTTER'S E. L. PORCELAIN INSULATOR.



PATTEE'S LAMP-HOUR RECORDER.

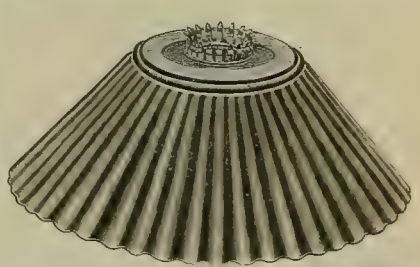


PORCELAIN BRANCH CUT-OUT.

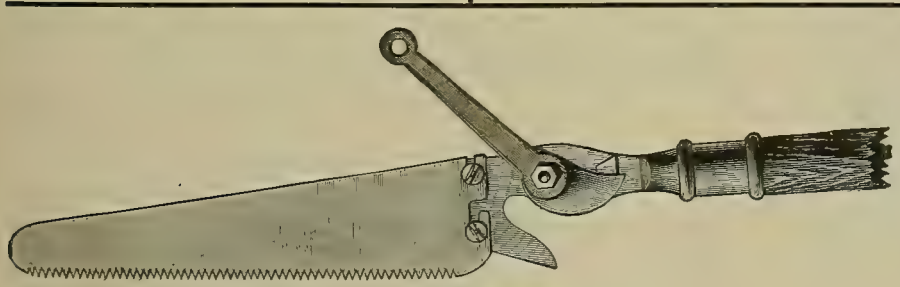
NEW MAKE OF ARMATURE PINIONS.

NEW DESIGN OF POLE TOP,
POLES AND INSULATORS

A FULL LINE OF
ELECTRIC RAILWAY SUPPLIES.



COMBINATION CONE SHADE.



COMBINATION TREE TRIMMER.

ELK HEAD ELECTROLIERS. MANY NOVEL DESIGNS.

ELECTRIC FIXTURES.

MOTOR CAR FIXTURES. SEND FOR CUTS.

W-A-T-C-H-E-S.

The World's Exposition in Paris, 1889, awarded a prize medal to The Giles Anti-Magnetic Shield for watches. It has been proven to be the best practical and permanent solution to the trouble electricians have with their watches.

The shield can be applied to any watch, or is furnished in new watches by

GILES BROS., - CHICAGO.

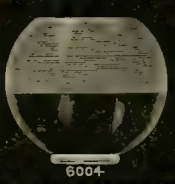
TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

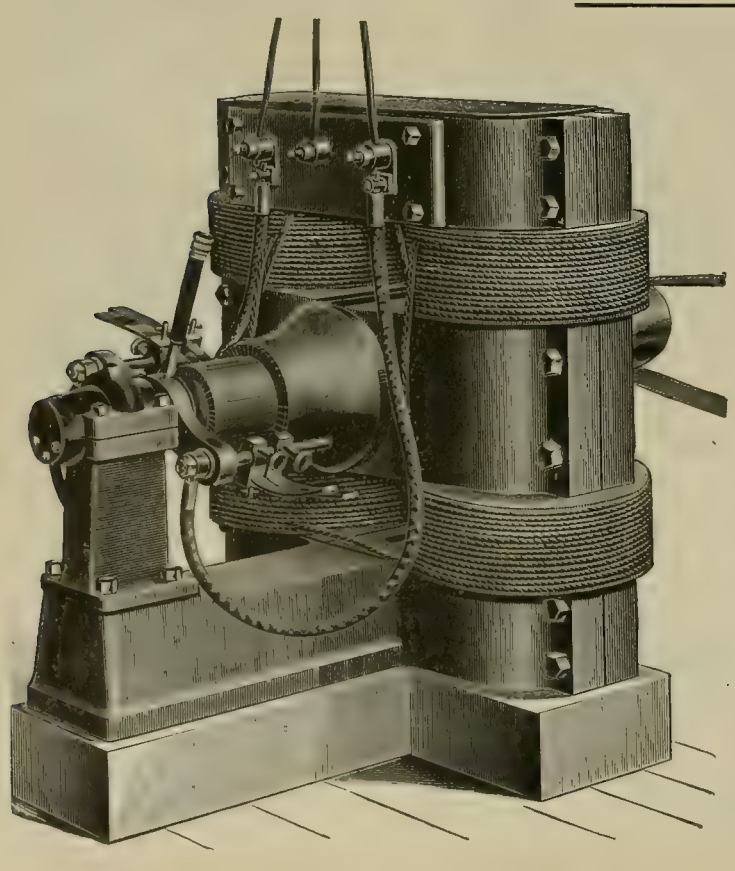
THE LECLANCHE BATTERY CO.,

149 West 18th Street, - - NEW YORK.

PHŒNIX GLASS CO
OF PITTSBURGH, PA.
MANUFACTURERS OF A FULL LINE OF
ELECTRIC LIGHT
GLOBES  SHADES
BOTH ARC AND INCANDESCENT.
RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.
ADAPTED TO ALL SYSTEMS.
729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

FOREE BAIN,

ELECTRICAL EXPERT AND MANUFACTURER.



I have more Electric Motors in Practical Operation in Coal Mines than all other manufacturers combined. They aggregate over

350 H. P. to Date.

These installations are not experimental—the Motors are in actual service cutting coal; some of them have been working

20 Hours Per Day

for more than one year, and during this time not one of them has required repairing.

NO SHORT CIRCUITS.
NO BURN-OUTS.

I have secured patents on a full and complete system of Mining by Electricity. Contracts solicited.

84 Market St., - CHICAGO.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

EDISON GENERAL ELECTRIC CO.,

EDISON BUILDING, Broad St., NEW YORK CITY.

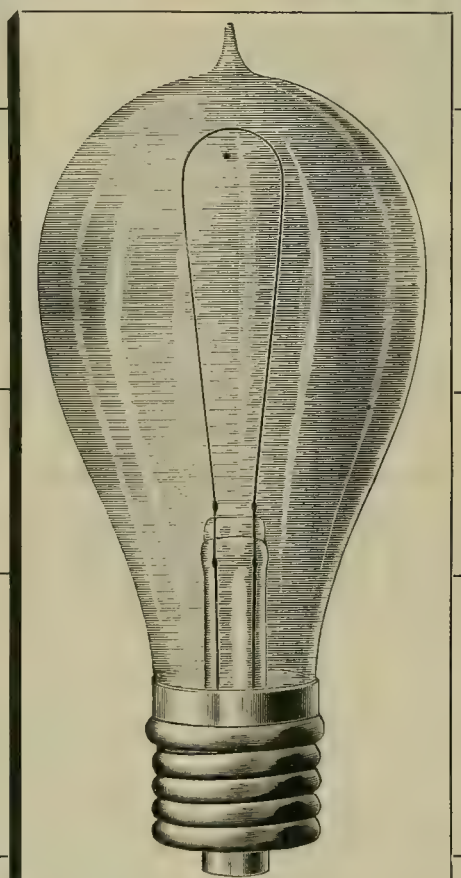
MANUFACTURERS AND CONTRACTORS.

INCANDESCENT, ARC AND ELECTRIC POWER PLANTS OF ALL DESCRIPTIONS AND SIZES, DYNAMOS, INCANDESCENT AND ARC LAMPS, FOR

ELECTRIC LIGHTING.

EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.



The Edison Incandescent Lamp.

No. 2.
No. 2 is the Thomson-Houston.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No. 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

DISTRICT OFFICES:

NEW YORK, Edison Building.

CHICAGO, Rialto Building.
DENVER, COLO., Masonic Building.
NEW ORLEANS, Cotton Exchange.
SAN FRANCISCO, 112 Bush St.
PORTLAND, ORE., Fleischner Building.
TORONTO, CAN., Bank of Commerce Building.

☞ Please address all communication to nearest District Office. ☜

FACTORIES:—New York City. Schenectady, N. Y. Harrison, N. J. Hamilton, Ontario. Sherbrooke, Quebec.

Cleverly
1018 CHESTNUT ST., PHILA.

Cleverly
1018 CHESTNUT ST., PHILA.

Electric Specialties to Contract.

General Electrical Supplies.

Cleverly
1018 CHESTNUT ST., PHILA.

I WAS AT THE
CAPE MAY CONVENTION!
"'TIS PITY 'TIS TRUE!"

Cleverly
1018 CHESTNUT ST., PHILA.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

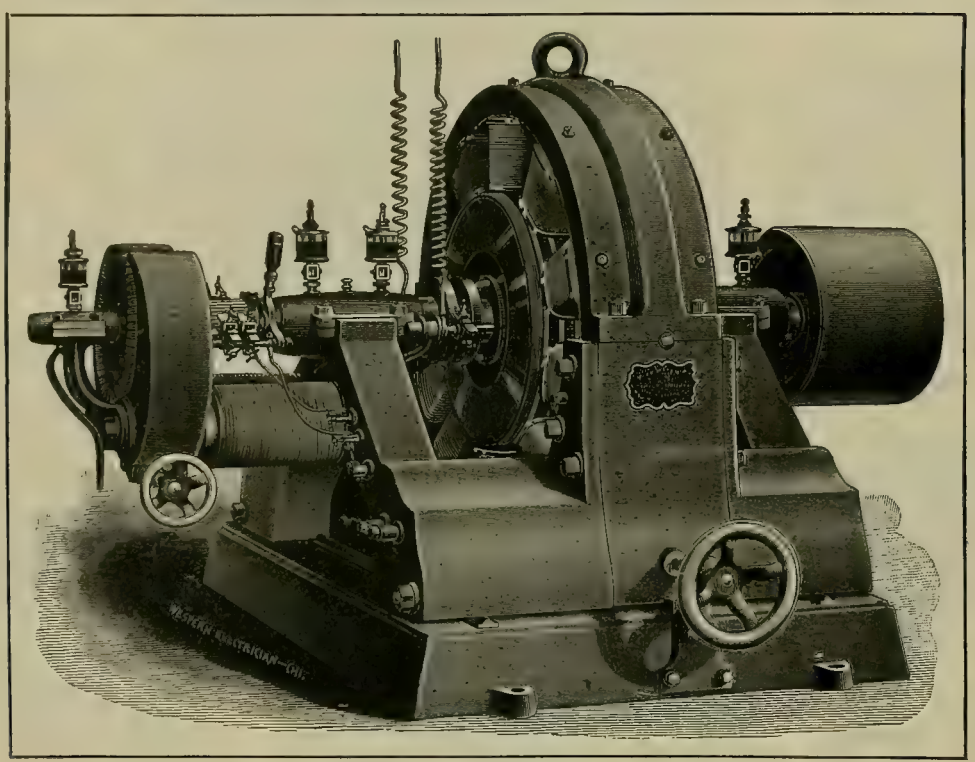
WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BEST OF ALL

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



SELF-CONTAINED ALTERNATING CURRENT DYNAMO—CAPACITY, 500 16-CANDLE-POWER LAMPS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

WE GUARANTEE ITS OPERATION, AND

DEFEND OUR CUSTOMERS.

We are Prepared to Undertake the Construction of Electrical Plants of Whatever Magnitude.

CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.,

EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., Seattle, Washington.
THOMAS WOLFE, Southwestern Agent, Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts., 141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts., 1517 Larimer St., Denver, Colo.
CHAS. M. BLANCHARD, Agent, Girard Building, Philadelphia, Pa.
L. N. COX, Agent, 16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agent, Room 12 Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts., 531 Wood St., Pittsburgh, Pa.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., History Building, 723 Market St., San Francisco, Cal.
SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Agents, Winnipeg, Manitoba.
A. IRVINE, Agent, Emelie Building, St. Louis, Mo.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD WILKINS
— TRADING AS —

PARTRICK & CARTER,

Manufacturers of and Dealers in Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE
NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

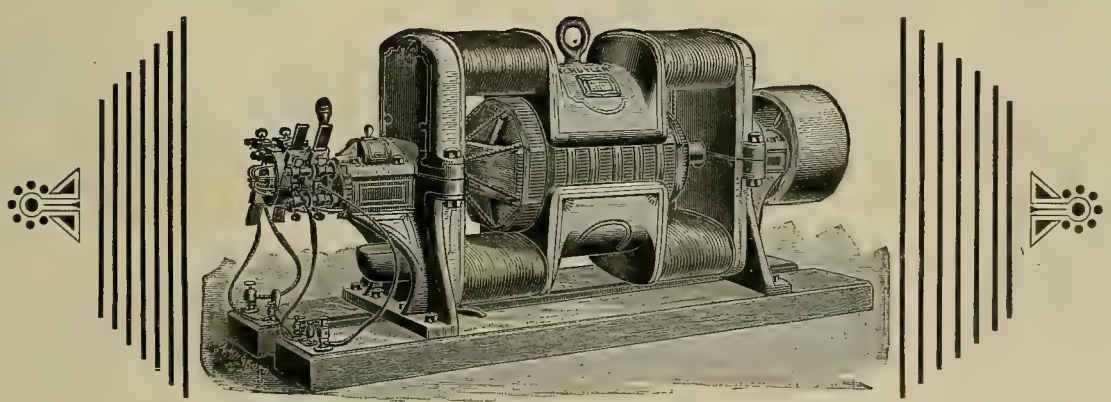
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction. Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices. Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

C. B. HOLMES, Pres't. & Genl. Mgr. G. W. GRIFFIN, Superintendent of Construction. WM. C. NICHOLS, Secretary & Treasurer.

The Hazelton Tripod Boiler

Is the quickest generator of steam,
Needs less repairs than any other, and
Is the most economical boiler in use.

ADDRESS

HAZELTON TRIPOD BOILER CO.,

170 TWENTY SECOND ST., CHICAGO, ILL.

OHIO STATE UNIVERSITY,

COLUMBUS, OHIO.

Civil, Mechanical, Mining and Electrical Engineering. SEND FOR INFORMATION.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

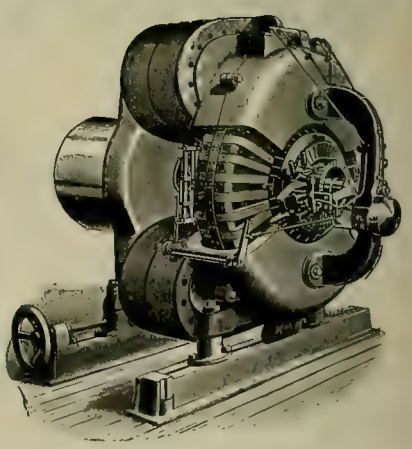
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)

MANUFACTURERS OF

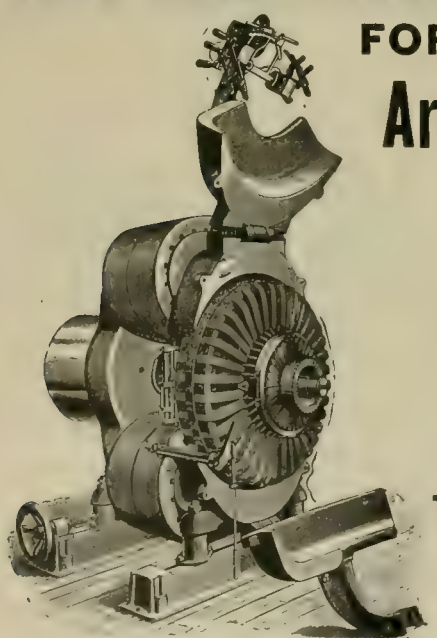
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED, HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE: No. 425, THE ROOKERY, CHICAGO, ILL.

NEW YORK OFFICE: 115 BROADWAY, NEW YORK.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Co.

OKONITE TRADE MARK.

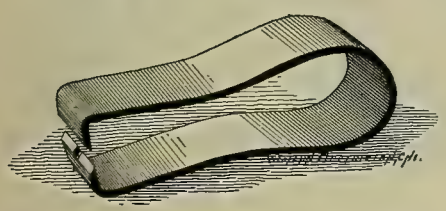
GENERAL WESTERN AGENTS FOR

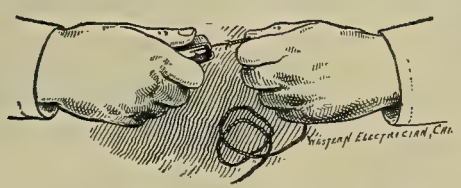
OKONITE AND CANDEE WIRES.

The Central Spark Arrester

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting to the globe.

THE PERRY WIRE PEELER.



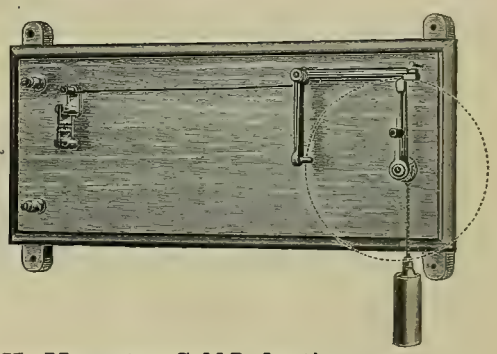


This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs.
Cleveland Switches, Paiste Switches, Branch Blocks,
And all kinds of Electrical Supplies.

THE HOT WIRE Lightning Arrester.



No Magnet or Self-Induction.
Furnishes Absolute Protection,
And is Automatic in its Action.

OUR PRICE ON THESE INSTRUMENTS IS VERY LOW.

ANTI-MAGNETIC WATCHES.

We have completed arrangements with the Electricians' Time Company by which we are enabled to offer to Electrical men a thoroughly first-class watch, absolutely protected from magnetic influence, and at a very low price. Each watch is accompanied by a guarantee, stating first what it is, and in cases where desired, payments are made easy. Send for a descriptive circular.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

A-L-E-X-I-T-E

The New

INSULATING MATERIAL.

WATER
ACID - -
FIRE - - **PROOF**

Can be Made in any Color

TO MATCH

Wood, Marble, Etc.

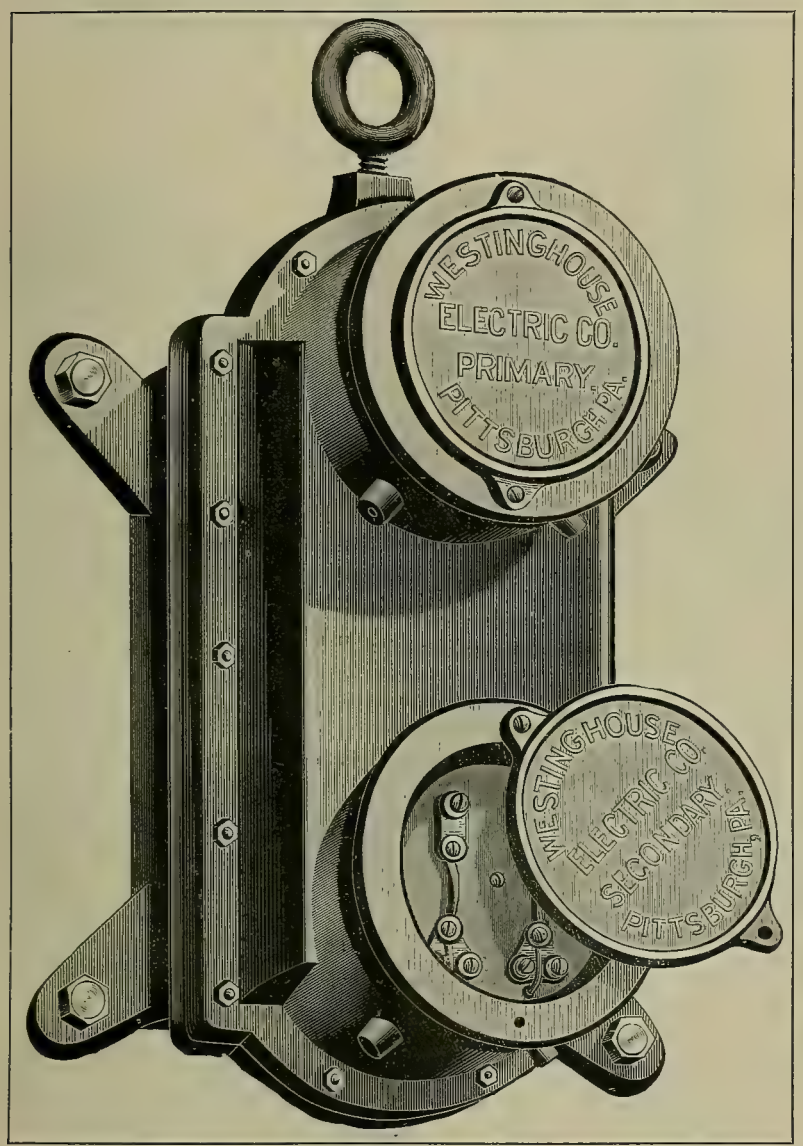
SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street,

NEW YORK.

CONVERTER EFFICIENCIES.

It Will Pay You to Throw Out Your Present Converters and Substitute Our Make.



COMPARISON OF CONVERTERS.

	Total Efficiency.	Converter Capacity Tested.
Thomson-Houston,	87.50 Per cent.	25.
Ft. Wayne Jenney,	87.	25.
National,	88.	20.
WESTINGHOUSE.	95.	20.

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

Incandescent Alternating Current Dynamos, Converters, Meters, Motors.

325 Central Stations and 600,000 Lamps.

Alternating Current Arc Lighting Apparatus.

Lamps burn 40 hours without renewal of carbon.

Arc Lighting revolutionized.

Send for Special Circular.

55 PLANTS, AND 5000 LAMPS SOLD WITHIN A FEW MONTHS.

CORRESPONDENCE SOLICITED.

WESTINGHOUSE ELECTRIC & MFG. COMPANY,

PITTSBURGH, PA., U. S. A.

BOSTON, NEW YORK, CHICAGO, CINCINNATI,
ST. LOUIS, SAN FRANCISCO, PORTLAND.

BURNLEY DRY BATTERY

PATENTED January, 1890.

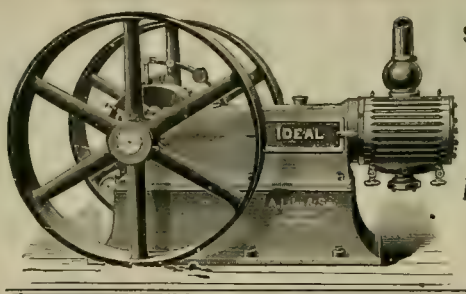
STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:—Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. **76 Cortlandt St., N.Y.**

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,

32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

Messrs. Hazazer & Stanley.

GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

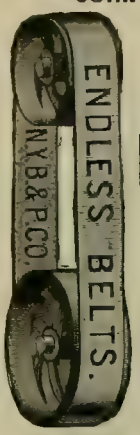
Yours truly, *CHAS. E. GOODRICH, Electrician, 503 Eighth Avenue.*

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTH, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 156 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1312 and 1313 W. 12th St.

IT KNOCKS THEM ALL!

BISHOP RUBBER COVERED WIRES.
BALATA INSULATED DROP CORD.

Prof. Henry Morton says: "These wires showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas."

THE "BISHOP"
Always Leads the Procession.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, - 341 ROOKERY BUILDING, CHICAGO.

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.
Edw. H. Johnson, President.

THE
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co.

MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

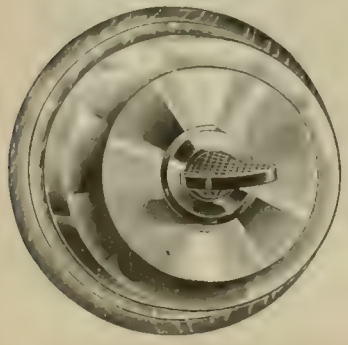
PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH

FOR INCANDESCENT WORK



Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,
12th and Market Sts.,
Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

GET THE BEST!

P. & B. INSULATING COMPOUNDS,
ARMATURE VARNISH,
INSULATING TAPE.
INSULATING PAPERS,
MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

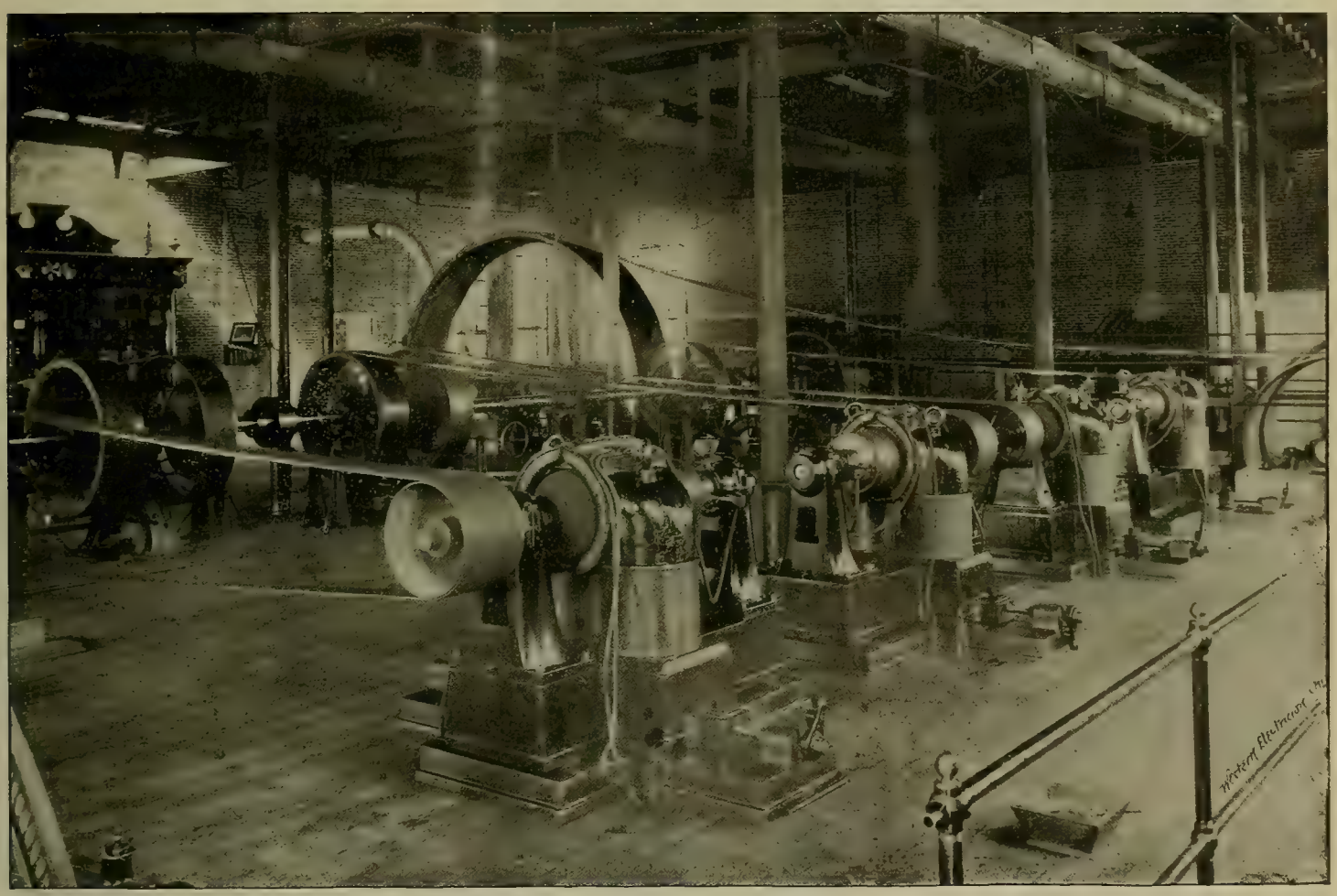
EVERY SATURDAY.

Vol. VII. CHICAGO, SEPTEMBER 6, 1890. No. 10

Union Depot Street Railway, St. Louis.

The accompanying cuts show the interior of the power station and the switch-board of the Union Depot line at St. Louis, Mo. This road is equipped with the Thomson-Houston electric railway system. The company is operating 16 miles of double track, and 35 motor cars. Each motor car is equipped with two 15-horse power railway motors, and draws a trail car. The power station is equipped with eight 80-horse power generators of a total capacity of 500,000 watts. Two 250-horse power Corliss engines furnish power. The engines drive a main shaft running the length of station, and each generator is connected to the shafting by leather belting. The shafting is arranged with clutches so that any one of the generators can be thrown out or into use. The switch-board, shown in the engraving on the next page, is an elegant affair, built of cherry with heavily carved posts and ornamental top. Mounted upon it are the rheostats, lightning arresters, switches, current indicators and circuit breakers, for each generator, together with two potential boards and voltmeters arranged for taking readings upon one or all of the generators. At the top of the board are arranged three clusters of five lamps each in the form of a star, together with a clock and steam gauge. The conductors leading from the generators to the switch-board are all laid beneath the floor. The cables are hung on brackets in a specially designed conduit. The road has been in operation since April 10th without the slightest trouble or delay, and cars are at all times carrying heavy loads. It is understood that the management of this road is so well pleased with its successful operation that it has placed additional orders with the Thomson-Houston Electric company for seven and a half miles of overhead and double track equipment and 25 cars, each to be equipped with 2 15-horse power railway motors. Six 80-horse power dynamos have also been ordered, together with 3 snow sweepers. The overhead work on this line consists of heavy round iron poles with a No. O hard drawn copper wire suspended over each track by the latest improved form of insulators. The track is built of the 54 pound Wharton rail supported on chairs and cross ties, and the roadbed is well ballasted. This road has a number of difficult curves and heavy grades; but, notwithstanding, remarkably fast time is made over it.

In addition to this system the Thomson-Houston company has equipped the St. Louis and East St. Louis Electric Railway company's line, and 6 motor cars on 2 miles of track are being operated satisfactorily. The same company also has under contract and is now equipping the Missouri Railway company's line in St. Louis, Mo. This road has 16 miles of track, 36 motor cars each equipped with 2 15-horse power railway motors, 2 electric snow sweepers and 5 generators of 100-horse power each. The Southern Railway company's road, of the same city, which is also being equipped, has 17 miles of track, 26 motor cars each furnished with 2 15-horse power railway motors and 4 80-horse power dynamos. In the course of a few weeks all these roads will be completed, and the Thomson-Houston Electric company will then have in the vicinity of 150 cars equipped with its apparatus in operation in St. Louis.



UNION DEPOT STREET RAILWAY, ST. LOUIS—GENERATOR ROOM.

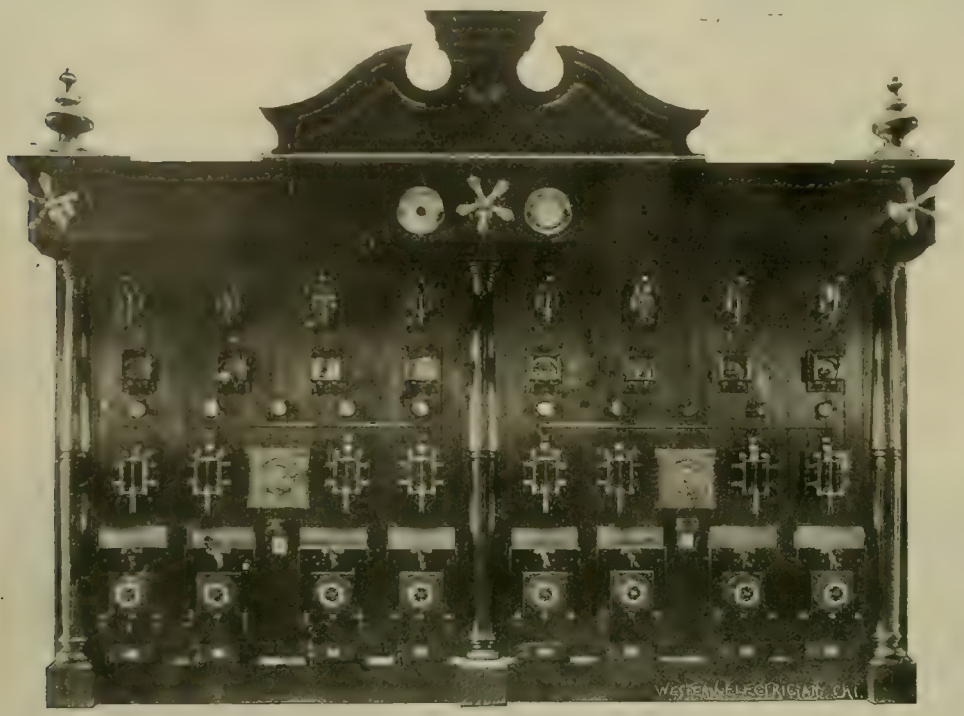
Chicago & Jefferson Urban Transit Company.

The Chicago & Jefferson Urban Transit company has been incorporated to operate electric street railways in Chicago and its suburbs. The capital stock is fixed at $1,000,000, and the incorporators are John Johnston, Jr., Henry Vannatta, Frank H. Dickey, Frank H. Baker, Thos. P. Keefe, Charles B. Hosmer, and Edward D. Hosmer. Mr. Hosmer said the company would start work within a few weeks. It is proposed to run a line of cars through the towns of Almira, Hermosa, Cragin, and Galewood, beginning at North and Arlington avenues, Chicago; also a line on Grand avenue, running northwest to the end of the old city limits.

The Capital City Railway company of Frankfort, Ky. has been formed by Fayette Hewitt, P. McDonald and J. W. Pruett, to construct electric street railways.

Electric Power for the Davenport & Rock Island Street Railway.

The Davenport & Rock Island street railway is to be equipped with electric power. On the 23d ult., F. W. Horne of the Thomson-Houston railway department closed the contract for the electrical apparatus with C. B. Holmes, representing the Holmes syndicate. It will be remembered this syndicate about a year and a half ago purchased the street railroads in Davenport, Rock Island and in Moline, and has since operated them by means of horse power, and on a portion of the road by steam dummy. The entire contract amounts to about $350,000. The equipment is for 28 miles of single track, and 5 miles of double track road. There are 53 curves and 37 turn-outs. Sixteen cars are to be fitted each with two 15-horse power motors. These are to run on streets the grade of which is 7 to 10 per cent. or over. Thirty-five cars will be fitted with single 20-horse power motors and these will run on all grades under 7 per cent. The power station for the system will be located in Rock Island, and the feeder wires will be carried across the government bridge, which together with another short bridge, is about 2,100 feet long. At the drawbridge the wires will be supported on towers. The engines in the power station will be either two 350-horse power Corliss, or seven 125-horse power high speed engines. Engines of the compound condensing type will be used. The McGuire truck has been specified by Mr. Holmes, and the St. Louis car company is to be awarded the contract to build the 51 cars.



UNION DEPOT STREET RAILWAY, ST. LOUIS—SWITCH BOARD.

Electric Roads and the Census.

A recent dispatch from Washington announces that the superintendent of the census has issued a bulletin containing interesting figures about the street railways in fifty-six cities having a population of 50,000 each or over. The motive power of the principal cities is thus summarized: Animal, 2,351 miles; electricity, 260; cable, 255; steam (elevated), 61; steam (surface), 221. These figures may surprise many persons who do not realize the true state of affairs, and it may be said, that they are misleading in a certain sense, though they may be true. Thus, while it is probable that the cities included in the list represent nearly every cable line in the country, it does not begin to show the cities and towns enjoying the electric system. But this fact suggests another equally important: It would be impossible to operate an extensive cable system in a city of less than 50,000 inhabitants, or even in a city of that population, except under the most favorable circumstances without great loss, while on the other hand substantial proof may be found that electric lines equipped with the latest appliances may be operated with success in cities of not only 50,000 inhabitants, but even 5,000 or less. The electric system is applicable to small towns as well as large cities, and when the next census is taken, the list of cities possessing electric roads will include nearly every municipality in the land.

It might be interesting in this connection to present figures, not official, but reliable nevertheless, which bear on this point. Private inquiry some time ago elicited the fact that there were in this country and Canada about 9,000 miles of street railroads, of which 5,902½ miles were still operated by horses, while 1,753 were converted into electric lines, and 441 were using cable. This does not include roads now in course of construction nor projected lines, but only roads in actual operation on which electricity had been adopted for propulsion. A comparison of the number of companies using electricity with those operating by cable is also interesting, inasmuch as there are 264 of the former and 44 of the latter. These figures were prepared, not for an electrical journal nor at the suggestion of electrical companies, but by thoroughly disinterested persons. The figures speak volumes of praise for the electrical system.

New Telephone Company at Chicago.

The Subscribers' Telephone & Service company of Chicago, has been organized by J. S. Jacobus, T. N. Jamieson and C. S. Hallberg, with a capital stock of $1,000,000. This company proposes to furnish telephones at $75 per year. It is said that the druggists who have opposed the Chicago Telephone company will support the new corporation but many of the leaders of that movement have refused to take any action in the controversy. The promoters of the new company refuse to divulge their plans, and it is not yet known whether the new company proposes to adopt a "new" system or wait until the expiration of the Bell company's patents. According to the daily papers, aldermen representing the annexed districts will assist the new company's project, and one of them has been quoted as saying that an ordinance will be introduced in the Chicago city council providing for a reduction of the rates now charged by the telephone company.

The River & Rail Electric Light Co.

In a previous issue of the WESTERN ELECTRICIAN there was presented a description of the battery and machinery employed by the River & Rail Electric Light company of New York in its storage car recently placed in operation on the dummy road in South Brooklyn. The River & Rail company, it will be remembered, is exploiting an accumulator and motor which are the invention of Prof. Wm. Main. The accompanying illustrations will prove of especial interest to those who are watching the progress of storage battery work.

Figs. 1 and 2 are views of the exhibition room of the company at 45 Broadway, New York. As will be readily noticed from the cuts, this apartment is tastefully fitted out and all the apparatus is most conveniently arranged for exhibition. The four cells shown to the right in Fig. 1 are of the type employed in street car work, and the eighteen cells above on the table are medical batteries. These cells each give an e. m. f. of 2½ volts, and are connected so as to be thrown on or off the different groups of incandescent lamps on the walls. There are also connections for the physicians' lamps, motors, cautery instruments, etc., on the table. The motor driving the large fan, it may be mentioned, is ¾-horse power, and the larger of the two, a

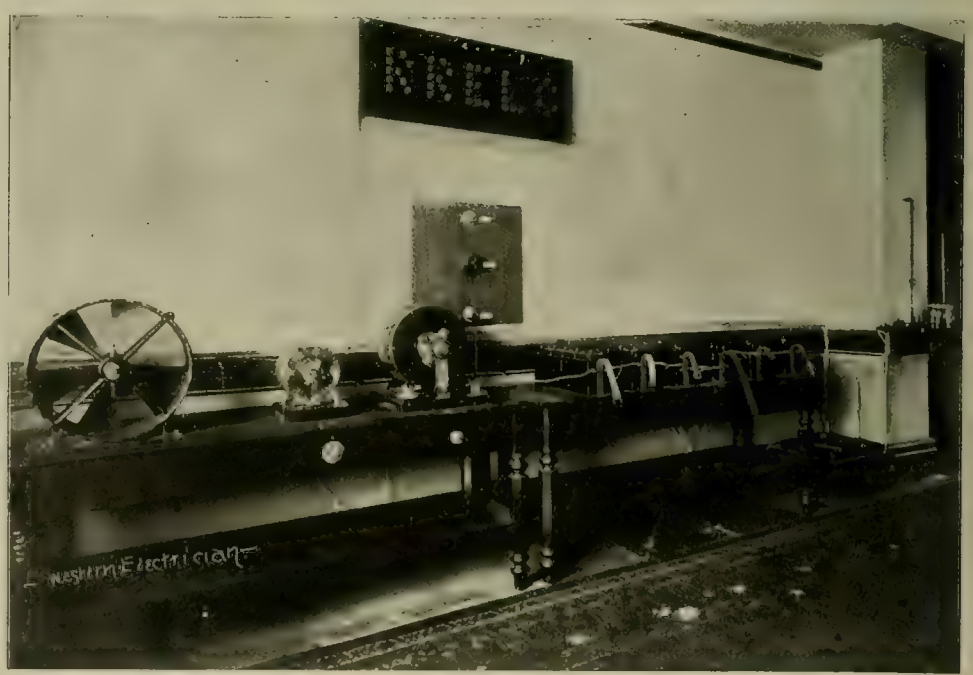


FIG. 1. THE RIVER AND RAIL ELECTRIC LIGHT COMPANY—EXHIBITION ROOM.

3-horse power machine, is of the same type as the street car motors. Figs. 3 and 4 represent respectively the surgeon's headlight and case of medical batteries exploited by the company. The lamp used in the lantern is of 4-candle power.

Edison Companies' Convention at Minneapolis.

The arrangements for the annual convention of the association of Edison Illuminating companies at Minneapolis, September 16th, promise the most interesting and instructive meeting in the history of that organization, and it is probable that the attendance will be far larger than at former conventions. This is due not only to the fact that the Edison interests are spreading, but to the announcement that Mr. Edison will be present, and also to the fact that the convention will be in session during the Minneapolis Exposition, the principal feature of which will be the Edison exhibit—the master and his works will both be seen. The Edison exhibit will be in the main, a reproduction of the display at the Lenox Lyceum and the Paris Exposition, but will be even more elaborate than these. The exhibitors will profit by their experience, and make the Minneapolis display the crowning feature of the exposition.

Special trains for the accommodation of delegates and their friends will be run from New York and Chicago. During the convention papers will be read and discussions engaged in, on the following topics: Lightning Protection, Results of Experiments; Insurance of Edison Central Stations; A National Code of Insurance Rules; Edison Patent Litigation; Central Station Steam Piping; Re-organization of Edison Interests; Grounding the Neutral Wire in Three-Wire Systems.

The present officers of the association are: President, John I. Beggs; vice-president, C. P. Gilbert; secretary, W. J. Jenks; treasurer, Wilson S. Howell; executive committee, A. L. Smith, Appleton, Wis.; C. L. Edgar, Boston, Mass.; Thos. P. Merritt, Reading, Pa.; E. R. Weeks, Kansas City, Mo.; C. J. Field, Brooklyn, N. Y.; J. I. Beggs, Chicago, Ill.

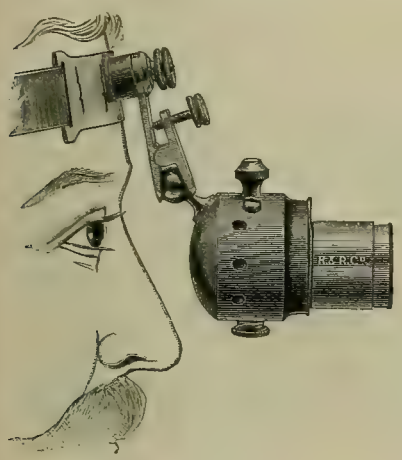
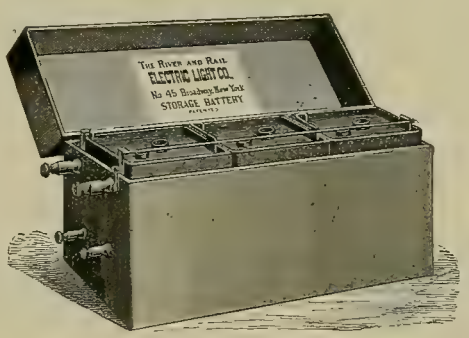


FIG. 3. SURGEON'S HEADLIGHT.



RIVER & RAIL ELECTRIC LIGHT COMPANY. FIG. 4. MEDICAL BATTERY.

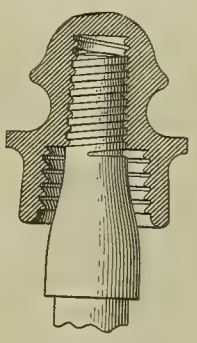
Electric Light Plant in McVicker's Theater, Chicago.

The fire at McVicker's theater, Chicago, last week possesses a peculiar interest for the old-timers in electric lighting, for it destroyed the first plant used for illuminating a theater in Chicago, if indeed not in the country. Incandescent electric lighting was in its infancy when the plant was installed and it appeared a great undertaking to light a theater by the new means, but so firm was Mr. McVicker in his faith in the improved method that he had his gas supply cut off the moment the plant was ready, and he never had cause to regret it. As a result he is even more convinced, if such a thing were possible, in electric lighting, and when his theater is rebuilt it will be supplied with the finest electrical plant in the country. The experience which Mr. McVicker has had with his plant has proved valuable to his brother managers. When the original plant was installed it was rather a crude affair and one cannot help admiring the confidence displayed by Mr. McVicker in depending entirely on this improvement. From time to time the plant was improved, modern appliances added, and it continued to give satisfaction. In providing for his new house Mr. McVicker will take advantage of his own experience and that which his brother managers have had in this line, and by combining them he hopes to be able to secure the finest electric light plant for theatrical purposes in the country.

FIG. 2. RIVER & RAIL ELECTRIC LIGHT COMPANY—EXHIBITION ROOM.

Insulator.

The cut shows a form of insulator designed as an improvement over the ordinary glass petticoat form. The illustration explains itself. The interior surface has upon it annular projections forming grooves. The upper sides of these grooves are inclined, but their under sides are nearly or quite horizontal. By this construction not only is the surface distance from the pin to the conducting wire increased, but the interior of the "petticoat" is much better protected from moisture by means of the ridges. These ridges protect the grooves, and thus keep at least a part of the surface dry, a consideration of great importance in insulation.



INSULATOR.

This insulator has recently been patented by Samuel Oakman of Melrose, Mass.

English Constant Current Dynamos.

The chief feature of the dynamos illustrated in the cuts is the method of regulating the electromotive force. These machines which were recently brought out in England by O. Firth, were designed with a view of rendering them specially available for arc lighting, electrodeposition, etc., where a variation of current is required. Regulation is accomplished by drawing the field magnets away from the armature, thus causing the e. m. f. at the terminals of the dynamos to fall. The regulator is worked by hand. Fig. 2 represents a type of machine made to supply the demand for a low-priced dynamo. It will be noticed that both machines are provided with three bearings. The cuts are reproduced from *Industries*.

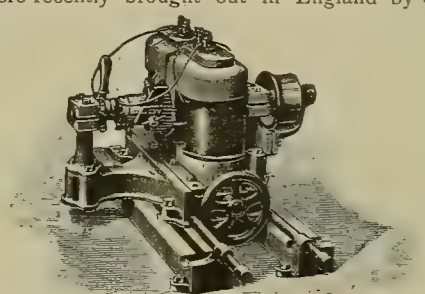


FIG. 1. ENGLISH CONSTANT CURRENT DYNAMOS.

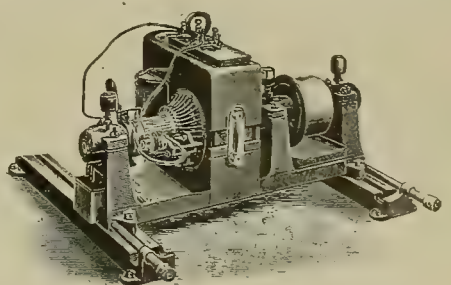


FIG. 2. ENGLISH CONSTANT CURRENT DYNAMOS.

The Westinghouse company has been awarded the contract for an electric light plant in the factory of the Central City Guano company at Macon, Ga.

Mercury Circuit Breaker.

In *Cosmos* is described a new mercury circuit maker and breaker, two forms of which are shown in the cuts. The French papers are inclined to think that these little devices may be used to great advantage. It would seem, however, that a simple form of switch of sheet metal under all ordinary circumstances, would better answer the purpose, though in laboratory work it may be possible that the use of the more complicated form might, under certain conditions, be found advantageous.

In Fig. 1 is shown the simple form of the circuit breaker. A curved tube of glass which is closed, contains at one end a bead of mercury *H*. The wires are sealed in at P. By tilting the tube, when it is properly supported, the mercury flows away from the wires and the circuit is instantly broken.

In Fig. 2 is shown the form in which wires are sealed at each end. By tilting the tube the

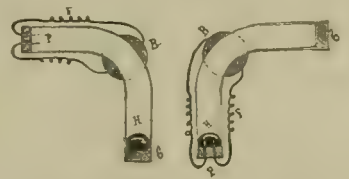


FIG. 1. MERCURY CIRCUIT BREAKER.

circuit leading from one electric source can be broken, and as the mercury falls to the other end of the glass it makes contact with the terminals of the other circuit. In Fig. 3 two views of the device arranged with a crank for tilting the tube, are presented. To prevent oxidation of the mercury the tubes, before sealing, are filled with nitrogen gas.

Development of Electrical Interests in Australia.

Electrical engineers and manufacturers of electrical apparatus of all kinds are giving considerable attention to the development of electrical interests in Australia, and many of these have already introduced their specialties in that market. Several American concerns have representatives in the larger cities and towns, and one of these—a Chicago house—recently received a large order, including telegraph and telephone apparatus and signal and alarm devices.

In the WESTERN ELECTRICIAN of August 24, 1889, an article by Charles Flesch was presented, showing the possibilities in Australia for electric lighting and motor companies. Since that time several articles of a similar character have been presented. Through the courtesy of Mr. Flesch, the WESTERN ELECTRICIAN is enabled to present additional information on the recent progress in electric lighting, etc., in Australia. A "tramway" company, after subjecting the electric system to a severe test for six months, has ordered additional electrical apparatus for the

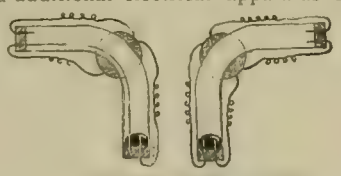


FIG. 2. MERCURY CIRCUIT BREAKER.

equipment of the line. A class in electrical engineering has been organized at the Working Men's college of Victoria, under the direction of a competent instructor. There are about 90 students at present. The course of study contemplated will include every branch of electrical science, and will be supplemented by practical work in the manufacture of devices and in the construction and operation of plants. The Hobart, Tasmania, city council has "confirmed the desirability of lighting the city by electricity," and a bill providing for the improvement has been ordered. An electric search light has been introduced at Hobart. It is operated by a Westinghouse dynamo.

The greatest advance in electric lighting has been made at Melbourne. The first public display of electric lighting in that city was on the marriage day of the Prince of Wales in 1863, and consisted of three arc lamps erected by the government at the postoffice, the old telegraph office, and at Parliament House. The supply of electricity was generated by chemical batteries of the Cullen type, a group being required for each lamp. Inasmuch as this system was far from being successful commercially, nothing was done until 1878, when two arc dynamos and lamps were received from London and placed on exhibition. It was not, however, until 1880 that an attempt was made to organize a company to manufacture electric and power machines. Then the Victoria Electric company was formed, which in November, 1881, was changed to the Australian Electric company with increased capital. In 1882 incandescent lamps were first exhibited at Athenæum hall, Melbourne, where they made a favorable impression. The Opera House company immediately put in 120 20 candle power lamps for trial, and soon increased the number to 600, dispensing entirely with gas. This was the beginning. Orders were secured so rapidly that the company had scarcely become well settled in its station when the original plant of 1,500 lamps had to be enlarged. At the outset the difficulties attending transmission of electric power with extremely low tension were apparent, and the company was obliged to confine its operations to a limited territory. About this time two rival companies, backed by English capitalists, appeared in the field, but the original company maintained its position and reaped the reward of the labors of its competitors. Street lighting was begun at this time, 16 arc lamps of the Brush type being employed. They proved successful, but the increased cost of lighting the streets by the new system made the city council hesitate about adopting the plan, and although it had popular approval, the project was permitted to expire.

There was a gradual increase in the incandescent plant from 1884 until 1888, when Ganz & Co. introduced their transformer system and installed a 3,000 light plant. Once more there was a boom in electric lighting, and it has not yet ceased. Owing to the growing demands of

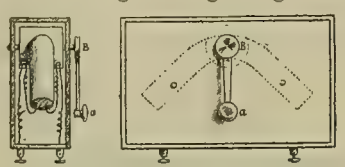


FIG. 3. MERCURY CIRCUIT BREAKER.

the company, it was found necessary to increase the capital stock to £250,000, and at the same time the company was reorganized under the name of the New Australian Electric Light company. The new company purchased a piece of land near South Yarra, and is now erecting a new plant, which it is intended to ultimately extend to 100,000 incandescent lights, and as many arcs as may be wanted. The specifications for the new station have been prepared so that the extension of the system may be made without materially altering the original plans of the company. There is a bright future for this company unless present indications are sadly misleading. At the last stockholders' meeting a 10 per cent. dividend was declared.

The New Australian company and its progenitors were not without rivalry, however. Numerous companies have competed for public favor, and some of these have promised to prove formidable rivals. The Union Electric company and the A. W. Alcock Electric Light & Motive Power company, limited, are now operating stations in Melbourne, but their combined capacity is only about 5,000 incandescent lamps. Never before, however, has there been so much interest displayed in electrical matters. Not only in Melbourne, but in many other cities and large towns, electric lighting and electric railway companies are projected, and all give promise of prospering.

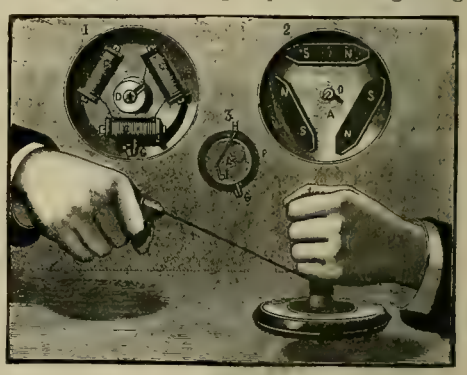
Reunion of Telegraphers.

The Old Time Telegraphers Society and the society of the United States Military Telegraph Corps, will hold their reunion at the Centropolis hotel, Kansas City, Sept. 15th and 16th. The first named organization will hold its annual business meeting on Sept. 15th, and the latter on Sept. 16th. The following named gentlemen have been appointed a committee of arrangements, which is a sufficient guarantee that the wants of the members and their friends will be anticipated and provided for: Day K. Smith, J. D. Cruise, H. C. Sprague; W. W. Smith, E. G. Fish, E. R. Weeks, G. M. Myers, M. D. Wood, I. C. Hubbell, F. K. Holtzinger.

Attention is called to the fact that members should, on purchasing railroad tickets, secure a certificate from the local ticket agent. In case there are 10 persons present at the meeting each will be given a certificate entitling him to return on one third fare. An invitation is extended to all old timers who were in the service before 1865, to attend the reunion, and all who were engaged in government service during the war, whether members of the association or not.

An Electric Top.

A writer in *La Nature* is responsible for the statement that nothing has appealed to the ingenuity and fancy of inventors more than the top. He proceeds to enumerate a vast number of curious toys of this kind, which have been designed and then describes the electric top shown in the cut. The little toy in appearance and in operation is not materially different from the ordinary humming top. The engraving

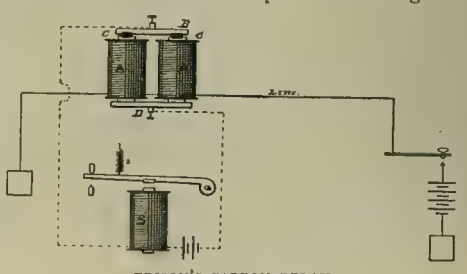


ELECTRIC TOP.

first shows the simple mode of spinning the top. The three little cuts represent the interior. In Fig. 2 the shell is seen to contain three small permanent magnets. In Fig. 1 are three coils of wire, *C* wound upon wooden spools, and connected in series; one terminal is connected to the zinc shell *E*, and the other to the little wooden piece *D*. To a spindle passing through both sections of the top, is attached a toothed wheel, Fig. 3, which, when the top is spinning, makes and breaks the circuit at *I*. When one of the sections of the top is spinning over the other, an electric current is induced in the coils, and when a person makes proper contact a slight shock is experienced. The cut is reproduced from *La Nature*.

Edison's Carbon Relay.

It is well known that the resistance and, of course conversely, the conductibility of imperfect conductors of electricity—*i. e.*, conductors of relatively high resistance—vary as the intimacy of contact of the particles changes. This latter variation may be produced by pressure, or, in other words, if a piece of an imperfect conductor be included in an electrical circuit and, other conditions remaining the same, pressure be applied, so as to compress the material, its resistance is lessened, and an effect is obtained equivalent to strengthening the current. This effect is the result of the particles coming into



EDISON'S CARBON RELAY.

more intimate contact or relation with each other. The same effect is observed, also, when there is interposed in a circuit two metallic conductors provided with roughened contact-surfaces, so that the contact between them is by numerous points. Pressure forces more and more of the points into contact, and thereby lessens the resistance in the circuit.

Mr. Edison utilizes this effect in the construction of his carbon relay, illustrated diagrammatically in the cut. In the figure *A A* are the spools of an ordinary electro-magnet whose cores

are connected by the usual yoke *D*. Upon the outer ends of the cores are placed blocks *C C* of some material of considerable resistance, as, for instance, carbon. Upon these blocks is laid the iron or steel bar *B*, acting as the armature to the electro-magnet. The ends of the cores and the bar are recessed, as shown, but not sufficiently to permit them to contact. The carbons are placed in the recesses. The device is connected in the line circuit as shown. The local circuit is indicated by dotted lines. The spring *s* of the sounder *S* is adjusted so that its resilience shall just overcome the magnetic attraction exercised by the magnet when the current is weakened by the normal resistance of the carbons *C C*. In the present instance the instruments are represented as arranged for a line on which a current is to be sent to cause a signal. It is evident, then, from the foregoing, if the circuit be closed through the relay magnet the latter's armature will be attracted, compressing the carbons *C C* and diminishing the resistance in the local battery circuit. This action causes the sounder *S* to attract its armature.

Mr. Edison claims that this construction makes a very delicate and effective relay, working reliably under great variations on the line without adjustment, and one in which all means of adjustment are dispensed with, any regulation required due to changes of electrical tension on the line being made upon the sounder only.

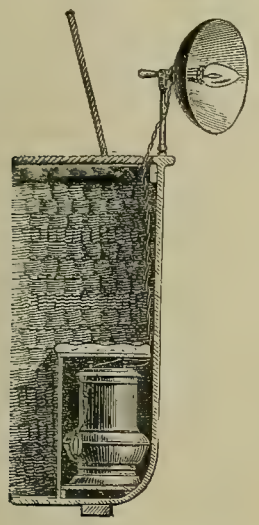
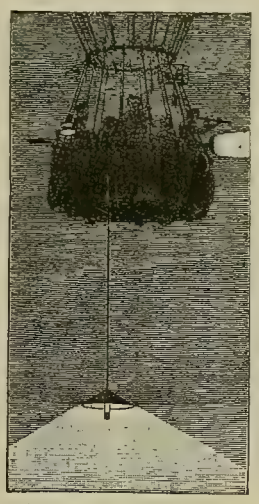


FIG. 1. SIGNALING BY ELECTRIC LIGHT FROM A BALLOON. FIG. 3.



Signaling by Electric Light from a Balloon.

In June last when an ascension was made in the balloon Figaro in Paris, several interesting experiments were made in sending signals by electric light from the air ship. During the last few years inventors have devoted no little time to the consideration of the best means of signaling from balloons, especially in France. Many patents relating to the use of the incandescent lamp for this purpose have been issued. Many of the inventions have proved upon trial to be utterly useless. The experiments, however, which were made by Jovis and Mallet in June last, it is claimed, indicated that signals can be sent by the incandescent lamp from a balloon with entire success.

In these tests current for the lamps was furnished by Renard storage batteries. Their weight was about 43 pounds. A special form of 25 candle power lamp was employed. The lamp was placed in front of a reflector which could be turned in any desired direction.

The battery was placed under the seats in the balloon, in the manner shown in Fig 1. The fastenings are so arranged that the batteries are not disturbed even when the balloon assumes a gyratory motion.

Fig. 2 represents the basket of the balloon with a few of the instruments used by the æronauts. The little device at *A* has nothing electrical about it. It serves to indicate any horizontal movement of the balloon. The instrument at *C* denotes any changes from the vertical in the position of the balloon. Two wires from a battery lead to the instrument. The connections are such that upon any marked movement of the balloon either up or down an alarm is sounded upon a little gong.

The compass is located at *B* and directly over it an electric lamp is arranged. By its light readings from all the instruments can be taken. The bottom of the compass case is glass, through which the æronaut can see objects on the surface of the earth and determine, therefore, the angle which the route of the balloon makes with the magnetic meridian. In order that the earth may be visible a lamp is hung below the basket in the manner shown in Fig. 3.

In flashing signals the Morse alphabet was used.

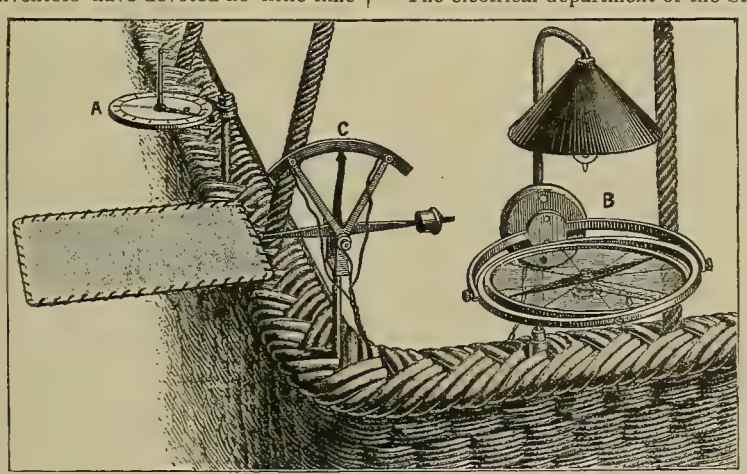


FIG. 2. SIGNALING BY ELECTRIC LIGHT FROM A BALLOON.

St. Louis Electrical Exhibition.

The electrical department of the St. Louis exposition will be unquestionably be the most attractive feature of the exhibition this year. There will be all the latest improvements in the telephone, telegraph, phonograph and electric lighting appliances. The writing telegraph will be exhibited in a perfected and interesting form. An improvement in the phonograph which has not heretofore been exhibited, will be one of the features of the display of the Edison company. Not a small feature of the exhibit will be the various electrical railroad signals, by means of which a moving train can telegraph to another moving train and thus avoid serious accidents. Appliances for the throwing of switches in crowded freight yards by electricity will also be exhibited. An electrical appliance by means of which an operator can play on several pianos at different places at the same time, will be exhibited.

One of the most interesting features of the exhibit will be the prismatic electric fountain, similar to the one exhibited at the Paris Exposition, but greatly improved. In this fountain no water is used, but the effect is produced by means of alternating electric currents, producing flashes of light, which are reflected by a complicated system of mirrors and prisms, producing a shower of many-colored lights, which is said to be most beautiful in its effect. What is apparently a stream of water, but in reality a flash of light, will constantly change and be simply dazzling in its effect. The unicle electric elevated railroad will be on exhibition.

Submarine Navigation.

A Washington correspondent calls attention to the fact that European inventors are devoting more time to the question of submarine navigation than Americans; at any rate they are accomplishing more it would seem, on the other side than in this country. The Gymnote, the Goubet and the Peral have all achieved at least a promising degree of success; and they have come up since the Nordenfeldt boats and others of European celebrity. The Gymnote, the invention of a French officer, depends for its motive force upon electricity, and from the first was found to be well under control; but the accumulators were not quite satisfactory for a time. Of late, it is said, better results have been achieved. The Goubet, invented by a well-known French engineer, has had many successful trials at Cherbourg. It descends perpendicularly, whereas the Gymnote dives at an angle. A feature of the Goubet is the facility with which it can be steered in any direction. Spain, however, thinks that she has in El Peral a better submarine boat than any other of the European powers. Its motive power, like that of the Gymnote and the Goubet, is electricity. It can be submerged with all desired ease, can stay a long time under water, has good facilities for supplying air to the crew, has good sea-going qualities, and while the appearance of its coursing tower above the surface of the water would disclose its approach to an enemy in the daytime, yet in an actual trial against the war ship Colon, it was found that under cover of the night it could probably reach an enemy without being detected. At all events the Spanish Government is so much impressed with the possibilities of the Peral, as an auxiliary harbor defence, that it is said to have decided to build a flotilla like it. It is understood that these boats will be larger, having accommodations for a crew of over twenty men. But the need of such a crew is not obvious, the fewer the number of men the more air and machinery space will be furnished. While these advances have been made in France and Spain, submarine navigation in this country appears to be about where it was three years ago. Perhaps less is expected of it by the present Navy Department than was hoped for by its predecessor. Secretary Whitney had only a minimum faith in the efficiency of ordinary torpedo boats like the Cushing and its successor now authorized. "The electric search light has," he said, "made their usefulness at night extremely doubtful. They are of value only upon occasions when they are invisible to an enemy. Such occasions are rare. The smoke of battle might conceal them, and for a nation having large classes of fighting ships they might prove of consequence, but that is not our situation at present. The statement of the fact that they are of value only upon rare and accidental occasions should rule them out as a reliable weapon for coast and harbor defence. A nation cannot select the nights when it will defend its harbors." Yet directly upon this declaration as to the ordinary torpedo boat, he added that "it is reasonably certain that boats entirely submerged, except as to a turret, small and protected against machine-gun fire, are practicable." It was with this view that toward the end of 1887 Mr. Whitney invited bids for the construction of a submarine torpedo boat. Whatever the cause, no contract was made by the Navy Department for a submarine boat under its own call, and the call has never been repeated. Besides the inventions of Peral, Goubet, Ramagote, Nordenfeldt, Campbell, and others in Europe, there are the well-known devices of Tuck and Holland in this country. The only question raised seems to be the ability of such a boat to go below the surface at so great a distance from the enemy as to be unperceived by him and then to make its way under water until it has reached the hull of the vessel aimed at and blown it up by the use of some high explosive. The difficulty experienced is in traveling such a distance under water without coming to the surface sufficiently to show at least the observation tower. This latter, to be sure, is not an easy mark to hit, and it need not take long for the boat to sink again below the surface. But with the aid of guard boats and other devices the enemy can probably protect himself if the discovery is once made. Still, even when the observation tower must be shown, with the aid of a dark night or a fog, there might be some chance of escaping detection, so that a good sub-surface boat possessing sea-going qualities, would furnish an auxiliary defence, even if not a defence of the first importance.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building. - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT. - Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Union Depot Street Railway, St. Louis. Illustrated	125, 126
Chicago & Jefferson Urban Transit Company	125
Electric Power for the Davenport & Rock Island Street Railway.	126
Electric Roads and the Census	126
New Telephone Company at Chicago	126
The River & Rail Electric Light Company. Illustrated	126, 127
Edison Companies' Convention at Minneapolis	127
Electric Light Plant in McVicker's Theater, Chicago	127
Insulator. Illustrated	127
English Constant Current Dynamos. Illustrated	127
Mercury Circuit Breaker. Illustrated	128
Development of Electrical Interests in Australia	128
Reunion of Telegraphers	128
An Electric Top. Illustrated	128
Edison's Carbon Relay	128, 129
Signaling by Electric Light from a Balloon. Illustrated	129
St. Louis Electrical Exposition	129
Submarine Navigation	129
Editorial	130
Telephone Convention	131
Electric Light Car on the Pennsylvania Road. Illustrated	131
Clam Bake at Vue de l'Eau	131
Electric Fountain at Lincoln Park, Chicago	131, 132
Municipal Telegraph and the Central Strike	132
The Copper Question	132
DEPARTMENTS.	
Correspondence	132, 133, 134
The Electric Light	134
The Electric Motor	134, 135
The Telephone	135
The Telegraph	135
Electrical Patents	135, 136

IN another column mention is made of the fact that the Holmes syndicate which controls the Davenport & Rock Island street railway has decided upon electricity as a motive power for this system. The decision of the syndicate may be regarded as a most decided victory for the electric system. The fact that C. B. Holmes, who is at the head of the most successful cable railway in Chicago, has declared himself and his followers in favor of an electric equipment to the extent of $350,000 is conclusive proof that except under certain circumstances, the cable system cannot compete with electricity.

THE views of Prof. Henry Morton on the dangers of electric lighting, presented in a paper read before the convention of the National Electric Light association, will be generally approved by the electrical fraternity. The article appeared in the report of the convention, published in the last number of the WESTERN ELECTRICIAN. Conservative electricians have always admitted that the handling of high tension currents was attended with a certain degree of danger, but they have contended at the same time that the proper means for securing safety was not to be found in prohibiting high potentials, but in the adoption of numerous safeguards, and in the rigorous enforcement of safety regulations. Managers of central stations have recognized these facts and they have endeavored to protect their employes and the public. An illustration of the methods employed was furnished in the WESTERN ELECTRICIAN, July 26th, in which an article was presented describing the safety precautions adopted in the Brush station at Rochester, N. Y. It will be noticed that the policy adopted in this case is consistent with the recommendations suggested by Prof. Morton, and the success attending the enforcement of these regulations shows that the requirements are understood.

THE subject of the proper classification of the lighting power of electric lamps, which was brought before the recent convention of the National Electric Light association by Dr. Louis Bell, is a most timely one. All along up to the present time consumers have been renting and buying lamps, and lighting companies have been furnishing them, in many cases, with the vaguest knowledge as to the actual amount of light obtained. In the majority of instances the consumer or purchaser of an isolated plant places himself entirely at the mercy of the company furnishing the current or selling the apparatus, and if the light appears to the eye to be up to that of lamps furnished a neighbor, all is well. Competition now, however, is rife, and as there is so little difference, practically speaking, between the different makes of high class apparatus, manufacturers are straining every nerve to attain to perfection in small points. All this, therefore, has a tendency to elevate existing standards, and also to create new, higher, and more correct ones. As Dr. Bell pointed out, light at best is a difficult thing to measure because we are not able to establish an absolute standard. When, therefore, we have a source of light the candle power of which varies in accordance with its position, and we also keep in mind that the shape of the carbon has a most important bearing on the distribution of the light, the establishment of a standard which would meet with anything like universal approval, would be by no means an easy problem. Still, we agree with Dr. Bell that an effort in this direction would be a most decided step in advance, and one which should be eagerly welcomed by lamp manufacturers who are making an effort to produce the best apparatus. What we want is, to quote Dr. Bell, "to find some one definite thing which we can all agree to call a lamp of a certain size, whether it be 16-candle power or 16 watts."

THE advocates of municipal control of electric lighting plants can find little consolation in M. J. Francisco's paper on that subject, read at the convention of the National Electric Light association at Cape May. "If a municipality," he said, "can sell electricity cheaper than private corporations, why should it not manage all other trades and industries?" This is reasonable, and it sums up in a word the position of practical business men who are opposed to the manipulation of enterprises of this class for the advancement of politicians and their schemes. Mr. Francisco devoted considerable attention to the claims of "visionary, theoretical dreamers," who advocated the socialistic scheme and showed that their statements were misleading. Referring to the disadvantages of operating central stations, by cities, and the influence of politics, he said: "No sane or fair-minded man will, with the corruption and fraud practiced by politicians at the present day, attempt to prove that it is for the best interest of the taxpayer to place faith in the honest or conservative management of any enterprise which can be manipulated in the political arena for the advancement of the men in power. The histories of New York, Philadelphia and many other cities are samples of such methods, and their purifying effects upon politics. Hypotheses and theory may do on paper, but actual results obtained by practical application and experience are the only reliable data upon which to base any statement relating to the cost of street lighting. In every case these have shown, where all the facts are given, that it has been for the best interest of the citizens and taxpayers to contract with an electric light company for lighting the streets of any city." The paper appeared in the convention report, published in the last number of the WESTERN ELECTRICIAN. Prof. J. P. Barrett, city electrician of Chicago, took exception to some of the figures given by Mr. Francisco, for a station under the former's management. Prof. Barrett, upon his return to Chicago after a short vacation, proposes to answer Mr. Francisco's criticisms as far as they relate to electric lighting in Chicago.

OUR Pittsburg correspondent this week mentions an incident which indicates how the people of Pennsylvania look upon the relative merits of natural gas and electricity for street lighting. The city of Washington, Pa., has been lighted by the former illuminant for some time. The local company has hitherto made no charge for the gas, but recently it came to the conclusion that it should be paid for its light. The city authorities would not consider the proposition for a moment. They held that if they had to pay anything it behooved them to purchase something really worth buying, so they decided to advertise for bids for electric illumination, and their course strikes us as entirely sensible.

SEPTEMBER is to be a month of electrical conventions. The Edison companies will meet at Minneapolis September 16th. The programme as presented in another column gives promise that the meeting will be of unusual interest. The National Telephone Exchange association will hold its annual convention at Detroit on the 9th inst. Gen. C. H. Barney, the secretary, reports that the meeting promises to be unusually interesting and profitable. The reunion of the Old Time Telegraphers and the Military Telegraph corps will take place at Kansas City September 15th and 16th. Our Kansas City correspondent reports that a large attendance is expected, and the committee of arrangements states that a hearty welcome is awaiting the veteran operators.

IN the last number of the WESTERN ELECTRICIAN containing a report of the Cape May Convention of the National Electric Light association, appeared a paper by H. L. Lufkin, on "A Proper Basis for Determining Electromotor Rates." Mr. Lufkin, it will be remembered, had already at a previous meeting given the convention considerable information on this subject. In the early days of the stationary motor business, and in fact at the present time, one of the greatest difficulties attending the introduction of a machine, in many cases, is the arrangement of a proper rate to be charged for current. To a power consumer the price of the motor is a secondary consideration, but the cost of current is of prime importance. In many instances the motor company loses a sale and the electric light company a sure and constant customer, through the latter's inability to decide upon a rate which would show a profit to the power company, but at the same time would not be prohibitory to the consumer. During the past few years, however, this subject has received the most careful consideration as lighting companies have awakened to the fact that power circuits grow in a most astonishing manner, and pay dividends of the steadiest kind. Those contemplating the establishment of a power circuit or experiencing a difficulty in deciding upon the rates to be charged for motor service, will find Mr. Lufkin's paper of interest.

In preparing his paper Mr. Lufkin had access to a large number of records of motors in actual service. From these records diagrams were plotted out which show the fluctuations in the current supplied to constant potential motors under the ordinary working conditions. A study of these tests revealed, among other things, that the average use of the motors in question was but 43.57 per cent. of their rated capacity. Mr. Lufkin also stated that he found the average power consumed in doing serviceable work is but three-eighths of the total power used. The remaining five-eighths is consumed in driving shafting.

Telephone Convention.

The National Telephone Exchange association will hold its convention at Detroit, beginning Tuesday, September 9. C. H. Barney, secretary of the association, reports the following program: First day at 10 A. M., an address of welcome will be made by the mayor. It will be followed by a business session. On the second day at 2:30 o'clock a carriage ride and lunch at Belle Isle Park Casino will be a feature, and at half-past eight in the evening, a banquet will be held at the Russell House. The boat ride and lunch on board during the afternoon of the third day will end the convention, and those who desire to leave the city early can do so, as the ride will be over about 5 o'clock.

It is stated that the arrangements for the third day's session will include a morning meeting so that any unfinished business from the previous session can be attended to at that time.

Electric Light Car on the Pennsylvania Road.

The accompanying diagrams illustrate an electric light car which is in service on the Pennsylvania railroad. It was constructed in order that ample illumination might be provided at points where temporary light is needed, either at a wreck or washout, or new piece of construction, or about yards or shops. It has been in very satisfactory use for about two years. The drawings are so clear that little description is necessary. Racks for 10 arc lights are provided, and the power is ample for running that number, or even two or three more lamps.

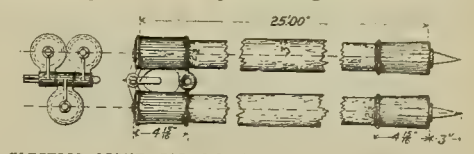
The boiler, which is only shown in outline, is of the upright tubular type containing 106 1½-inch tubes 2 feet 3½ inches at the center and slightly longer at the sides, the top flue sheet being concave. The entire length of sheet, which includes the fire-box, is 6 feet 9⅝ inches, and the outside diameter, 3 feet 4 inches. The stack is 11¾ inches interior diameter at the throat. The lamp tripods are 25 feet high, of the simple form shown in the illustration, and are carried in racks on top of the car, as indicated. The car is supplied with the list of miscellaneous supplies given in the appended table, and is thus prepared to quickly furnish almost any desired amount of light. The cuts are reproduced from *Engineering News*.

List of Supplies.

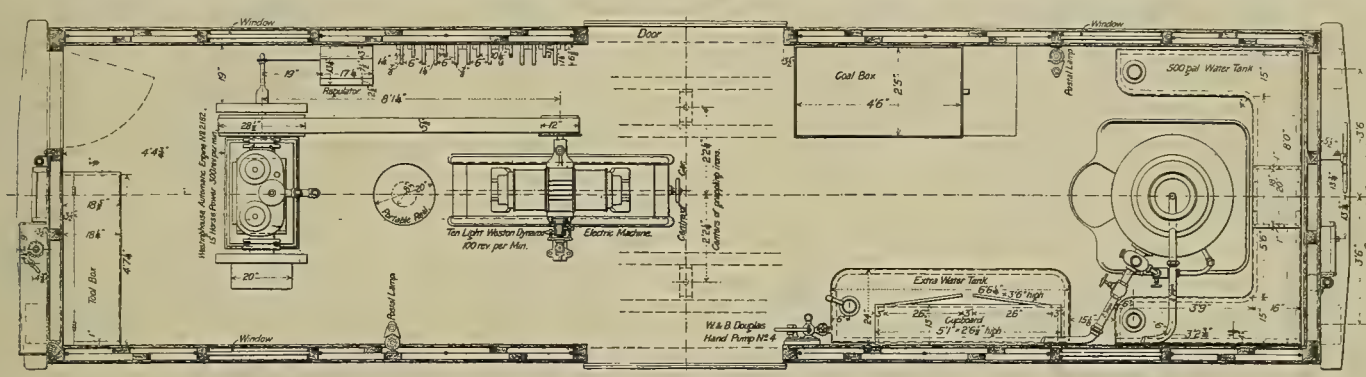
2 Reels of flexible wire 1,000 ft	6 " " paper.	2 Combination lamps.
1 Reel of flexible wire 75 ft. long	6 Sheets sand paper.	8 Tin cups.
10 U S arc lights, 2,000 candle power	6 White lamps.	2 Balls candle wicks
500 Carbons.	2 Red "	3 Postal lamp globes.
25 Poles	2 Signal "	3 " " wicks.
12 Pole joints.	2 Postal "	3 Torch wicks.
12 Pieces of ⅝ in rope, 50 ft long, for poles.	7 Torches.	1 " tube
25 Porcelain carbulator knobs and screws.	1 Broom	1 Order book
10 Glass insulators with brackets and nails.	2 Red flags.	1 Funnel.
6 Cross-arm hooks.	2 Green "	2 Glass water gauges.
1 Pick.	4 White "	1 Glass for Lubricator.
1 Crowbar	1 3-gall. can crankcase oil	10 Lbs waste.
2 Balls of tape ¾-in. wide	1 2-gall. bucket " "	1 Sponge.
7 Jumpers.	1 " cylinder oil	1 Funnel for filling tanks from stand pipes.
5 Pair of line connectors.	1 " Cooling Co. frt. dobe	6 Class V No 743 journal bearings.
1 Ball heavy twine.	1 Qt. oil can for engine and dynamo.	4 Water buckets.
1 Pair of vises and straps.	1 Portable reel with 1,780 ft. of E. L. wire	4 Screw jacks.
1 Pair of climbers.	1 Tallow pot.	4 Blocks for jacks 3 in. x 6 in. x 2 ft. 6 in. long.
2 No 8 pliers.	1 2½-gall. oil can passenger engine oil.	2 Cakes soap.
2 Large screw drivers.	1 2-gall oil can signal oil	1 Box unmersal metal polish.
1 Hatchet.	2 1 " castor oil.	1 Box lye.
1 Pole axe.	1 12-in monkey wrench.	1 Scrub brush.
1 Cross cut saw, 26-in. blade.	1 Pipe wrench.	1 Fire shovel.
1 Hard hammer.	2 Solid wrenches. 1⅛ x 1½ in jaws	1 " hook.
1 Small soft hammer.	1 S wrench, 1½ in. jaws.	1 " scraper.
1 Large "	1 4-in. Spanner wrench	1 Flue Blower.
2 Hydrant hose connectors.	1 " monkey "	1 Spanner for No. 4 injector.
2 Commutator Brush w'rch's	3 Safety plugs for boiler.	1 Sponge bucket.
2 Cape chisels.	1 Safety plug cover.	1 " hook.
2 Flat chisels.	3 Manhole plugs with lead joints.	1 " packing iron
2 14-in. flat fine files.	1 Spiral spring for governor	1 Flue auger.
2 14-in. ½ round coarse files.	1 Pair flag holders.	50 Ft. ¾-in. hydrant hose.
6 Sheets emery cloth.		25 Ft. 1½-in. hose for hand pump
		7 Straight poles.

The Clam Bake at Vue de l'Eau.

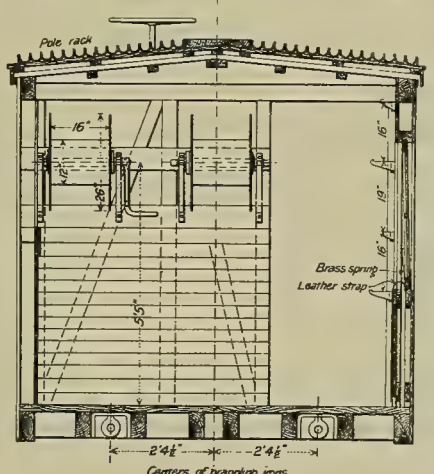
The sequel to the summer convention of the National Electric Light association is the clam bake given by the American Electrical Works of Providence, R. I. The twelfth bake of this kind took place August 23 at Vue de l'Eau, near Providence. One hundred and seventy-four persons were present, and before the clam bake they amused themselves by roaming over the grounds of the Vue d l'Eau club, kicking the football, shooting at the target, etc. When the serious part of the proceedings was instituted Gen. O. E. Madden was called upon to act as toastmaster. He made a brief speech in which he called attention to the great advances made during the last few years in the electrical field. He also read a number of letters from persons who regretted their inability to attend the clam bake. Eugene F. Phillips, president of the American Electrical Works, was introduced but refused to make a speech on the ground that a toastmaster had been elected for that very purpose. To the toast "The Rhode Island Clam," John Addeman, ex-secretary of state of Rhode Island, made a humorous response. S. Smith spoke for the telegraph, and H. L. Storke for the telephone. Marsden J. Perry made a brief speech in which he spoke of the charms of the spot at which the clam bake took place. P. H. Alexander made an informal talk, after which T. C. Martin responded for the electrical press. The gathering was a highly enjoyable one.



ELECTRIC LIGHT CAR ON THE PENNSYLVANIA ROAD—LAMP TRIPOD.



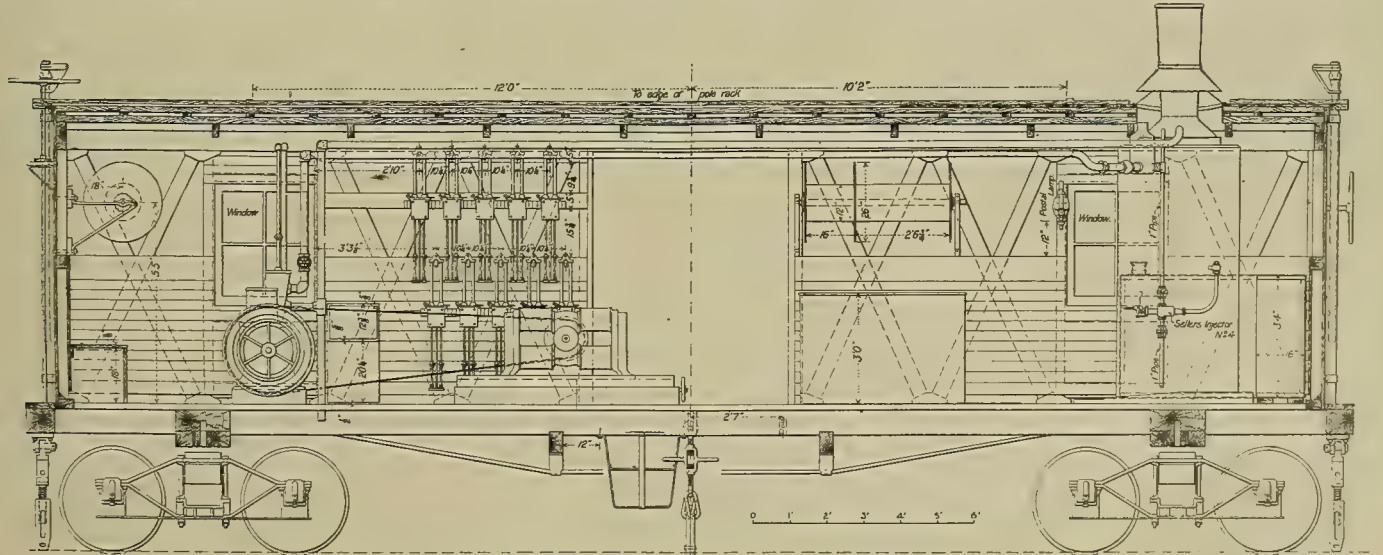
ELECTRIC LIGHT CAR ON THE PENNSYLVANIA ROAD—PLAN.



ELECTRIC LIGHT CAR ON THE PENNSYLVANIA ROAD—SECTIONAL END VIEW.

Electric Fountain at Lincoln Park, Chicago.

Chicagoans who visited Lincoln Park last week saw the new electric fountain, presented the city by Charles T. Yerkes. On Monday evening it was dedicated to the city. As the streams spouted rays of light played in the same direction as the streams. There were all the colors of the rainbow, sometimes all turned on together, and again the jets were all of the same hue. Red, green, violet, blue and pure white lights were seen in succession and then all together. The white and green tints suggested an ordinary waterfall under a strong light. After



ELECTRIC LIGHT CAR ON THE PENNSYLVANIA ROAD—SECTIONAL VIEW.

various colors had been shown, the whole fountain was illuminated with a white light. The last color shown was red, and as the flow of the different jets slowly ceased, it looked like a fire dying out. A moment later and there was to be seen nothing but the glowing coals of a big fire, and the show was over.

Municipal Telegraphy and the Central Strike.

The dependence of the police in large cities for the efficiency of their system upon the telegraph is illustrated in the following story concerning the big strike on the New York Central Railroad: The telegraph operators who are on duty at police headquarters day and night are in constant communication with every precinct of the police department. When it becomes necessary, as it has during the railroad strike, to mass the police at different points where trouble is expected, it is of vital importance that all the wires running into this room should be in working order. When the strike of the New York Central road was declared, on Friday evening four weeks ago, the police wires on the east side above Fourteenth street did not respond. Inspector Byrnes knew on Friday afternoon that a strike was imminent, and he had notified the captains of precincts through which ran the Central's tracks to hold all reserves in readiness. Capt. McElwain telegraphed to him at 6:45 that the strike was declared. Inspector Byrnes was acting superintendent, and as there were a good many ugly rumors afloat it was considered necessary to order out extra men. Old "Pop" Stevens, the veteran telegraph operator, was instructed to send out such an order. He tried the wires, and not a police precinct above Fourteenth street on the east side responded. Mr. Stevens rushed into Inspector Byrnes's office in great excitement with the news. The inspector, to avoid arousing the suspicions of the newspaper men who were at headquarters, went down to the cells on the basement floor, and by climbing through a rear window, entered the operating room and locked the door. The wires were tried again without response. Four linemen were sent out to find and repair the break, and orders were sent over the Western Union wires to forty detectives of Inspector Byrnes' staff to report at once at police headquarters. These men were stationed along the east side precincts where they could get telephones, and were instructed to keep the central office informed of the actions of the strikers. At 8 o'clock the linemen reported that they were unable to locate the break in the police wire. In the meantime Sergeant-Detective Mangin telephoned from the Murray Hill Hotel that the signal station switches at Fifty-seventh street were threatened. It began to look as if the police were going to have a busy night. Inspector Byrnes sent the linemen out again, and an hour later they came back unsuccessful. One of them named Lyman then declared that he was going to find that break if it took all night. At 11 o'clock Lyman returned. "If you will let me steal a Western Union wire, inspector," he said, "I will put your wires in working order." "Take all the wires you need, and the poles with them," was the answer. Lyman hurried out, and within an hour "Pop" Stevens was rubbing his hands in high glee and Inspector Byrnes wore a broad smile. Lyman completed the circuit by using a Western Union wire from Fourteenth to Thirty-fifth streets. The break was repaired the next day.

"You don't know what a load was taken off my shoulders," said Inspector Byrnes in telling the story, "when Lyman's success was evident and the upper precincts responded."

The Copper Question.

The copper question has again attained prominence in the financial world, the interest manifested now being almost as great as at the time of the collapse of the copper syndicate, which had its headquarters in France, the failure of which caused immense loss to many investors and involved more than one large company in financial ruin. The large stocks left on the hands of the men who had advanced money on the property weighed down the market as if they had been so much lead. Nominally that "reserve" has since been reduced to about 2,000 tons, and the price has risen rapidly in consequence of the lessened pressure. It is generally understood that the change has come about by reason of a great increase in consumption, most of which is in the widening field of electrical appliances, but there is some reason to fear this is partly a mistake. Hints are thrown out to the effect that the reduction in stocks is more nominal than real, being accomplished by a shifting from visible to invisible supply. This device was freely indulged in by the old syndicate, and the London *Financial Times* boldly charges it as morally certain that a similar manipulation has been arranged now, "in order that by creating a false idea with regard to the metal itself the price might be kept up until the French operators for a rise in Rio Tinto shares should be able to unload." It is thought they have more than once recently felt the pulse of the market to find out if it were strong enough to permit the contemplated selling, but were disappointed, and so continue to hold on. If this be true it may be in order to prepare for another surprise of an exceedingly disagreeable character, though it can hardly cause such a revulsion as that which followed the discovery that the Societe des Metaux was practically a fraudulent concern. The consumption of copper has much increased within the last two years, but the facilities for production are more than sufficient to keep pace with a wider using, and it may be found that the rise of about 50 per cent. in price is more than is warranted by the conditions of a healthy market. Still, it is not impossible that the change in the silver situation will furnish a sustaining power sufficient to prevent serious loss to innocent holders of copper here and in other countries.

The contract for the electric railway on Tacoma avenue, Tacoma, Wash., has been awarded Robert McIntyre.

CORRESPONDENCE.

New York Notes.

NEW YORK, Aug. 30.—Carelessness in handling electric wires continues to result in accidents, but it is a matter of congratulation that occasionally there is evidence that all the instruction of experts on this most important topic has not been wasted. Thus last week a fallen electric light wire crossed the tracks of the New York Central railroad, and the engineer seeing it, stopped the train until it could be removed. A short delay was occasioned, but the precaution of the engineer was certainly praiseworthy. All the electric wires are not buried although Mayor Grant would have the public think they are. Two accidents were reported last week, due to poor construction of an overhead telephone or telegraph wire. It fell across an electric light wire, and while dangling in this manner struck a small boy, shocking him. A policeman who came in contact with the same wire was rudely awakened by the shock he received. His surprise overcame the sense of injury but it was not greater than that of the property owners in the district over which he is guardian.

The fire in the drying room of the Interior Conduit and Insulating company's factory destroyed large quantities of material and the apparatus employed in the factory. The tubing which was finished was not destroyed, it is reported. There will of course be a slight delay in the filling of orders but the company has already under way the plans for replacing the property destroyed.

The unfounded report that the Edison General company is about to move its New Jersey plants to Schenectady is attributed to the strikers at West Albany and Schenectady, who applied to the company at Schenectady for employment. The capacity of the lamp factory of the Edison General company at Harrison, N. J., is being increased by the construction of a new building.

The property owners in Broad street, Elizabeth, are making complaints against the city because of the maintenance of the "unsightly poles" on which the fire alarm wires were formerly strung. Since the telephone company has erected larger poles the wires have been put on them but the old poles remain.

The Consolidated Newark & Schuyler Electric Light companies are about to build a new central station. The building will be situated near the city dock on the Passaic river on a lot 250 feet square. Contracts have been awarded to the amount of $80,000, and the capacity of the new station will be very large.

The New York & New Jersey Telephone company for six months has been trying to get the consent of the common council of Newark to build a subway for its wires in that city, and has offered the city a place in its subway for all of its fire-alarm wires in return for the franchise. The petition was tabled last spring and has been there ever since although it is evident that the telephone company expects to get the franchise, having purchased property upon which to erect a central station at a cost of $1,000,000.

Some of the officials of the city of Toronto were in town during the week inspecting street railway systems. The electric and cable cars were of special interest and it is more than likely that the day is not far distant when Toronto will be able to boast of an electric street railway.

The convention at the Hudson Institute for the Deaf and Dumb was attended by 350 delegates from the various institutions throughout the country. The announcement of a gift of $25,000 from Alexander Graham Bell, the inventor of the telephone, for the promotion of special teaching, was received with enthusiasm.

The Newark Rapid Transit company has lately mortgaged its property including real estate, rights of way, buildings, live stock, plants and franchises to the amount of half a million, which money is to be used in equipping its lines with the electric system. If the courts should sustain the claim that the common council had no power to grant permission to run cars by means of overhead electric wires, storage battery cars will be resorted to. W. H. T.

Pittsburg, Pa.

PITTSBURG, Pa., August 30.—On the condition that the borough council free the McKeesport Street Railway company of McKeesport, Pa., from all license fees, that corporation intends to transform the motive power of its lines from horse to electric power. The McKeesport Light company, which has been operating an electric light plant of about 2,000 incandescent lights' capacity very successfully, is about to make extensive improvements in its central station. McKeesport has grown considerably within the last year and the company is compelled to double the capacity of its apparatus.

The Pleasant Valley Electric Railway company of Allegheny City has submitted a financial report of its lines to the department of internal affairs at Harrisburg, Pa., from which it appears that the company carried during the year 4,583,000 passengers; total receipts, $231 479.03; expenses, $153,644.97; surplus, $61,441.53. It is only fair to say the company never made any money when the road was operated as a horse car line.

Natural gas for street lighting is to be supplanted by electricity at Washington, Pa. A local natural gas company has hitherto supplied the borough without cost but refuses to do so any longer, the result being that the borough company has advertised for bids to light the streets by electricity.

The Pleasant Valley Electric Railway company is engaged in putting up a new switch-board at the power house in Pleasant Valley, which is said to have no equal in the country. The peculiarity of the board is in the fact that it will be composed of brick and terra cotta lumber and the face is to be covered with cement. It is thought that the arrangement will greatly decrease the danger from fire.

The new works of the Standard Underground Cable company at Brinton, near this city, are rapidly approaching completion. It has now been decided by the company to erect a rolling mill as well as a copper wire mill in connection with the plant. The rolling mill is to roll the brass and in the wire mill all the copper wire needed by the company is to be made. The copper will be brought from the copper mine in Montana, purchased some time ago by George Westinghouse, Jr.

It appears now that the Squirrel Hill electric road is to take another lease of life shortly. Judge Magee a few days ago refused to grant to the city an injunction against the railway company, preventing the latter from traversing one part of Schenley park. The judge stated in his opinion that the city had granted the company the right to go through the park some time ago and it could not now be taken away without good reasons.

In addition to this fact, it is also stated that the Pittsburg Traction company is negotiating for the purchase of the line and if this deal should be consummated, the building of the road will be immediately commenced.

H. P. Palmer and J. P. Conner, two Pittsburg boys, claim to have invented an electrical device, which is to make the overhead trolley wire system of electric railways a thing of the past. The boys have already applied for a patent for their invention, the particulars of which are details of a system of underground connection.

The main features of the plan consist of a series of iron boxes arranged along the street car tracks and placed within the ground permitting the tops of the boxes only to be visible on the surface. These boxes are eighteen inches long and they are buried in the ground at intervals of a car's length. Fastened to the bottom of the truck is a bar of iron placed the entire length of the car and attached in a manner so as to slide over the tops of the boxes in the ground. By this means the connection of the current is made. E. H. H.

Cleveland, O.

CLEVELAND, Aug. 30.—It appears as if all the large machine shops and iron manufacturing establishments would add electrical specialties to their line. The latest enterprise of this kind is reported from the Ford-Washburn Electric company, just organized. This company controls patents relating to the manufacture of ventilated armatures for dynamos and motors. The device is extremely simple, and is reported to be very effective. The company is turning out dynamos whose capacity ranges from 15 to 300 lights, and motors from ⅛ to 25-horse power.

Manager Dougherty of the Cleveland Electrical company, is enjoying an Eastern trip.

A new incandescent electric light plant is being erected at Norwalk, O.

The telephone franchise in Akron has been extended five years beyond its termination, or until 1898.

A special commission in Toledo is investigating alleged defects in electric street lighting. R.

Louisville, Ky.

LOUISVILLE, Aug. 30.—The Consolidated Electric Railway company is experimenting with a new gearing for its electric motor which, it is claimed, will secure noiseless operation. Heavy manilla ropes are used. The car is stopped by applying the brake, allowing the motor to run continuously. When the brakes are eased, the car starts again.

Ellis Teroy, formerly an employe of the Louisville Electric Light company, is charged with stealing several blocks of electric light wires leading to Lion Garden.

The Shallcross ferry-boat and the Tell City, a Henderson packet, ordered electric light plants here last week. Stationary motors have been installed recently to operate a broom-maker's machine, a jeweler's lathe and a sausage-cutting machine.

At Nashville there is about to be commenced the instal

lation of the Citizens' Rapid Transit Electric Railway. The street cars, it is said, will be furnished by the John Stephenson company of New York. They will be lighted and, it is now stated, heated by electricity. The motors will be of the Sprague type. L.

Topeka, Kan.

TOPEKA, Aug. 30.—The following is the first official announcement of the position and construction of the dam across the Kansas river to secure the water power which will be converted into electrical power. It comes direct from Captain Anthony in his official capacity as chief engineer. He said:

"The dam will be built 212 feet west of the Pottawatomie reserve line, about three and one-half miles west of the Chicago, Rock Island & Pacific railway bridge. It will be 771 feet in length, constructed on a solid concrete base, faced with masonry. Seven thousand yards of concrete will be used to carry the structure to the present level of the river and from there to the top of the dam will be of solid masonry. While the dam will be level on top, it is necessary to go nearly twice as deep on the north side of the river as on the south to secure a rock bottom the entire distance. The total height of the dam on the south side will be 20 feet; on the north side 42 feet. The base will be 29 feet 4 inches wide; the top, or crest, nearly 6 feet wide. The up-stream face will have a slope toward the top of .0521 inches to the foot. The down stream face will be a curve with a radius of 17.1 degrees. On the south side of the river a flume of solid masonry will be built, 80 feet wide and 200 feet long. In the north wall of this flume the turbine wheels will be placed and an electric plant erected in the power house above them which will be a reserve plant. If nothing unforeseen happens the power will be delivered from the plant at the dam not later than February, 1891. We shall then proceed to the construction of raceways and power stations in or adjacent to the city. We will have, with the present estimates, 4,000-horse power at our dam that will be available in case of accidents to the other stations.

"In the construction of the dam we shall put in six counterports, 100 feet apart, 22 by 6 feet, and carry these up with the dam to a sufficient height so that at any time it may be needed, and satisfactory arrangements should be made with the company, the counterports can be used for piers upon which to place a bridge with sufficient strength for railroad service, and which could be floored for team transit. The top of the dam will be protected by a solid sheet of railroad iron, which will be bent or curved to fit the up-stream side 4 feet down the face, and bolted to the rock. One and one-half inch bobs will be drilled 4 feet apart and 12 feet deep, across the entire length and in these steel rods will be driven and filled with lead.

"We are now engaged in getting our delivery specifications for power from those who have contracted with us and are hoping to complete our work by to-night, and both Mr. Holmes and myself will then leave for Ohio to contract for our water wheels, and from there go to New York and Boston to contract for our electrical machinery and transmission. We expect to return and commence our construction on or about Oct. 1, and if nothing happens to interrupt, more than we now contemplate, we hope to be able to furnish power to our patrons already contracted, not long after the beginning of the new year.

"We shall incorporate at an early date. The name of the corporation will be the 'Topeka Water & Electric Power company.'" M.

Lincoln, Neb.

LINCOLN, Aug. 30.—A railroad war of unusual proportions is on in this city just now. The new electric street railway is desirous of crossing the tracks of the Burlington, the Elkhorn and the Missouri Pacific on Eleventh street. A number of injunctions have been sued out, but recently the electric company obtained permission to put in their crossings. The Missouri Pacific sent down an engine to remain over the crossing to prevent work, but the engineer was met by Capt. Corder of the police force, who announced his intention of protecting the electric company in its work.

Thursday, however, hostilities were renewed. About 2 o'clock the electric line workmen reached the track of the B. & M., but the officials of that line blocked their progress by placing an engine and several cars on the crossing. Sheriff McClay and his deputies, with Marshal Melick and several officers, were on the ground, and in compliance with the order of the court ordered the street opened that the work might continue. The train was moved, but this caused some of the more hot-blooded of the railroad men to offer some resistance, and the officers began making arrests for interference. During this procedure an old man in the employ of the company made an attempt to strike a deputy and they clinched. Meanwhile other officers came to the rescue, and with the combined efforts of Sheriff McClay, Deputy Hoal, Marshal Melick and Officer Palmer, he was loaded in a vehicle and manacled.

When peace finally reigned the street railway men were ordered to proceed with the work of taking up the heavy rails spiked on the crossing by the B. & M. people during the night. An armistice was agreed upon at 3 o'clock and peace again is triumphant. F.

St. Joseph, Mo.

ST. JOSEPH, Mo., Aug. 30.—W. J. Hobson returned from New York last week, where the final arrangements were completed for leasing the Wyatt Park line to the People's Street Railway Electric Light & Power company for a period of forty-nine years. The Wyatt Park line maintains the organization and pays its dividends as before, and has simply been leased to the People's line for a per cent. of the gross earnings. At the annual meeting of the stockholders of the road, a new directory was chosen as follows: John A. Bowers of New York; W. T. Van Brunt, W. J. Hobson, J. W. McAllister, C. W. Hobson of St. Joseph. The directors then met and elected W. J. Hobson president of the company, and C. W. Hobson secretary and treasurer for the ensuing year. President Hobson was seen and said: "I can now talk advisedly about the affairs of the company. The Waytt Park line has not been sold, but has been leased to the People's line at a per cent. of the gross income for a period of years. The controling interest in the road is owned by a syndicate of New York men and myself. Some of them are stockholders in the People's line, and some are not. The People's company offered to give more out of the earnings than we could make ourselves, because they can operate it cheaper. The Wyatt Park company expects to make some investments in the near future, one north on Seventh, east on Farson, and again north on Ninth or Tenth streets, to the city limits; the other an extension to the Union depot. We will either make arrangements with the Union line to run our cars through to the Union depot, or get our passengers through for one fare, or we will build to the depot We have a franchise to the Union depot, now known as the circle cable franchise. If we build the line, it will be finished before the summer is over I think this deal will be of benefit to the residents in Wyatt park. The Wyatt park stockholders have abundant capital, and the railway line extensions can be pushed forward promptly, while they receive their rent for the use of the line."

As to the rumored sale of the Union line to the People's line, it is said on good authority that negotiations are progressing rapidly, but no deal has yet been consummated. If any deal is made at all, the road will be leased to the People's company, not sold. In fact, it cannot be sold, as there is a law in this state, one of the old granger laws, which prevents the absorption of one railway company by another.

General Superintendent McDaniels of the Missouri & Kansas Telephone company, is in the city looking over the St. Joseph exchange and superintending several improvements in the office that are being made with a view of extending the service and bettering it.

Chief among these improvements is a desk, situated at the center of the operating room, the top of which is a bewildering mass of brass keys and checks, the latter bearing no little resemblance to the regulation trunk check. The desk is designed for the chief operator. Owing to the increased demand for telephones, the company has found it necessary to extend the switchboard, the addition being 200 instruments, making 1,000 now in use in the city.

Mr. McDaniel denied the statement that his company would dismiss the injunction suit now in the circuit court of the county, which prevents the electric service on the Union line farther south than Sixth street and on Duncan street. "The present system of street railways in St. Joseph is very injurious to the telephone service," said Mr. McDaniel. "While we are doing everything in our power to repair evils, it is next to impossible to give the service we desire so long as the electric street railways are operated by the single trolley system. We did offer to dismiss the injunction against the Union company if they would pay the costs incurred in the proceedings, but they were not willing, and now we will fight the suit to a finish. Similar suits have been brought in other cities where the telephone and electric street railway service conflicts, and the telephone companies have invariably won. The lower courts have sometimes decided against us, but the higher tribunals never have. What every electric street railway should do is to put in the double trolley system which prevents induction and loss of current to the street railway. It only requires an additional trolley wire, and is even more economical in the end than the single trolley. We have experienced a great deal of trouble with our Savannah line which should be the best worker of any, and we propose to sue the Union company for damages on that account."

The common council committee on public improvements has not yet held a meeting to consider the petition of residents along the Wyatt park line for an improvement of the services, but an informal conference was held last week with the company's attorney, which may result in something. Attorney Brown of the People's Street Railway company, made a statement to the gentlemen to the effect that the People's company is operating the same number of cars on its line as was run by the Wyatt Park Railway company before the line was leased by the People's and that if necessary more cars would be put on, and tha as soon as the many changes now going on in the system are completed, the service will be improved in every respect, including improved motors on the Wyatt Park line.

It is stated that the People's company has ordered 20 new cars for service in the city, and the officials declare that they are unable to make it more efficient while the pending changes are being made.

When the time comes to collect the tax bills for paving Francis street from Ninth to Thirteenth, the People's Street Car company will be made defendant in a large number of suits, wherein the court will be asked to make the street car company pay for that part of the street paved where were formerly located the company's tracks. When the question of granting the company permission to take up its tracks was before the council, the matter was closely watched by property owners along the street, who, if the request was granted, intended to make the city a party of the suit. The permission was refused, however, and now the property owners will look entirely to the street car company, claiming that the ordinance granting it a right to lay tracks on the street was in effect a contract wherein it bound itself to bear a certain portion of the paving expense.

The Union line power house, at the head of St. Joseph avenue, was used last week for the last time to operate the Union line street cars. The line has been connected with the People's power house, which will hereafter furnish the power required to operate all the lines in the city. Arrangements will shortly be commenced to turn all the company's buildings at the head of St. Joseph avenue into repair shops, where the repairing for all the lines in the city will be done. O.

Denver, Colo.

DENVER, Colo., Aug. 30.—The telephone company of this city and the Postal telephone company have been engaged in a controversy which has finally resulted in the decision of the Postal company to take the case into court. The trouble between these companies has been brewing since the Postal Telegraph company established a branch in this city on August 1 last. Immediately after Superintendent Benzie of the Postal company made application to the Colorado Telephone company to have a telephone placed in the company's office, he was informed by Superintendent Field of the telephone company that owing to the number of orders ahead of his application he would have to wait some time before an instrument would be put on. Mr. Benzie was not astonished at this, but finally he got tired of waiting, and called on Mr. Field. The latter informed him he says, that his company would not put in a telephone for the Postal company because his company was dominated by the Western Union Telegraph company. Then he wrote a note to Mr. Benzie in which he said he would put in the telephone in about three weeks. Mr. Benzie was made aware that Denver was not the only place in Colorado in which the telephone company had an office. On Friday telegrams were received at the Denver office of the Postal Telegraph company from the Pueblo and Colorado Springs managers which conveyed the information that the telephones had been removed from their respective offices on that day. The Colorado Springs agent said that the Colorado Telephone company's agent at that city put in a telephone for him just fifteen days previous to Friday. On that day this agent suddenly appeared at the office and said he had been notified by the general manager at Denver to take this telephone out of the office at once.

The same thing exactly was done in Pueblo, according to the telegram of the agent of the Postal Telegraph company at that place. An agent of the telephone company also called at his office on Friday and took out the instrument. The agent said that he had been notified by his manager in Denver to watch this telephone and learn if possible if the company was using it for messages, which were afterward sent over the Postal company's wires. He contended that he had ascertained that this was being done and said that this was the reason for removing the instrument.

The Postal authorities determined to declare war against

the Colorado Telephone company and its alleged ally, the Western Union Telegraph company. It was determined to employ legal methods to arrive at the desired point. The Postal company takes the position that the telephone company, like many other chartered organizations, is bound to serve the public.

Then the fact that no objections were made to supplying the Western Union company with telephones and that no effort was made to prevent this company from receiving messages which it afterward sent over its wires, made these officials believe they knew who was the moving spirit in the business.

Not long ago similar effort was made in Ohio and Illinois to prevent the Postal company from obtaining 'phones for use for its offices, but the courts were appealed to and the Postal company was victorious. The ground upon which the Telephone company is expected to defend itself, is that the latter company has violated its rules by charging toll.

The fight between the city cable and the tramway company is becoming more and more interesting every day. Both are working hard to secure all the franchises that can possibly be obtained from the city government. Large forces of men are at work pushing the new construction ahead with great rapidity. Last week the tramway made a grand spurt with a force of several hundred men and succeeded in laying their new tracks from Curtis up Twenty-second street to Lincoln avenue, where they were stopped by the injunction pending, which includes the right of way on Grant avenue. Meanwhile it has leaked out through Colonel Randolph that his company will begin the construction of a new line along Lincoln avenue from Seventeenth parallel with the tramway's company's line on Broadway to Harmon, and the district beyond this point.

On top of this comes the announcement from Governor Evans and Rodney Curtis that the tramway company will extend its Lawrence street electric road in a line due south, turning when several blocks within the corporation line of South Denver, and running due east to the site of its $40,000 depot, where a junction will be formed with the Broadway line, thus completing a wide circuit of a dozen miles of rapid transit.

The electric motor line to Brighton will be established. All of the property owners along the line of the proposed route have taken hold of the project with a vim that means success for the enterprise. The length of the road will be about twelve miles, running along the track of the Union Pacific into the heart of Brighton, thus enabling the residents of this growing suburb to ride into the city for business at a fare of five cents. It will now only be a matter of a few weeks until all the subscriptions necessary toward guaranteeing the completion of this line will have been raised. The road will probably use the most improved pattern of the Sprague system of motor and operate enough cars to carry all the passenger traffic between the two points.

Samuel H. Bates, head operator in the Associated Press office, is about to leave Denver for New York. He has been in Denver nearly eleven years. He was employed first as superintendent of the telephone company, in which capacity he served the company three years, afterward with the Colorado Electric company, then with the American District Messenger company, and latterly with the Western Union Telegraph company, with which company he has remained for the last seven years, handling, most of the time, all the Associated Press matter.

There is said to be a big deal pending by which the City company will secure possession of the Berkeley motor line. The tramway company now connects with the motor line and by a system of cheap fares has a monopoly on all business to Elitch's Zoo and Berkeley lake. It is said that the City company wants to smash this alliance and can only do so by securing possession of the motor line. The City company is now building an electric road around Sloan's lake, which will connect them with the North Denver and Larimer street lines. The electric road will cross the motor track near its present terminus in North Denver and if the deal is made the City company could make as good connections as are now made by the tramway. One of the officials of the Berkeley company admits that a traffic deal is pending.

D.

Kansas City, Mo.

KANSAS CITY, Aug. 30.—W. S. Elliott, the representative of the Edison General Electric company of Chicago, was in the city last week. During his stay Mr. Elliott made a thorough inspection of the streets and avenues of the two Kansas Cities, as well as their suburbs. He will make an extended report of the situation, and it will not be detrimental to the two cities at the mouth of the Kaw. It is said that the company stands ready to construct an extensive plant in the two Kansas Citiss, uniting them in much the same manner as the electric systems unite Minneapolis and St. Paul. This means the construction of many miles of electric road at a cost of hundreds of thousands of dollars. The company has inaugurated the movement by starting two electric road projects in Kansas City, Kan. The granting of a franchise to the West Side Electric company, in which A. R. Ford, of the firm of Ford & Troup, is interested, has already been mentioned. It will start at the corner of Fifth street and Minnesota avenue, and will extend out Fifth to Washington and out Washington to Third, and then out the Quindaro boulevard.

Another road, projected by the same company, will run through the south side of Kansas City, Kan., over the Seventh street viaduct, just completed, and north to the Quindaro boulevard. The interests of this road are being looked after by Norton Thayer and T. J. Enright. Rumor has it that the two roads will join near Fifth and Minnesota, forming the first link in the proposed system.

D. A. Williams of this city, has returned from a trip through the East and Canada. Mr. Williams also made it a point to see many members of the Old Time Telegrapher association and United States Military Telegraph corps, which organizations will hold their annual convention or reunion in this city in September. Mr. Williams is one of the Old Timers. He reports that wherever he went he found much interest taken in the coming meeting, and that the indications are good for a large attendance. The Western Union office in New York was to have sent an unusually large delegation, but owing to the burning of the office not so many will attend. Dr. Norvin Green, president of the Western Union, was extended a special invitation to be present. General Manager Eckert and General Superintendent Tinker of the Western Union, both members of the corps, have promised to come.

P.

THE ELECTRIC LIGHT.

An electric light station is being erected at Winchester, Tenn.

A 200 incandescent light plant will be installed at the Anderson, S. C., hotel.

An electric light plant is among the improvements contemplated at Earlington, Ky.

The Spartanburg, S. C. Oil company has given a contract for a Westinghouse plant.

The Greensboro, Ala., Electric Light company has been formed; capital stock $5,000.

The Selma, Ala. Electric Light and Gas company contemplates installing an incandescent plant.

Radford, Va., Water & Light company, capital $50,000, has decided to erect an electric light station.

The Belmont Park company contemplates the erection of an electric light station at Nashville, Tenn.

Beeville, Tex., has outgrown kerosene and gas, and its enterprising citizens are now clamoring for electric lights.

Negotiations are pending for the purchase of the Brush station at Galveston, Tex., by the Citizens' Electric Light company of the same place.

The Wheeling, W. Va., Electrical company has decided to construct a new central station for electric lighting, and double the capacity of its present plant.

The Uniontown, Pa., Light & Heat company has been granted a franchise to install an electric light plant, erect poles and wires, and engage in commercial lighting. The power station is nearly completed.

Parkersburg, W. Va., is considering the question of establishing an electric light plant for street illumination. The matter is at present in the hands of the mayor, and he is engaged in securing information on the subject.

The Philadelphia market house is to be illuminated by the Westinghouse alternate current arc lighting system in the near future. The Westinghouse company has sold the city officials a 40-light plant for use in the market house.

The electric light and pumping station of the Rome, Watertown and Ogdensburg Railroad company at Windsor Beach near Rochester, N. Y., was recently destroyed by fire, entailing a loss of $2,000. A defective furnace caused the fire.

The Turtle Creek Valley Electric company of Wilmerding, Pa., is about to add a 60 light arc machine of the new Westinghouse alternate current type to its central station equipment. It already has in service 1500 lights' capacity of Westinghouse incandescent dynamos.

C. A. Ross, representative of the Thomson-Houston company in Kansas City, Mo., reports these sales: 650-light alternating plant for Brookfield, Mo., 650 light alternating plant for Marysville, Kan., and a 30-light arc plant and a 650-light alternating plant for Marysville, Mo.

The San Antonio Gas company of San Antonio, Texas, appears to be well satisfied with the working of the Westinghouse alternate current incandescent system. It has at present in operation Westinghouse apparatus for 1500 lights, and has just placed an order for a 750-light increase.

The Edison General Electric company, through its Louisville office, has closed a contract for an electric street railway system at Maysville, Ky., including five double motor cars. The road will be four miles long, and will be completed in eighty days. The Edison-Sprague system will be used.

One of the progressive towns of the vast and rich mineral state of Montana is Anaconda. An electric light company has been formed in Anaconda and the Westinghouse incandescent system has been chosen. The plant will have an initial capacity of 3,000 16-candle power incandescent lamps and sixty arc lights.

The National Electric Development company has just completed the installation of an incandescent plant at the Victor Mills, Hollister, Cal. The same company has also signed a contract for a 250 light plant at the Paso Robles Hotel, Paso Robles; also a 500-light plant for the Tulare Electric Light company, Tulare, Cal.

The new state of Washington is a pretty lively place. There is no lack of enterprise within it. The towns of the state are rapidly adopting electricity for lighting and motive power purposes. The electric lighting company of New Whatcom has decided upon the Westinghouse alternate current system, and will immediately install a 750-light plant.

Our Spanish-American neighbors are beginning to see the advantages which electricity possesses as an illuminant. Some time ago the Westinghouse company sold a 1500-light alternate current incandescent outfit to dispel the darkness in the Brazilian town of Juiz de Fora. The Juiz de Fora company is well pleased with its purchase, and has just asked the Westinghouse people to ship a 750-light machine to supplement the present capacity of its central station.

Electric lighting in Birmingham, Ala. promises to assume considerable importance. A new company to be known as the Consolidated Electric Light company has been incorporated with a capital of $500,000, to manufacture electrical apparatus and operate a central station. J. F. B. Jackson, R. M. Mulford and Robert Jamieson are incorporators. It is reported that the Edison Electric Light company and the Birmingham Electric Light & Gas company will combine.

Arthur Thomson, of the new Edison Electrical company of Oakland, Cal., has issued a prospectus for that company, which is soon to be incorporated with $500,000 capital stock. Some time ago the Edison company applied for a franchise in Oakland and did not get it. It has now combined with the Electric Light & Motor company, and will absorb the latter. The Edison system will be used for incandescent lighting, and the Brush system for street lighting. The franchise thus acquired is for 47 years.

The incorporation of the following named companies is reported: The Verona, Pa., and Oakmont Light, Heat & Power company, the Edison Electric Light & Power company, Mt. Pleasant, Mich.; capital, $10,000; Buckhannon, W. Va., Electric Light company; Clyde, N. Y., Electric Light & Power company, capital, $32,500; Deland, Fla., Electric Light & Ice company, capital, $150,000; Waynesboro, Ga., Electric Light company; W. A. Wilkins, Prest. Dallas, Tex., Electric company, capital, $300,000; Citizens' Electric Light & Power company, Fort Worth, Tex.; capital, $20,000, incorporators, H. Wells, H. Sulze and others; Orangeburg, S. C., Electric Light & Power company, incorporators, E. F. Slater, J. M. Oliver and C. G. Danzler.

THE ELECTRIC MOTOR.

The Rochester, N. Y., Electric Railway company hopes to have its line from the center of the city to Ontario Beach completed and ready for operation under the new system in a couple of weeks.

The Calumet Electric Railroad company is erecting a $3,000 power house at Ninety-fourth street and Stony Island avenue, Chicago. The work of track laying, etc., is progressing rapidly.

The electric street railway at Rockford, Ill., was completed last week and the first train run. The people were delighted, and they have since enjoyed rapid transit facilities which their metropolitan neighbors do not possess.

G. A. E. Kohler, manager of the Chicago office of the Eddy Electric Manufacturing company, last week installed a No. 3 electro plating machine in Rand, McNally & Co.'s printing house. This is one of the largest machines the company manufactures.

The Rochester, N. Y., Street Railway company has been instructed by the city council to remove the steel poles already erected on Lake avenue and replace them with wooden supports. This will doubtless end the controversy between the street railway company, the council and the residents of Lake avenue.

The Thomson-Houston Electric company will equip the Tacoma and Puyallup Street Railway company's lines with its electric system. The contract is for the entire construction of the road, the power house and the cars. The power house will be equipped with two 80-horse power Corliss engines, and four Thomson-Houston railway generators. Six motor cars and trailers will be in operation as soon as the line is completed.

A company has been formed to build a surface road running from Buffalo through all the river villages to Niagara Falls. The line will start from a point on the city line, from the terminal of the proposed Niagara street electric line, and run north through Tonawanda and Wheatfield to the Falls. It will be operated by electricity. The power station will be located at Tonawanda, and it is said that express trains will be run on a regular time table.

The annual convention of the New York State Street Railway association will be held at the Powers Hotel, Rochester, N. Y., September 16th. During the year many changes have been made in the street railway lines of the state, a large percentage substituting electricity for animal power. It is intended to make electricity, in its application

to street car service, a special feature of the meeting, and an invitation has been extended to the managers of the electric companies to attend and present the claims of their particular system. As is well known, the Rochester lines are being equipped with the Short electric system, and the visiting members will have a fine opportunity to inspect the method of track and overhead construction.

The electric street railways of St Louis, controlled by John Scullin, cross those of George D. Cappen, and it was feared a controversy would arise as to the terms of crossing. Mr. Cappen said the only question that could be raised would be on the stringing of the trolley wires. "Of course," said he, "the under wire has to be jumped, which cuts off the current, but the interval is so short that it has no perceptible effect in the running of cars. The two companies are on friendly terms and are not likely to antagonize the interests of each other to any great extent" Mr. Scullin, however, seems to have a preference for the under wire in the crossing. In making the crossings of these wires a device is used which will hold the wires stationary with relation to each other, and also insulate them from each other. Several devices have been invented for this purpose, but the one used, equipping the Lindell railway plant, consists of a hard rubber plate about 10 inches in diameter and nearly 1 inch thick. The upper wire in the crossing is fastened to the upper side of this plate, while the lower one is suspended from it by a short casting, thus holding the wires about 2 inches apart, and on opposite sides of the plate. Short guide wires extend from the upper wire to the under side of the plate, these being fastened to the upper trolley wire about 14 inches from the plate. These short wires are placed on each side of the plate, to conduct the trolley wheel under it. Under the plate these wires approach to within 7 inches of each other, or within 3½ inches of the other trolley wire in the crossing. In the 7-inch space between the wires there is a guide of non-conducting fiber which guides the trolley-wheel in its passage under the plate and keeps it from coming in contact with the other trolley wire in the crossing.

THE TELEGRAPH.

The Gamewell Fire Alarm Telegraph company, New York, has begun an action in the United States Circuit court to restrain the city of Aurora, Ill,, from using apparatus which the complainant claims infringes patents it controls.

It is officially reported that there are now 89 telegraph offices in San Salvador, with about 1,467 miles of wire. The telegraph service, in general, is satisfactory. The rate for an inland message, or one to any of the four sister republics, consisting of five words and not including the address and name of sender, costs about 10 cents.

The war between the pool sellers of Chicago has attracted much attention throughout the country, and it is interesting to note that, through the agency of the Western Union, the fight has been closed, that company cutting off all telegraphic reports to pool sellers. Without this information, of course, the pool sellers were obliged to close their doors Thus the Western Union solved one branch of the gambling question that has troubled Chicago for years.

An engineer and fireman employed by the New York Central Railroad company were killed at Fisher's Station, near Rochester, N Y., in a collision Aug. 11th. The coroner's inquest resulted in a verdict declaring E. G Kirk, an operator in the train dispatcher's office, responsible for the accident, as it was shown that Kirk had given a wrong order. The operator was arrested, but was afterward released. The attorney for the railroad said Kirk was one of the most faithful men in the employ of the company, and Joseph Drexelius, train dispatcher, said the mistake was one which was very liable to occur. The representative of the company said Kirk would be reinstated in his position.

THE TELEPHONE.

The question of telephone communication between London and Paris is now in a fair way of solution, according to reports from the other side. The French government has appropriated $80,000 toward defraying the expenses of the enterprise, and there is now no reason why the undertaking should not be rapidly pushed to a speedy completion Not only those interested in electrical matters, but the entire civilized world will watch with interest the accomplishment of this enterprise.

A dispatch from San Francisco says: "The Bell Telephone company is likely to have a persistent rival in a party of Chinese in this city whose ingenuity has enabled them to perfect an instrument which works remarkably well, and it is asserted, is not an infringement on the Bell patents. The new instrument was brought to light through an investigation of the telephone company, which became suspicious of the increasing number of orders for the removal of instruments from Chinese shops For many months Wong Ching Wah, otherwise known as W. C. Young, a highly educated and intelligent Chinaman, has been engaged in electrical experiments with a view to perfecting his smattering knowledge of the science, obtained in an Eastern college. Wah is employed as a teacher in a Protestant Episcopal mission at 915 Clay street, and has been able to prosecute his experiments only at odd hours when his services were not required at school. About a year ago he conceived the idea of attempting the construction of a telephone. From the electrical supply house on Mission street he purchased the necessary parts of instruments, and a wood engraver on Kearney street, under his Chinese customer's instructions, knocked together a box for the reception of the completed telephone. Wah screwed the parts together, and the result was so satisfactory that he straightway constructed a second similar instrument. This he set up in a neighboring meat shop, the first instrument having already been placed in position in Mission. Wah and his meat shop friend strung a wire between the two points and then each rushed home to his telephone for the first test. It worked like a charm, and within a week the proud electrician had received from his friends and acquaintances a dozen orders for similar telephones. He filled orders as rapidly as possible, and as fast as new instruments were completed and put in position, those of the Bell company were removed." Authentic reports have not been secured in Chicago where nothing is known of the discovery. This is not the first time reports have been received of the operation of Chinese telephones in San Francisco, but heretofore they have not amounted to anything.

Personal Mention.

Prof. B. F. Thomas of the Ohio University of Columbus, O., was in Chicago last week.

C. A. Ross, who has been appointed representative of the Thomson-Houston company in Kansas City, Mo., was in Chicago last week.

Prof. H. S. Carhart of the electrical engineering department at the University of Michigan, Ann Arbor, made a brief stay in Chicago last week on his way to Ann Arbor from the meeting of the American Association for the Advancement of Science at Indianapolis.

Business Mention.

The Stilwell & Bierce Manufacturing company, Dayton, O., is making a specialty of fitting up complete power plants for electrical purposes.

Fraser & Chalmers of Chicago have secured the exclusive agency for the engines made by the Triumph Compound Engine company of Cincinnati for Utah, Montana, Idaho and Washington.

The Pond Engineering company of St. Louis announces the following specialties: Armington & Sims engines, steel boilers, Standard Rocking and Sheffield grates, Lowe heater, Hopper purifier, Pond separater, Blake pump.

O. W. Ditsch has issued an announcement to his friends and patrons that he is now located at 410 Grand avenue, Kansas City, Mo., where he is prepared to furnish all kinds of electrical supplies, and do all kinds of electrical construction work.

The Indurated Fibre Pipe company, 40 Wall street, New York, have received flattering testimonials from the Bell Telephone company of Philadelphia. The Bell company has used the indurated fibre pipe underground for eighteen months with no appreciable deterioration of insulation. J. L Brownell, president, showed a sample of pipe that had been underground four years, which appeared wholly uninjured by the elements.

The Consolidated Fruit Jar company, 49 Warren street, New York, is exhibiting samples of its fuse wire on tin sheets bearing a very handsome lithograph. This lithographing process is a feature of one of the departments which has recently been enlarged. The company is prepared to make everything in metal goods especially such as are being used by the electrical companies.

The John Stephenson company received an order from the Edison General company for six cars for the Elmira street railroad July 30 and delivered them August 23. On August 25 the president of the railroad company acknowledged the receipt of the cars in good order. The John Stephenson company is prepared to build electric cars on short notice as this transaction indicates.

The recently introduced specialties of the Electrical Supply company, Chicago, are illustrated in a handsome special catalogue, fully describing their devices. They include electric lighting apparatus, lamps, switches, wire and high insulation brackets; also batteries, testing and measuring instruments, etc. This company also carries a full line of standard electrical devices. These are fully described and illustrated in the regular catalogue.

The Sun Electric company of Chicago, which furnished the electric lights for the exposition building on the lake front last fall, have just been awarded the contract for the same work during the ensuing season The company will instal a special plant of 175 arc lamps in the exposition building on their new automatic principle The satisfactory service given by the Sun company last year was commented on by the patrons of the exposition.

The Edison General Electric company has established an office at Louisville, Ky. Campbell Scott, who formerly had charge of the Sprague department of the Gaynor Electric company in Louisville has charge of the electric railway and wiring department, and George H. Stout of the electric lighting. The office is a branch of the Chicago department of the Edison General company, and will operate in Kentucky, Southern Indiana, Tennessee and West Virginia.

The business of the Baxter Electric Motor company of Baltimore, has been growing so fast of late that it has been compelled to force its battery of boilers to their utmost capacity in order to drive all the necessary machinery and generators for testing purposes. In order to relieve the boilers of this undue strain the company is installing another 100-horse boiler purchased from John T. Coleman of Baltimore, Md. When this is installed the power facilities, it is stated, will be equal to those of any electrical manufactory in the country.

The Great Western Electric Supply company of Chicago, has received a large invoice of telegraph apparatus. Learners' outfits are being rapidly disposed of. The company will devote special attention to telegraph trade. The company is also selling large quantities of the Sansom batteries which have heretofore been better known in the East than in the West. The catalogue is expected out this week. It is promised that it will be complete, and well arranged, and is termed a "sketch catalogue." All the standard supplies and specialties mentioned in it have been carefully worked out.

The Electric Merchandise company of 11 East Adams street, Chicago, have just issued a new catalogue of electric railway supplies and material. The book is complete, comprising current indicators of all kinds; switch connections, lamps, insulating material, electric head-lights, trolleys, street car mats, cables, hangers, poles and brackets. The company are also agents for the Burton electric heater, the Wisconsin Bridge & Iron company's iron and lattice poles, the Novelty Electric company's poles, tops and specialties, and many other devices for use in street railway work and construction. The catalogue is one of the most complete of its kind, and will be of assistance to persons engaged in electric street railway construction and operation.

Considerable inquiry has resulted from the recent advertisement in the WESTERN ELECTRICIAN, "What is canvas jacket?" It now comes to light that this is a new patent woven insulated wire, put on the market by the Illinois Electric Material company of Chicago, and is claimed to be thoroughly moisture proof as well as fireproof, and especially intended for line work. From tests made it is claimed that this new wire will stand abrasion 40 per cent. better than any other on the market, and that by reason of the peculiar web in the weaving the tensile strength is increased over 11 per cent. These charactetistics will certainly make it a very profitable factor in all kinds of line and pole work. The Illinois Electric Material company reports a fine trade in poles and wires, and that the new specialiies which they have recently put on the market, are being received with great favor.

The Taylor Manufacturing company of Chambersburg Pa., maker of the Beck automatic engine, reports the following sales: Two engines to the Brennan Hotel company, New York; engine to the Newberry Oil Mill company, Newberry, S. C.; engine with complete steam plant to the Bedford City, Va., Land company; engine with complete steam plant to Streator, Ill Gas & Electric Light company; engine to People's Gas & Electric Light company, Canton, Ill.; engine for the Grace Baptist Church Philadelphia; engine for the Pogue company, Cincinnati, O.; engine for Alex. Crow's Mills, Philadelphia; engine with four boilers to Fort Scott, Kan., Rapid Transit Railway company second engine and complete steam plant to Wonderland Theater, Buffalo, N. Y.; engine with complete steam plant to Thomson-Houston Electric Light company, Kitanning, Pa.; engine to the Greenwood, S. C. Oil company; engine for H. H. Yard, Belmar, N. J.; an engine to the Old Dominion Paper Bag company, Roanoke, Va.; engine with complete steam plant to Albertson, Murray & Co. Waycross, Ga.; engine for Abbeville, S. C Cotton Seed Oil Mill & Fertilizer company; engine for Bridgewater Carriage company, Roanoke, Va.; engine for the Devon Inn, Devon, Pa ; second engine to Brooks & Sons, Philadelphia, Pa.; engine with complete steam plant to W. M. Blount, Bainbridge, Ga.; two engines for Pittsburg Plate Glass Works, at Ford City, Pa.

The Central Electric company of Chicago has just received a large stock of the new Stoddard porcelain cut-outs. This device has come into great favor with electrical construction men, and the Central people report large sales The company have placed in stock a number of Perry wire peelers, a device which was illustrated in the WESTERN ELECTRICIAN a short time ago. This handy little tool is just adapted for the use of bell hangers and incandescent wiring men. The company is gratified by the favor with which its new spark arrester is being received by the public. This device, as well as preventing sparks falling from arc lamps, also prevents flies and other insects from getting into the globes. The company is exhibiting a handsome line of anti-magnetic watches, and has completed arrangements with the Electrician's Time company for handling these goods. The watches range in price from $10 up, and as each one is accompanied by a guarantee from a responsible firm, and the method of payment made easy for the purchaser who cannot afford to pay for the timepiece in cash, they will doubtless meet with great favor among electrical men. The Thomson-Houston company's railway department has secured the contract for the electrical equipment of the Davenport, Rock Island & Moline railroad. This contract, which is one of the largest ever let in Chicago, will amount to over $300,000. The Central Electric company has secured the order for supplies on this contract. This is perhaps the largest electrical supply order ever placed in this city, amounting as it does to upward of $40,000.

Electrical Patents.

Issued Aug 19 and 26, 1890.

434,427. Thermo-Electric Battery. Harry B. Cox, New Haven, Conn.

434,428. Thermo-Electric Generator. Harry B. Cox, New Haven, Conn.

434,429. Thermo-Electric Generator. Harry B. Cox, Hartford, Conn.

434,444 Secondary Battery. Thomas H. Hicks, Detroit, Mich.

"Claim.—The combination of a series of plates clamped together, with insulating frames between them, said frames being made of greater width than the battery plates, whereby vertical recesses or grooves are formed between the projecting ends, and of waterproof cement in said recesses."

434,450. Electric Welding Clamp. Hermann Lemp, Lynn, Mass.

434,457. Electrode for Batteries and the Method of Making the Same. David Pepper, Jr., Philadelphia, Pa.

434,458. Method of Making Secondary Battery Plates. David Pepper, Jr., Philadelphia, Pa.

434,468. Method of Electric Welding. Russell Robb, Boston, Mass.

The invention consists in interposing a piece or pieces of conducting material of less conducting mass than the parts to be welded at the point of contact, passing an electric current through such material, and then applying pressure.

434,488. Electric Power Transmission. Elihu Thomson, Lynn, Mass.

This invention comprises an alternating current-supply main feeding the armature of alternating current motors, a unidirectional supply-main feeding the fields of said motors, and a common return for the alternating and unidirectional mains.

434,489. Electric Power System. Elihu Thomson, Lynn, Mass.

434,500. Thermo Electric Generator. Harry B. Cox, Hartford, Conn.

434,501. Electric Meter. Jules Cauderay, Paris, France.

434,509. Ceiling Block Connector. Charles W. Hunting, Baltimore, Md.

434,530. Process of and Apparatus for Forming and Welding Metals by Electricity. Elihu Thomson, Lynn, Mass.

434,531. Induction Discharge Protector for Welding Apparatus. Elihu Thomson, Lynn, Mass.

434,532. Process of Electric Welding. Elihu Thomson, Lynn, Mass.

The improvement consists in applying lateral compressing or condensing force to the weld during the application of the endwise welding pressure or force, which tends to upset the metal, so as to form a lateral expansion at the joint.

434,557 Volt or Ampere Meter. Rudolf Eickemeyer, Yonkers, N. Y.

434,558 Device for Measuring the Intensity of Magnetic Currents. Rudolf Eickemeyer, Yonkers, N. Y.

434,579. Apparatus for Transferring Electric Car Batteries. Frederick G. Corning, New York, N. Y.

434,580. Apparatus for Transferring Electric Car Batteries. Frederick G. Corning, New York, N. Y.

Claim 5 reads: "The combination, with the charging-benches, the ascending grades, and the gravity platform opposite the benches, of mechanism for controlling or arresting the descent of the platform at will."

434,581. Apparatus for Transferring Electric-Car Batteries. Frederick G. Corning, New York, N. Y.

434,582. Mechanism for Transferring Electric Car Batteries. Frederick G. Corning, New York, N. Y.

434,585. Telegraph Relay. Thomas A. Edison, Menlo Park, N. J.

Application filed Aug. 9. 1880.

"Claim 1. The combination of an electro-magnet, a magnetic armature, and a conducting material whose resistance is varied by pressure situated between the core of said magnet and said armature, and adapted to be compressed by said armature upon its attraction by said magnet."

434,586. Electric Generator. Thomas A. Edison, Llewellyn Park, N. J.

Claim 7 reads: "The combination, with a body expanded and contracted by variations in temperature, of a magnet, a movable keeper for such magnet, and an adjustable connection between such expansible body and said movable keeper."

434,587. Thermo-Electric Battery. Thomas A. Edison, Llewellyn Park, N. J.

"Claim 2. In a thermo-electric couple or battery, the combination of two metals having a moving contact, with a source of heat acting on one of such metals, the other metal being heated only by conduction at the point of contact."

434,588. Magnetic Ore Separator. Thomas A. Edison, Llewellyn Park, and William K. L Dickson, Orange, N. J.

434,589. Propelling Mechanism for Electric Vehicles. Thomas A. Edison, Llewellyn Park, N. J.

The last claim reads: "12. The combination, with dynamo machines having their armatures connected in parallel to the main circuit and provided with an equalizing connection for the armatures, of a secondary battery joined to the equalizing connection and in a branch around both armatures."

434,590. Dynamo Electric Machine. Justus B. Entz, New York, N. Y.

434,593. Galvanic Battery. William M. Fink, Elizabeth, N. J.

434,596. Electric Push Button. Philip Hathaway, New York, N. Y.

434,614. System of Electrical Distribution. Henry E. Walter, Schenectady, N. Y.

"Claim 11. The combination, in a three-wire system of electrical distribution, of a permanent ground connection from the neutral wire thereof, a switch for connecting the positive or negative wire to ground, and an indicator of electric current in the earth circuit thus formed."

434,639. Tower for Electric Lighting. David Maxwell, Detroit, Mich.

434,640. Thermal Battery. Hugo Mestern, Munich, Germany.

"Claim 1. In a thermo-electric or furnace battery, a pair of electrodes, one of which is provided with screw-threads engaging similar threads on the casing or mantle of another electrode."

434,671. Electric Valve-Closer. Lemuel Mellett, Boston, Mass.

434,682 Trolley for Electrically Propelled Cars. William L. Stevens and Edwin J. Wescott, Boston, Mass.

434,684. Electric Railway System. Charles J. Van Depoele, Lynn, Mass.

434,685. Alternate Current Electric-Railway-Train System. Charles J. Van Depoele, Lynn, Mass.

434,686. Electric-Railway-Train System. Charles J. Van Depoele, Lynn, Mass.

434,687. Electric-Railway System. Charles J. Van Depoele, Lynn, Mass.

434,746 Electric Belt and Appliances. Robert E. Williams, Dallas, Tex.

434,816. Multiple Circuit Electric Motor. Charles J. Van Depoele, Lynn, Mass.

"Claim 1. An electric motor having multiple field-magnet poles and multiple circuits therefor energized successively, and an armature energized by the common return of all the independent circuits."

434,827. Electric Railway. Adelos Gorton, Camden, N. J.

434,835 Portable Electric Signaling Device. Peter Pearson, New York, N. Y.

434,853. Contact Box. Ferdinand A Wessel, Brooklyn, N. Y.

434,863. Apparatus for Transferring Electric Car Batteries Frederick G. Corning, New York, N. Y.

434,869. Secondary Battery Plate. William B. Hollingshead, Bronxville, N. S.

Active material, as red lead, black oxide of manganese, or other non-cohesive substance, and an integral inclosing crust of porous material, are used together.

434,871. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

"Claim 20. In an electric railway, a working conductor, from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity, in combination with a traveling electric motor or vehicle receiving electricity therefrom."

434,879. Electric Insulator. Samuel Oakman, Melrose, Mass.

434,880. Recording Telegraph. John B. Odell, Chicago, Ill.

434,881. Printing Telegraph. John B. Odell, Chicago, Ill.

434,882. Speed Varying Mechanism. John F. Ott, Orange, N. J.

434,884. Apparatus for Recutting Files. Charles C. Peters, Springfield, O.

434,885. Electric Conductor. William A. Phillips, Schenectady, N. Y.

434,899. Electric Switch. Charles H. Wilson, Chicago, Ill.

434,917. Hanger for Incandescent Lamps. Paul J. Chassagne, Akron, Ohio.

434,922. Non Interfering Signal Box. William E. De-Crow, Boston, Mass.

434,925. Ceiling Fuse Block. Horace A. Fitch, New Bedford, Mass.

434,943. Electric Connector. Edward L. Orcutt, Somerville, Mass.

434,949. Gearing for Electrically Propelled Vehicles. Nathan S. Possons, Cleveland, O.

434,951. Dash Pot. Michael Raughtigan, Norwich, Conn

434,961. Section Insulator for Overhead Electric Conductors. Elihu Thomson, Lynn, Mass.

The fourth claim is given:

"The combination with the two ears adapted to be attached to adjacent ends of an open sectional line conductor, of a connecting frame connected to each of said ears through insulation, and a protecting-cap for the insulation at each point of connection."

434,992. Insulator. Charles O. Muehlberg, Pittsburg, Pa.

434,993 Motor for Street Cars. William H. Patton, Chicago, Ill.

One of the objects of the invention is to provide means for driving the car in either direction from a single motor, or two motors in the same circuit, without reversing the motor or motors.

435,011. Trolley for Electromotor Cars. Samuel D. Cairns, Troy, N. Y.

435,015. Dynamo-Electric Machine. William F. Collins, New York, N. Y.

435,024. Incandescent Lamp Socket. Frederick C. Rockwell, Hartford, Conn.

435,029 Cut-Out for Electric Lamps. William G. Bremer, St Louis, Mo.

435,030. High-Resistance-Shunt Compound, William G. Bremer, St Louis, Mo.

435,036. Method of and Means for Bending Electrotype-Plates. Patrick M. Furlong, New York, N. Y.

435,047. Incandescent Lamp Socket and Key. Walter F. Smith, Philadelphia, Pa.

435,048. Cut-out. Walter F. Smith, Philadelphia, Pa.

435,049. Cut-out for Electric Lamps. Walter F. Smith, Philadelphia, Pa.

435,084. Electric Lighting System. Alexander H. Bauer, Chicago, Ill.

435,093. Electric Switch. Charles H. Herrick, Winchester, Mass.

435,097. Electric Signal for Cable Railways. Solomon J. Jacobs, New York, N. Y.

435,098. Automatic Disconnector for Overhead Conductors. Andrew L. Johnson, Richmond, Va.

The device may be placed at intermediate points along any electrical circuit having suspended wires, care being taken to have the springs strong enough to draw the wire and close the arms whenever a break occurs.

435,102. Fuse Block. Nathan S. Possons, Cleveland, Ohio.

435,105. System for Electric Circuits. Frederick Stitzel, Louisville, Ky.

435,110. Electric Forging-Machine. George D. Burton, Boston, Mass.

"Claim 4: The combination of forging-dies, an upsetting plunger, and electrodes for heating the rod to be worked."

435,111. Electric Bar Heating and Feeding Apparatus for Forging-Machines. George D. Burton, Boston, Mass.

435,114. Means for Distributing Electric Energy. Sebastian Z. de Ferranti, London, England.

The invention consists of two fuses, one in each branch of the circuit, and springs held compressed or strained by such fuses, and mechanism worked by the spring liberated by the burning of a fuse to instantaneously disconnect the other fuse.

435,116. Guard for Electric Light Globes. Robert M. Gardiner, Hamilton, Canada.

435,132 Electric Switch. Joseph W. Battershall, Attleborough, Mass.

435,152. Electric Switch. John A. Norton, Bridgeport, Conn.

435,166. Trolley or Contact Support for Electric Cars. Leonard Atwood, Philadelphia, Pa.

435,185. Electrical Watchman's Clock. Harvey S. Park, Chicago, Ill.

435,193. Duplex Tube. Elisha J. Steele. Torrington, Conn.

435,213. Electric Alarm for Clocks. William H. Deane, Brooklyn, N. Y.

435,223. Electric Cut out. Charles Heisler, St. Louis, Mo.

435,248. Electric Arc Lamp. Erneste Rothlisberger, Lima, Ohio.

435,259. Electric Device for Preventing Accidents on Railways. Gilmore Thew, Peru, N. Y.

435,261. Generator for Electric Engine Circuits. Charles J. Van Depoele, Lynn, Mass.

435,262. Structure for Supporting and Insulating Suspended Bare Conductors. Charles J. Van Depoele, Lynn, Mass.

The eighth claim follows:

"The combination, with an electric-railway pole, of a removable cap and an insulating-connection connecting the cap to and supporting the same upon the pole."

435,263. Electric Railway Conduit with Tubular Conductor. Charles J. Van Depoele, Lynn, Mass.

Claim I follows:

"A tubular conductor and fixed contact devices extending from the exterior to the interior thereof."

435,264. Reciprocating Electric Hammer. Charles J. Van Depoele, Lynn, Mass.

435,283. Method of and Apparatus for Welding by Electricity. Charles L. Coffin, Detroit, Mich.

The method consists in bringing the edges to be welded in proximity to each other, embracing said edges between conductors connected with one pole of a generator of electricity, connecting one of the articles to be welded to the other pole of said generator, and passing a heating current of electricity through said articles and the embracing conductor.

435,284. Process of Heating Metals by Electricity. Charles L. Coffin, Detroit, Mich.

435,292. Autographic Telegraph. Harry Etheridge, Pittsburg, Pa.

435,295. Automatic Telephone Connector. William H. Ford, St. Louis, Mo.

This case contains twenty-seven sheets of drawings and twenty-two pages of specifications. Of the nine claims the sixth is given:

"The combination, with a number of counters and a connecting box common to all of said counters, of an intermediate isolator electrically connected on the one hand with each individual counter, and on the other hand with the branch circuit wires leading respectively through the counting magnet and polarized magnet of the connecting box."

435,296. Contact Brush for Dynamos. Eugene Franklin, Greenville, S. C.

435,314. Telephone Tablet. Walter S. Mendenhall, Covington, Ky.

435,332. Automatic Current Regulator. René Thury, Geneva, Switzerland.

435,338. Feeding and Justifying Mechanism. James A. Watson, Washington, D. C

435,340. Automatic Electric Train Signal and Controlling Device. William H. Wilson, New York, N. Y.

435,343. Articulated Electro-Magnet. Fred. H. Brown, Chicago, Ill.

435,346. Galvanic Battery. Charles J. Hubbell, New York, N. Y.

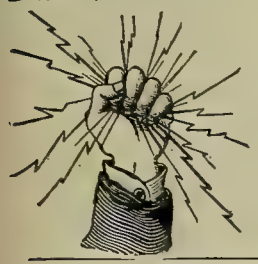
435,368. Extension Electrolier. James T. Robb, Mount Vernon, N. Y.

435,376. Electro-Magneto Therapeutic Chair. Frederick H. Brown, Chicago, Ill.

11,108. Regulation of Electric Arc Light Circuits. Daniel Higham, Boston, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

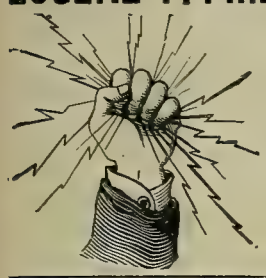
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS: W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

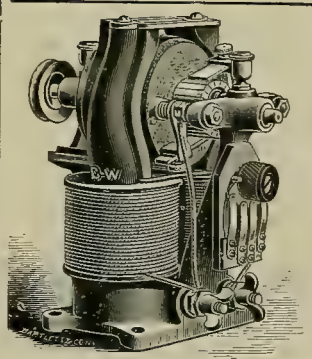
THE TURNER BRASS WORKS
MAKE ANYTHING IN BRASS
4 LASALLE AVE CHICAGO.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE

Crocker-Wheeler

PERFECTED MOTORS

Develop Full Power at Half the Speed of other Makes and are, Therefore, Noiseless.

WORKS:

14th, Washington and 13th Streets,

NEW YORK.

SUNBEAM

Gives a constant light of great beauty and maintains its Rated Candle Power.

Write for New Catalogue.

THE SUNBEAM INCANDESCENT LAMP CO.,

Randolph and Canal Streets, - - CHICAGO.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Belt Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

INSULATED WIRES AND CABLES,

OKONITE TRADE MARK.

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

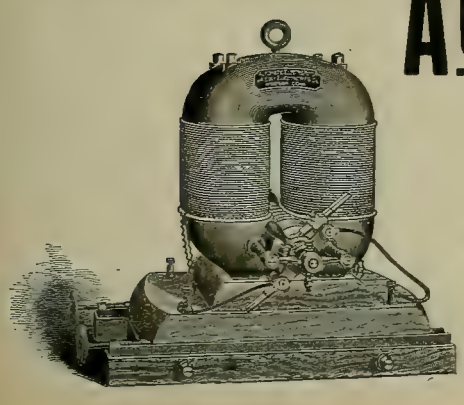
BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS

In all Sizes from One-half H. P. Upward.



High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 78 Customhouse St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue,

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

—— Electric Light and Street Railway Goods a Specialty. ——

SEND FOR CATALOGUE AND SPECIAL PRICES.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

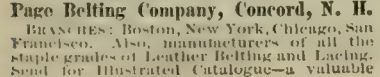
SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

INTRODUCING ENTIRELY NEW PRINCIPLES.



Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 10c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, • • CHICAGO.

Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

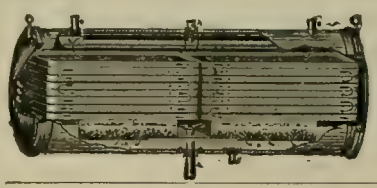
Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

INCANDESCENT and ARC LIGHTING and MOTORS.

Isolated Lighting a Specialty.

H. H. HUMPHREY,

1034 New York Life Building.

Contracting and Consulting Electrical Engineer. OMAHA, NEB.

C. H. & D. R. R.

BEST ROUTE

From **CINCINNATI** to the North and North West.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most ence and is consequently the most non-absorbent that can be produced, eing the TRUE HARD PORCELAIN.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue **1--66** of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

THE CURTIS

PATENT RETURN STEAM TRAP.

IT is noiseless, positive, rapid, will return all condensation back into the boiler, and works equally well in connection with reduced pressure or exhaust steam, also when the return is below the water line of the boiler.

THE CURTIS REGULATOR COMPANY,

91 BEVERLY ST., BOSTON, MASS.

GENERAL AGENCIES.

NEW YORK, 109 Liberty st. CHICAGO, 218 Lake st.
PHILADELPHIA, 2035 N. Front st. MINNEAPOLIS, 210 N. Third st

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

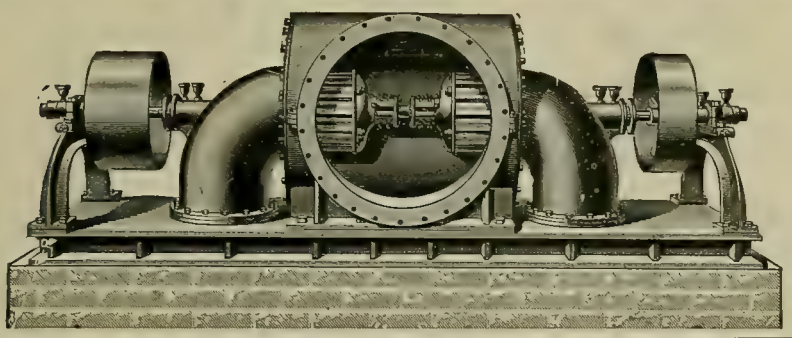
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires, Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

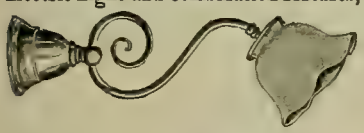
STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO. MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

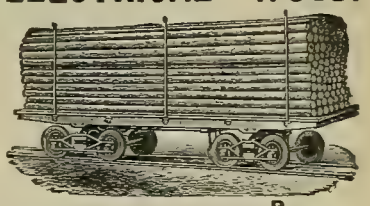
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE & MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE & MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

WESTERN ELECTRIC CO.,

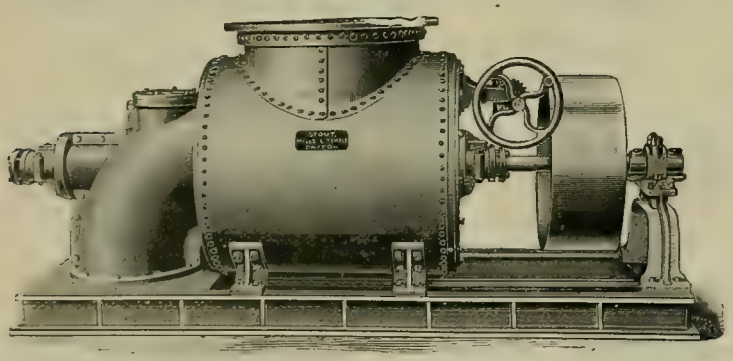
WE ARE THE EXCLUSIVE WESTERN AGENTS FOR THE SALE OF

A. G. DAY'S KERITE WIRES FOR TELEGRAPH, TELEPHONE, AND ELECTRIC LIGHT USE.

PRICES ON APPLICATION.

CHICAGO. NEW YORK.

The New American Turbine Water Whee.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST. CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

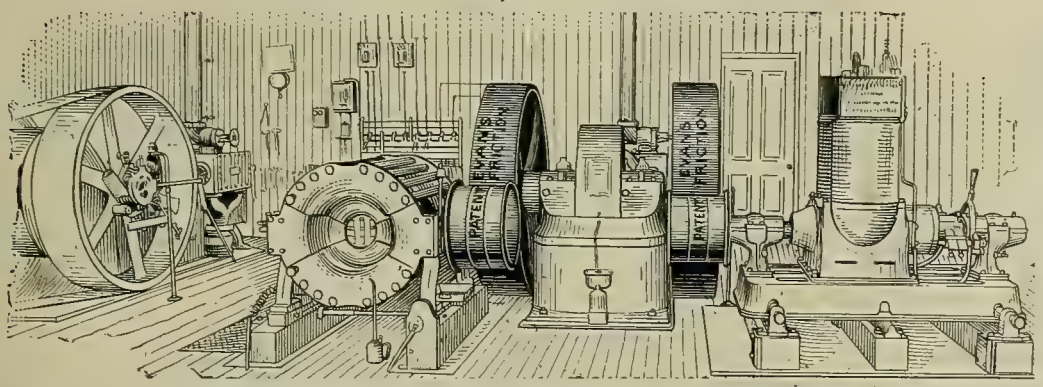
ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

The EVANS SYSTEM OF DRIVING DYNAMOS.

HUTCHINSON WATER, LIGHT AND POWER CO.



Thomson-Houston "M. D." and Edison No. 16.
Running constantly since January, 1890.

This cut of a portion of the Hutchinson (Kansas) Water, Light and Power Co.'s station is introduced to illustrate still another way in which two dynamos may be driven directly from an engine. There are many places where, owing to the shape of the space allotted to the engine and dynamos, this arrangement is most desirable. In cases where the location permits, however, room can be saved by using the arrangement shown in the blue print of the plant on board the steamship "Portland." This arrangement has also a further advantage in that when both dynamos are in gear the pressure of one dynamo pulley on the engine bearings is counterbalanced by the pressure of the other, and is not all in one direction: as is usually the case in common practice.

The plant in the new Shoe and Leather Exchange Building in Boston, is of the same type as that shown in this cut. Two 650 light Mather dynamos are driven, one from the fly-wheel, and the other from the governor wheel of a McIntosh & Seymour Engine.

These two plants are instances where the advantages of our system are unusually apparent. In the case of the station at Hutchinson where the arc machine furnishes the current for street lamps, and the incandescent machine for commercial lights, it is a great advantage to stop and start either machine as the requirements of the service may require.

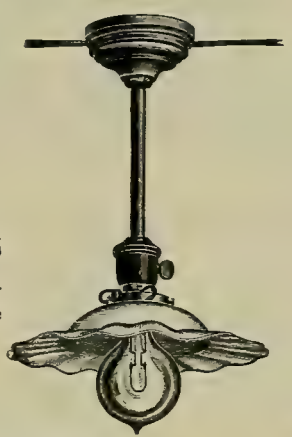
This is equally true of the plant in the Shoe and Leather Exchange Building. For a portion of the day one machine will furnish all the current necessary to supply what few lamps may be in use; but later in the day, or in cloudy weather, the demand for lights may be in excess of the capacity of one dynamo, and it will then become necessary to throw in the reserve machine. This can be done without even slowing the speed of the engine.

EVANS FRICTION CONE CO., 85 Water St., BOSTON.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

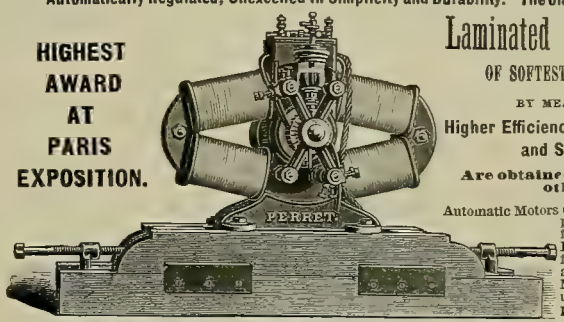
620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE. 190 Fifth Ave., GEORGE CUTTER, Agent.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,
79 and 81 Washington St., Brooklyn, N. Y.,
—MANUFACTURERS OF THE—
PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

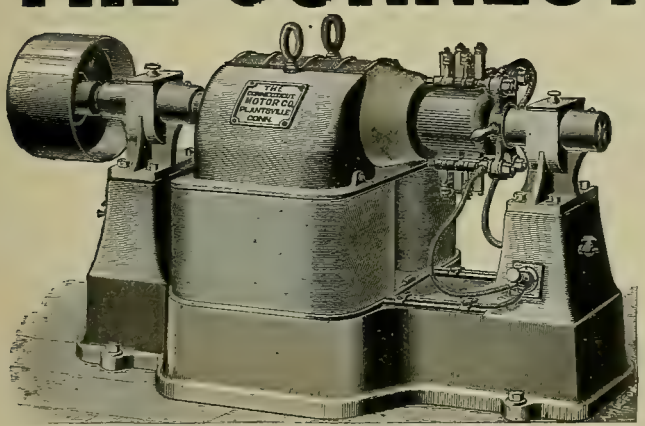
HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:
PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL
Electric Motors and Generators

1-2 TO 50 HORSE POWER.
FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

DICTIONARY
—OF—
ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

OKONITE
TRADE MARK

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

JOHN STEPHENSON CO.,

LIMITED,

NEW YORK.

STREET CARS

FOR

ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.

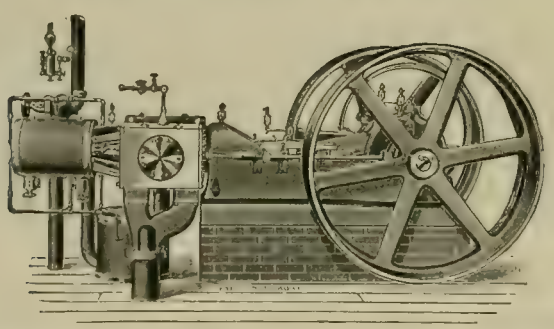
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

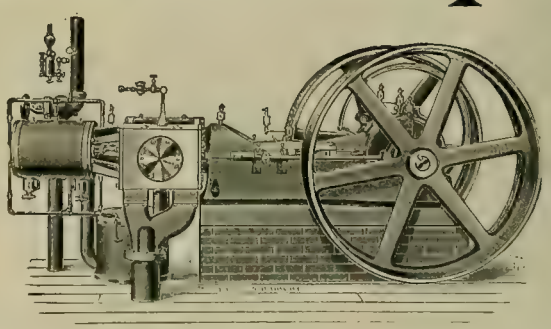
SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

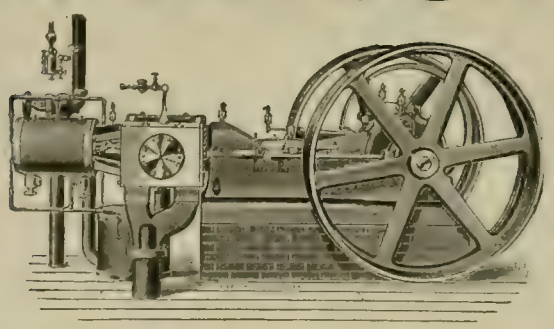
None so Good, None to Equal.



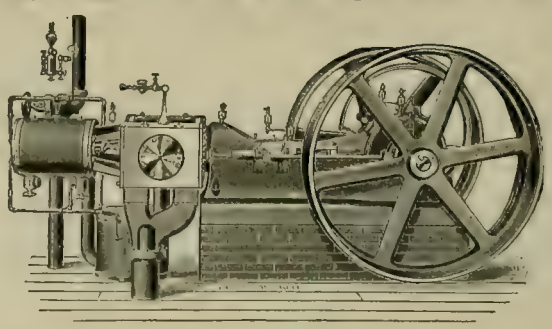
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

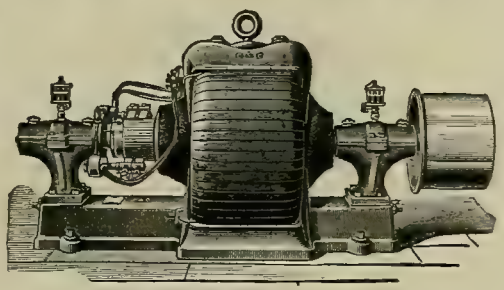
144 ADAMS ST., CHICAGO.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

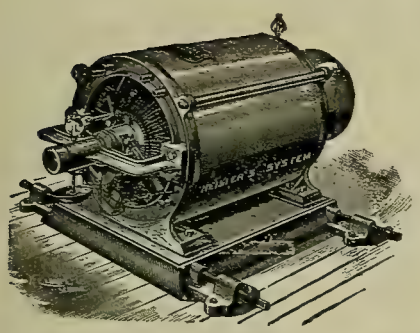
Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.



UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.

"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.
Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.
CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75 CENTS.

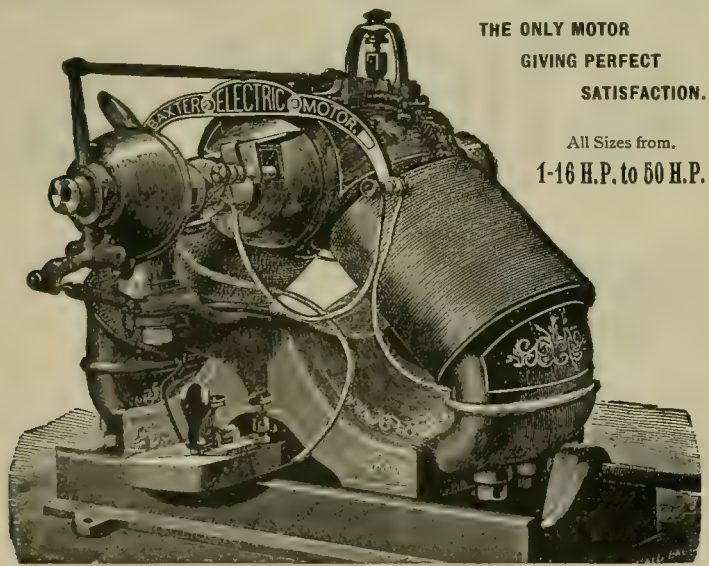
This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,
MANUFACTURERS OF
Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——
Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent. 103 Adams St., Room 8, Chicago, Ill.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

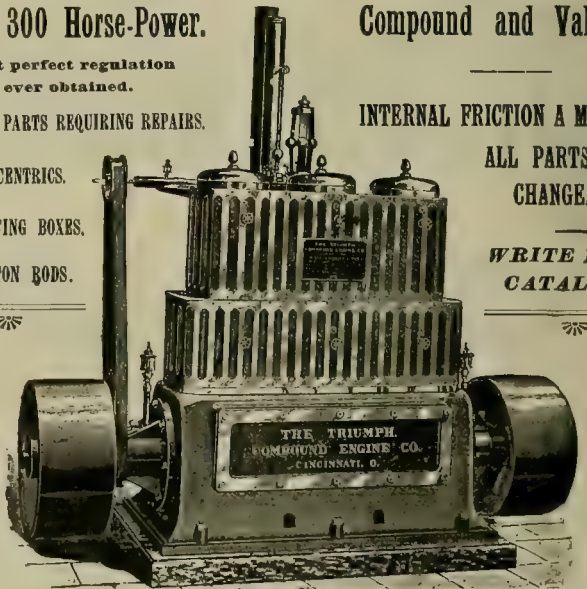
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,
SOLE BUILDERS,
211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.
FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

ARMATURES REPAIRED AND REWOUND
COMMUTATORS TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY.
DUPLICATES OF ALL KINDS.
GENERAL DYNAMO REPAIRING & JOBBING.
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

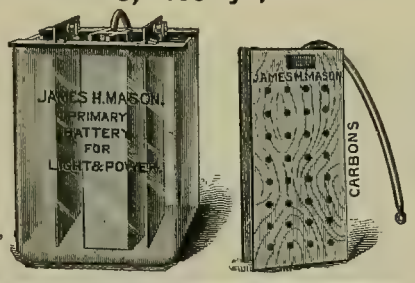
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



BARNES' NEW SENSITIVE DRILL
Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 13 South Fourth St., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

Factory: JERSEY CITY, N. J.

Over 105 Roads operated under Our System, and that Successfully, both financially and electrically.

EDISON
GENERAL ELECTRIC
COMPANY,

Edison Building, 44 BROAD STREET,
NEW YORK CITY.

ELECTRIC STREET RAILWAYS.

Our Electric system for Street Railways has been found to be the most durable, reliable, economical and convenient.

New roads in course of construction going on in all parts of the country.

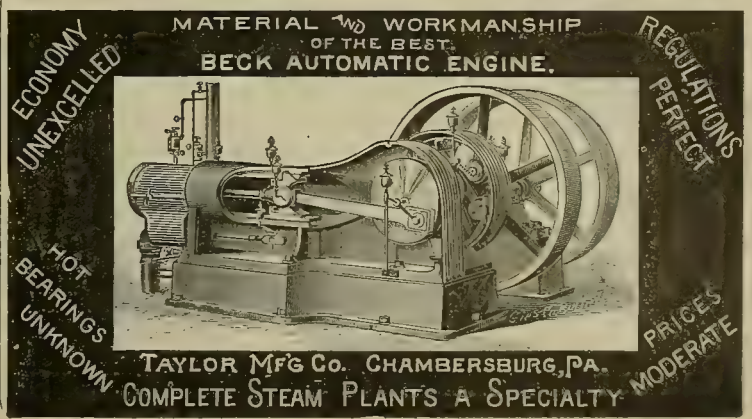
Railroad Managers and Others interested in this business are earnestly requested to correspond with us, to *get facts* and *data* showing the advantages and possibilities to be obtained by Electric Traction over any other existing methods.

DISTRICT OFFICES:

NEW YORK, Edison Building. CHICAGO, Rialto Building.
SAN FRANCISCO, Chronicle Building. NEW ORLEANS, Cotton Exchange.
PORTLAND, ORE., Washington Bldg. DENVER, Masonic Building.
TORONTO, CAN., Bank of Com. Building.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

C., B. & Q. R. R.
—IS THE—
Best Appointed Line
—FOR REACHING THE—
West, Northwest and Southwest.



NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2000	"
" " " "	3d " (Just ready.)	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition (Just ready.)	2,500	Cop'es
Bell Hangers' " "	1st "	2,500	"
" " " "	2d "	1,000	"
Total within Eighteen months		15,000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1 00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

250 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

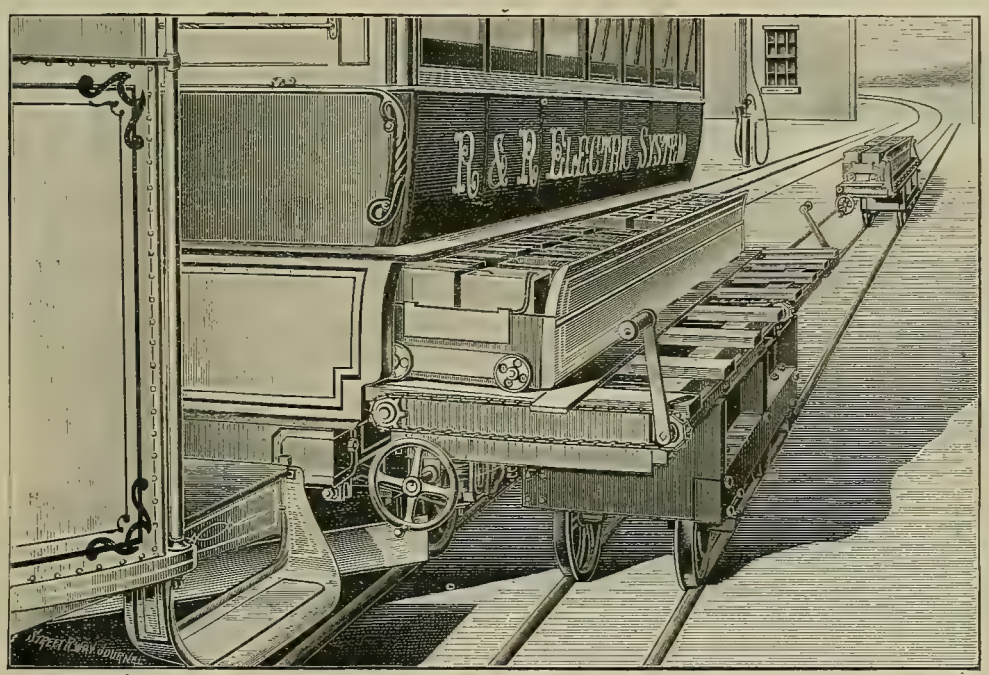
SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



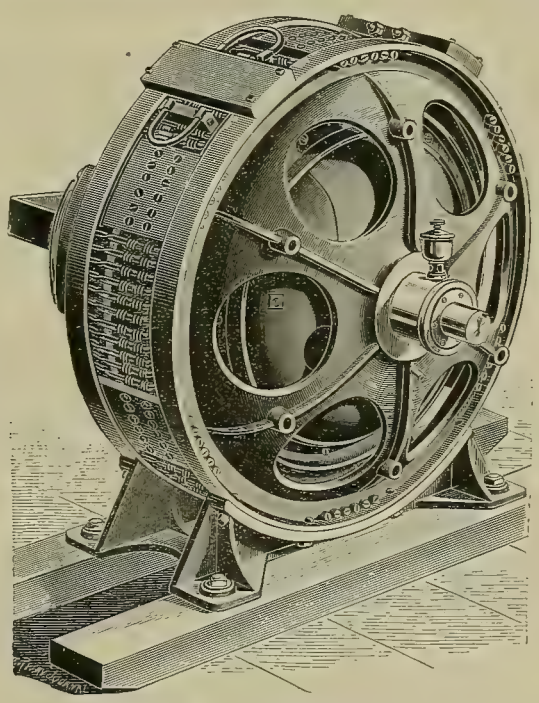
METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

Cars are Lighted by Batteries That Propel The Motor.

THE MAIN Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

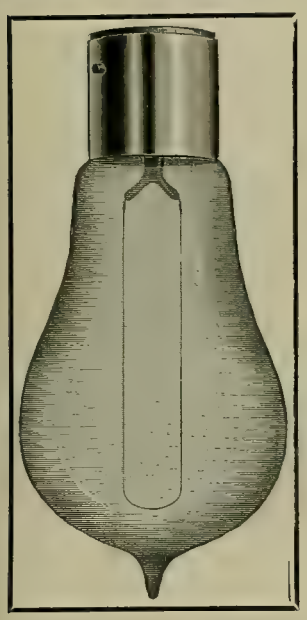
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

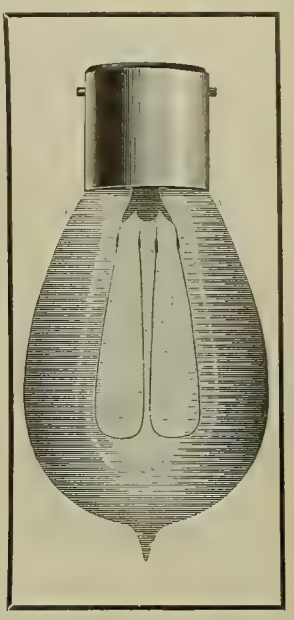
THE

Perkins Electric Lamp Co.

ALL CANDLE POWERS.

TO FIT ANY SOCKET. ANY VOLTAGE.

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

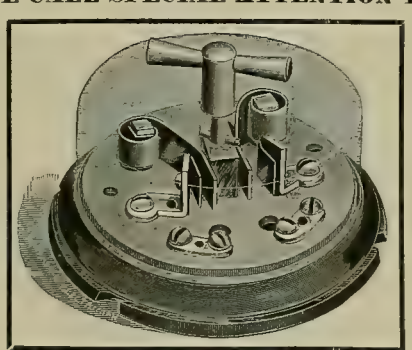
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

WE CALL SPECIAL ATTENTION TO

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

— FOR —

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE
ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

HABIRSHAW INSULATION.

(CONTINUED FROM LAST WEEK.)

Last week we referred to the quality of Habirshaw Insulation. The following list shows a few places where it has been used:

United States Steamship Trenton.
United States Steamship Chicago.
United States Steamship Boston.
United States Steamship Yorktown.
United States Steamship Pensacola.
United States Steamship Philadelphia.
United States Steamship Petrel.
United States Steamship Atlanta.
United States Steamship Baltimore.
United States Steamship Newark.
United States Steamship Vermont.
United States Steamship Charleston.
United States Steamship San Francisco.
United States Steamship Concord.
United States Steamship Remington.
United States Monitor—Miantonomah.
Torpedo Station and War College, Newport, R. I.
United States Patent Office, Washington.
Naval Academy, Annapolis, Md.

STEAMERS.

Puritan (Fall River Line.)
Pilgrim " "
Plymouth (People's Line.)
Drew " "
New York " "
Dean Richmond "
Iroquois (Clyde Line.)
City of Birmingham (Southern Line.)
Olivette " "
Caracas " "
City of Washington " "
Kansas City " "
Gate City " "
Connecticut (Providence Line.)

Equitable Building, New York.
Washington Building, New York.
Brown Bros., Building, New York.
Union Trust Building, New York.
Farmers' Loan & Trust Co.'s Building, New York.
Union League Club, New York.
Union Club, New York.
Mechanics' Bank, New York.
Tuxedo Club, Tuxedo Park, New York.
American Institute, New York.
Metropolitan Museum of Art, New York.
Drexel Building, Philadelphia, Pa.
Broadway Theatre, New York.
Tremont Theatre, Boston.
Amphion Theatre, Williamsburg, N. Y.
Park Theatre, Brooklyn.
Herman's Theatre, Brooklyn.
Hyde & Beman's Theatre, Brooklyn.
Auverne Hotel, Auverne, Long Island.
Hotel Cordova. St. Augustine, Fla.
Fenwick Hall, Saybrook, Conn.
Columbia College, New York.
Grand Central Depot, New York.
Madison Square Presbyterian Church, New York.
Central Railroad Co., New Jersey.
Elgin National Watch Company's Factory, Elgin, Ill.
W. K. Vanderbilt's Residence and Yacht, New York.
Francis H. Leggett & Co., New York.
T. C. Eastman's Abbatoir, New York.
Monroe County Insane Asylum, Rochester, N. Y.
North Dakota Insane Asylum.
New York State Insane Asylum, Utica, N. Y.
Morgan Line Pier, New York.
White Star Line Pier, New York.
Statue of Liberty, New York.
Washington Bridge, Harlem River, New York.
Hudson River Tunnel, New York.
Edison Central Station, Brooklyn, N. Y.
Madison Square Garden, New York.
Leonard & Izard, for use under the Mackinac Straits.

AND STILL THEY COME.

THE BRUSH ELECTRIC COMPANY

STILL CLAIMS THE EXCLUSIVE RIGHT TO MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

AGAIN SUCCESSFUL

THE BRUSH ELECTRIC COMPANY
vs.
THE WESTERN ELECTRIC LIGHT & POWER COMPANY, et al.
(Western Electric System.)

Opinion by Judges Brown and Ricks in the United States Circuit Court for the Northern District of Ohio, filed August 15, 1890:

"Any dissimultaneous arc forming separation by mechanism resulting in the suc-"cessive burning of the carbons, is an infringement of the Brush patent."

So called double fixed carbon, three carbon or flat carbon lamps are crude and unsatisfactory.

The Court say:

"Defendants experts are constrained to admit, not only that Brush was the first to "invent the principle of substitution in his double carbon lamp, but that the Western "Electric Company could not successfully compete with the companies using his patent, "in furnishing all night electric lighting plants unless it could provide double carbon "lamps to its customers."

"We should have felt fully justified in disposing of this case by a simple reference to "the opinion of Judge Gresham in the Brush Electric Company vs. The Ft. Wayne Electric "Light Company, in which the same construction was placed upon the Brush patent, but "in view of the importance of the questions involved, and of the elaborate preparation of "counsel, we have deemed it proper to give it an independent consideration."

"We are clearly of opinion that complainant is entitled to relief in this case, and a "decree will, therefore, be entered for an injunction, and the usual reference to a Master "to assess and report its damages."

BRUSH APPARATUS ALWAYS RELIABLE.

ARC AND INCANDESCENT LIGHTING SYSTEMS, ELECTRIC MOTORS, GENERATORS, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

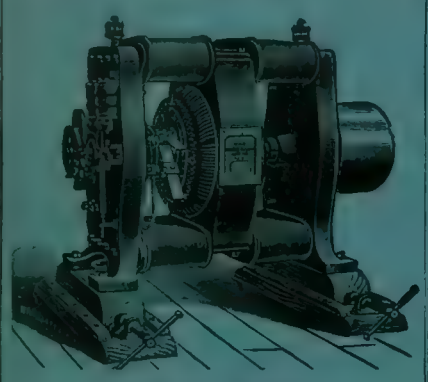
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



WOOD ARC DYNAMO.

MAIN OFFICE:

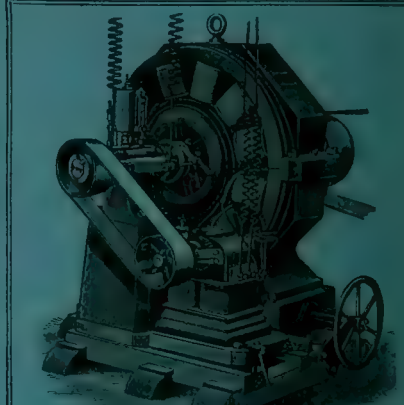
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

The Consolidated Electric Storage Co.,

MANUFACTURERS OF

THE JULIEN ELECTRIC STORAGE BATTERY.

Exclusive licensees for the whole of the United States of the Storage Battery Patents of Charles F. Brush [lately owned by the Brush Electric Company], and sustained by the Circuit Court of the United States.

Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

BATTERIES FOR LIGHT AND POWER,

Sold at Prices so Low as to Defy Competition.

For Agencies and Licenses apply at the Company's Office at

120 Broadway, NEW YORK CITY.

All other inquiries, more especially those in relation to Purchase of Batteries, should be addressed to the Philadelphia Office of the Company.

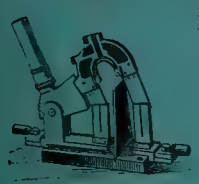
926 Drexel Building, PHILADELPHIA, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, SEPTEMBER 13, 1890. No. 11

"AJAX SWITCHES"



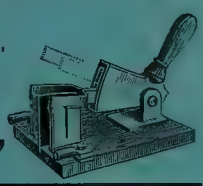
FOR CENTRAL STATIONS AND POWER CIRCUITS.

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,

74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

To Make YOUR TELEPHONES TALK

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

—INDORSED BY THE—

United States and German Governments.

BEST ANTI-FRICTION METAL

For Dynamo, High-Speed Engine, Steamship, Car, and all Machinery Bearings.

MAGNOLIA ANTI-FRICTION METAL CO.,

Owners and Sole Manufacturers,

London Office: 75 Queen Victoria St.
Chicago Office: 41 Traders' Building.

74 CORTLANDT ST., NEW YORK.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

For Addresses of DISTRICT OFFICES SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave., CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment.

Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964		3,964
Westinghouse		27,710	27,710
Edison		10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734		734
Ball	613		613
Western Electric	566	250	[illegible]
Indianapolis Jenney	794		794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324		324
Van Depoele	285		285
Waterhouse	222		222
Heisler		500	500
Remington	159	300	[illegible]
Sperry	130		[illegible]
Excelsior	90		90
Hochhausen	60		60
Weston	30		30
Fuller	10		10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,067
Edison	...	[illegible]
American	1,537	175
United States	632	6,141
Schuyler	1,066	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	[illegible]
Remington	129	.....
Sperry	160	.....
Excelsior	205	30
Hochhausen	70	...
Weston	[illegible]	.....
Fuller	10	.....
Reliance	[illegible]	.....
National	.....	[illegible]
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Ansonia Brass & Copper Co.. i
Allis, E. P. & Co..... vii
American Electrical Works. . xv
Abendroth & Root Mfg. Co.. i
Ball Engine Co..... xxii
Baggot, E..... xvi
Barton, Geo. P..... xvi
Bernstein Electric Co..... —
Brush Electric Co..... xxix
Butler Hard Rubber Co..... xx
Bain, Foree..... xvi
Brown, Frank T..... xvi
Barnes, W. F. & Jno..... xx
Baxter Electric Motor Co..... xxx
Bleckert & Nelson..... xvii
Bunnell & Co., J. H..... —
C. B. & Q. R. R..... xxv
Cleverly Electrical Works... xvi
Colburn & Co., I. W..... xvi
C. & C. Electric Motor Co... xxii
Central Electric Co..... xi
Continental Dynamo Co..... iv
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... —
Consolidated Electric Storage Co..... —
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... —
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xviii
Electrical Supply Co xxviii
Empire City Electric Co..... xviii
Eastern Electric Cable Co. xv
English, Morse & Co..... xvii
Excelsior Electric Co..... ... xxi
Elektron Mfg. Co..... xix
Eddy Electric Mfg. Co..... xv
Eddy, Henry C..... .. xiv
Electric Construction & Sup. Co iv
Edison Mfg. Co..... xxii
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Railway Dept..... xxv
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co..... xix
Eureka Tempered Copper Co.. xvii
Easton Electric Co..... iv
Electric Merchandise Co..... xvi
Electrician Publishing Comp'y, xvi, xxiii, xxiv
Evans Friction Cone Co..... xix
Empire China Works..... xvi
Fibrone Mfg. Co..... xv
Forest City Electric Works.... vii
Fort Wayne Electric Co..... xxx
Fletcher & Fletcher Electric Co xvi
Globe Carbon Co..... xvii
Greeley & Co., E. S..... xiv
Gibson Gas Fixture Co.....xviii
Giles Bros..... xii
Great Western Electric Sup. Co. v
Hazelton Tripod Boiler Co.... xxv
Heisler Electric Light Co..... —
Hill Clutch Works..... vii
Holmes, Booth & Haydens.....xvii
Harmount, G. A..... xii
Hazazer & Stanley..... xiv
Holtzer-Cabot Electric Co..... i
Hawkeye Electric Mfg. Co.... —
Holmes & Co., C. H..... xvii
Humphrey, H. H..... xiv
Ireson, Chas. L.. ..... —
Interior Conduit & Insulation Co. xiv
India Rubber & Gutta Percha Co. i
Ide & Son, A. L..... xiv
Illinois Electric Material Co.... xiv
Jewell Belting Co..... xv
Jones Bros. Electric Co..... vii
Knapp Electrical Works..... xxvii
Law Telephone Co..... xv
Leclanche Battery Co..... xii
Laminar Fibre Goods Co..... xvii
Mitchell Vance Co..... xxx
Monitor Electric Co..... xii
Munsell & Co., Eug..... xv
Munson Belting Co., Chas..... xiv
Mason, Jas. H..... xxi
Magnolia Anti-Friction Metal Co i
N. Y. Belting & Packing Co...— —
National Carbon Co..... iv
National Electric Mfg. Co..... x
Noye Mfg. Co., Jno. T..... xvi
Northwest Thomson-Houston Co. vi
Ohio State University..... xii
Ostrander & Co., W. R. xviii
Okonite Co..... xv
Partrick & Carter xx
Phoenix Glass Co..... vi
Paiste, H. T..... xiv
Pond Engineering Co..... xvi
Powell Co, Wm..... —
Pumpelly Storage Battery Co.. xxi
Phillips Electrical Works, E. F xv
Page Belting Co..... —
Queen & Co..... xvi
River & Rail Elec. Light Co.. ix
Roeblings' Sons Co., Jno. A... xix
Shultz Belting Co..... vii
Stilwell & Bierce Mfg. Co. xvi, xvii
Standard Carbon Co..... xx
Stephenson & Co., Jno xxiii
Schuyler Electric Co..... xx
Southern Electrical Supply Co..xxiii
Sperry Electric Co..... xviii
Sawyer-Man Electric Co..... xii
Schoverling, A xii
Standard Paint Co.....xiv
Standard Underground Cable Co. i
St. Louis Electrical Supply Co..xxi
Standard Electrical Works... xvi
Sunbeam Incandescent Lamp Co.xv
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxvi
Taussig, S..... xvi
Taylor Mfg. Co.....xxv
Triumph Compound Engine Co xxv
Turner Brass Works..... xv
Union Hardware Co.....xiv
United Electric Traction Co.... vii
United States Electric Lighting Co..... xiii
Van Nuis C. S..... i
Woodbridge & Turner..... xvii
Westinghouse Electric Co. xv
Wollensak, Jno. S..... xxi
Western Electric Co xviii
Weston Electrical Instrument Co..... xiv
Western Power Construction Co. xxiii
Wanted..... .. —

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co.
Pumpelly Storage Battery & Elec. Motor Co.
The River & Rail Electric Light Co.

Aluminum.
Aluminum Brass & Bronze Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Aluminum Battery Elec ric Light & Power Co.
Bunnell & Co., J. H
Central Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Hazazer & Stanley
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Mitchel-Vance Co.

Electroliers and Combination Fixtures.—Continued.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
American Electrical Works.
Ansonia Brass & Copper Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Mitchell-Vance Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.

Lamps, Incandescent—Contd.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

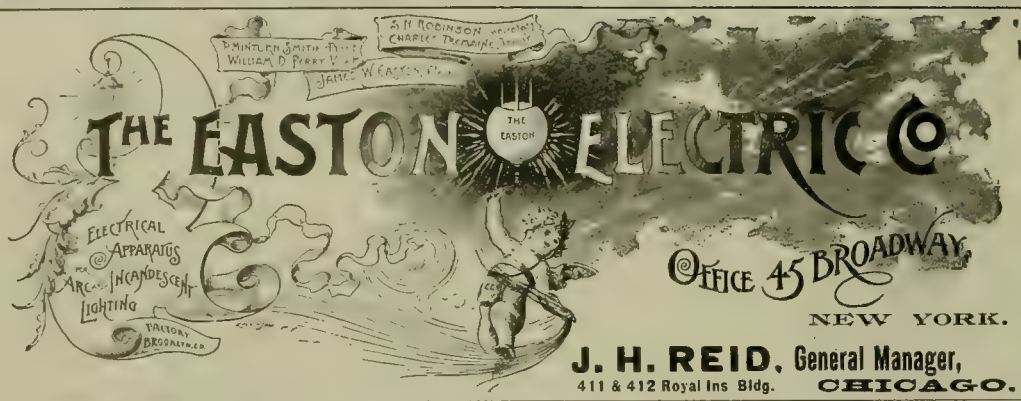
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



OFFICE 45 BROADWAY, NEW YORK.

J. H. REID, General Manager,
411 & 412 Royal Ins Bldg. CHICAGO.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE.

SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

—o(FOR)o— TELEPHONE ONE DOES THE WORK FOR LONG OR SHORT DISTANCE

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

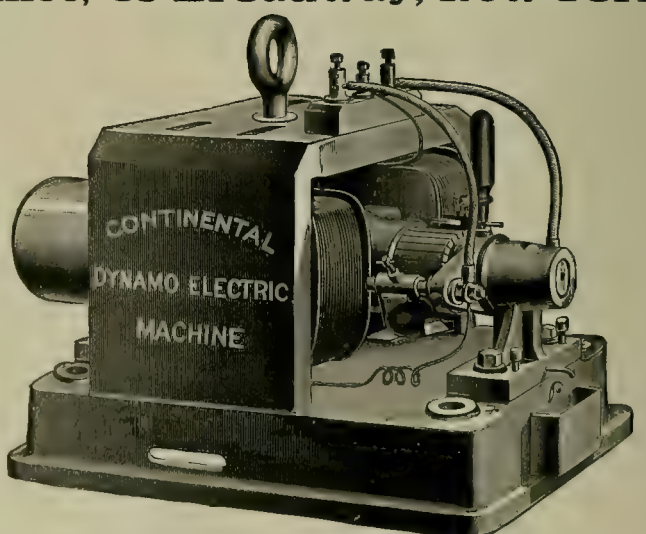
JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2 Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, Journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192
FIFTH AVE.,
CHICAGO.

Makers of the Choicest Electrical Supplies.

General Western Agents:

K. W. CUT-OUTS,

Gas Lighting Apparatus,

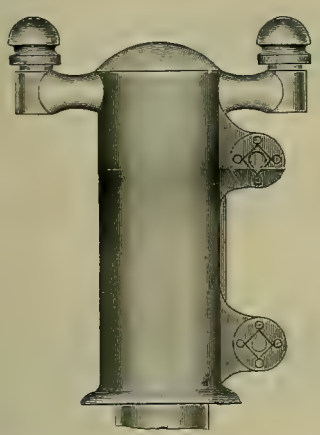
Samson Batteries,

Tested Fuse Wire.

PETTINGELL, ANDREWS & CO.

THE ELECTRIC GAS LIGHTING CO.

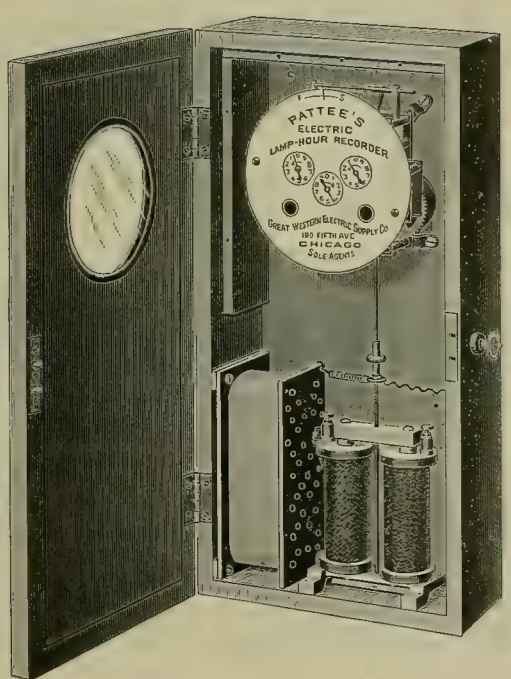
Massachusetts Electrical Engineering Co.



VERSTRAETE POLE TOP.

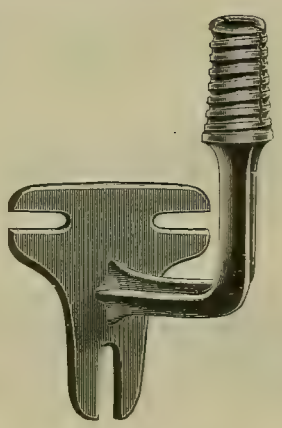
ALL THE MOST DESIRABLE FEATURES ARE COMBINED IN IT.

[SEE SPECIAL CIRCULAR.]



PATTEE'S LAMP-HOUR RECORDER.

[SEND FOR SPECIAL CIRCULAR.]

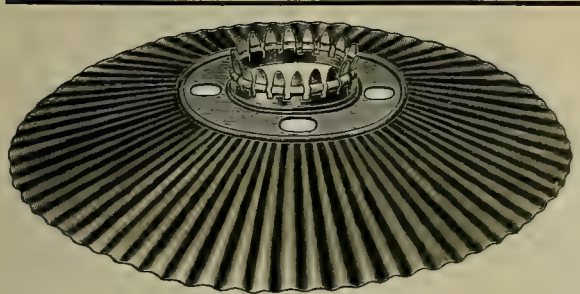


CHUBBUCK BRACKET.
PATENT ALLOWED.

STRONGEST.
LIGHTEST,
TOUGHEST.

WALL BRACKET.
Made of Malleable Iron.

[SPECIAL CIRCULAR.]



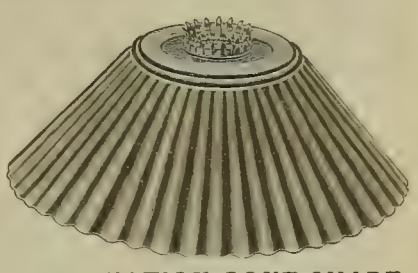
COMBINATION TIN SHADE.

CUTTER'S COMBINATION SHADE.
PATENT ALLOWED.

FIT WESTINGHOUSE, SAWYER-MAN, OR T-H. SOCKETS DIRECTLY.

NO TREMBLING.
NO TOOLS.
NO HOLDER.

The Most Economical Shade Made.



COMBINATION CONE SHADE.

☛ Our Sketch-Catalogue is out. Send business card for a copy.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS

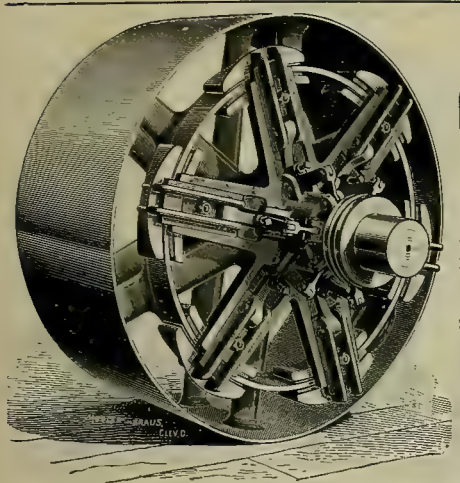
EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.



COPYRIGHTED BY H. W. HILL.

HILL

Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT FULLED LEATHER BELTING

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

Shultz PATENT Leather Woven Link Belt

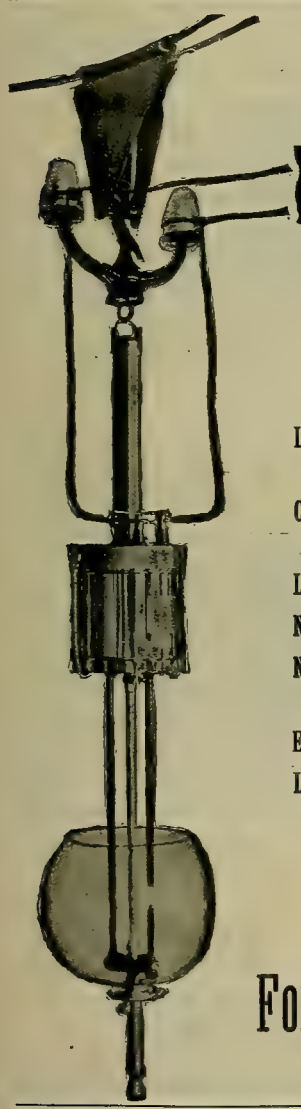
ALL LEATHER.
NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.
BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER

BRANCHES: 161 Summer St., Boston, Mass.; 225 Pearl St., New York City; 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St. Louis, Mo.



THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago. 111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

CINCINNATI HEADQUARTERS

ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.

WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE · FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·

THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.

The JONES-BROS-ELECTRIC-CO. 28 30 & 32 WEST COURT ST.

EDISON GENERAL ELECTRIC CO.,

EDISON BUILDING, Broad St., NEW YORK CITY.

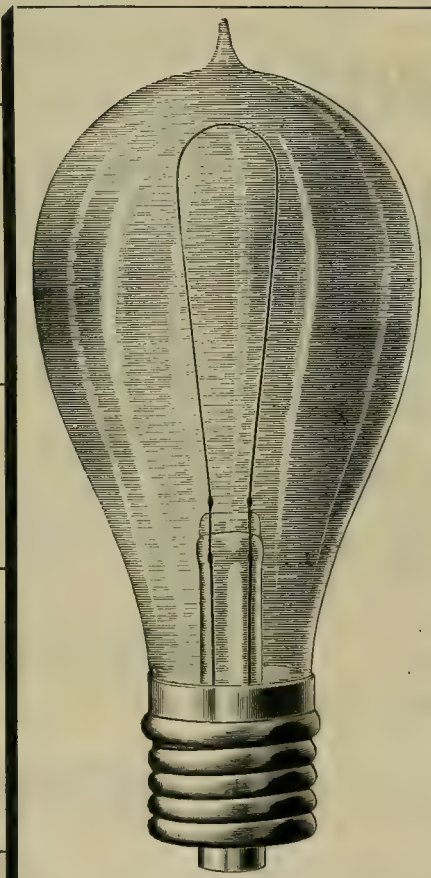
MANUFACTURERS AND CONTRACTORS.

INCANDESCENT, ARC AND ELECTRIC POWER PLANTS OF ALL DESCRIPTIONS AND SIZES, DYNAMOS, INCANDESCENT AND ARC LAMPS, FOR

ELECTRIC LIGHTING.

EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.



The Edison Incandescent Lamp.

No. 2.
No. 2 is the Thomson-Houston.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No. 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

DISTRICT OFFICES:

NEW YORK, Edison Building.

CHICAGO, Rialto Building.
DENVER, COLO., Masonic Building.
NEW ORLEANS, Cotton Exchange.
SAN FRANCISCO, 112 Bush St.
PORTLAND, ORE., Fleischner Building.
TORONTO, CAN., Bank of Commerce Building.

☞ Please address all communications to nearest District Office. ☜

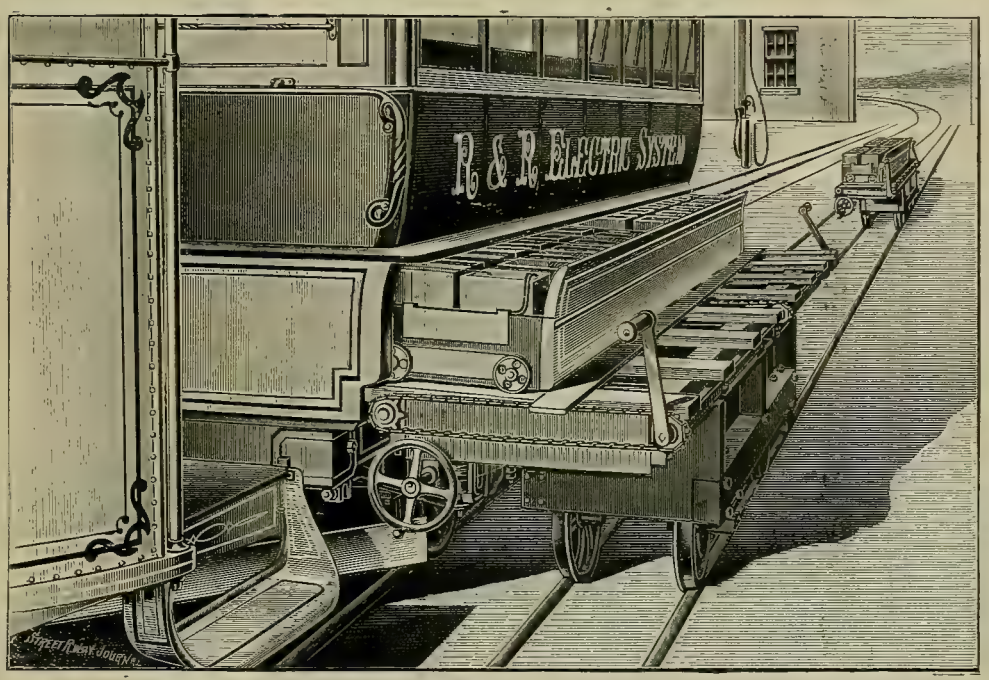
FACTORIES:—New York City. Schenectady, N. Y. Harrison, N. J. Hamilton, Ontario. Sherbrooke, Quebec.

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



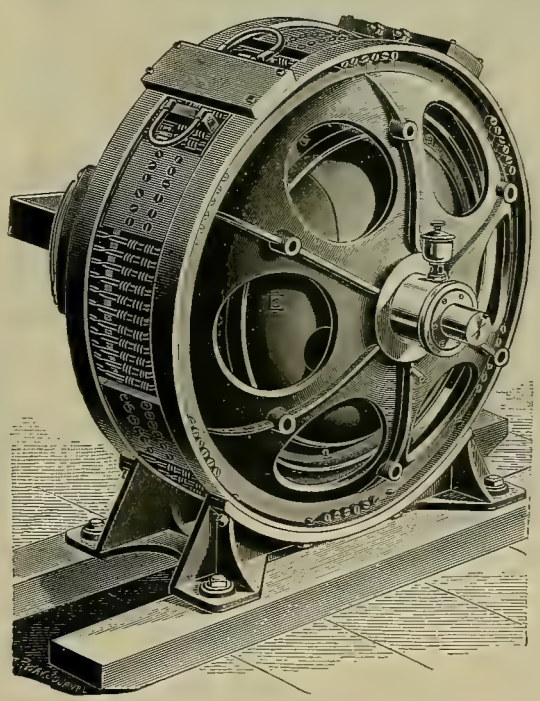
Cars are Lighted by Batteries That Propel The Motor.

METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

THE MAIN Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

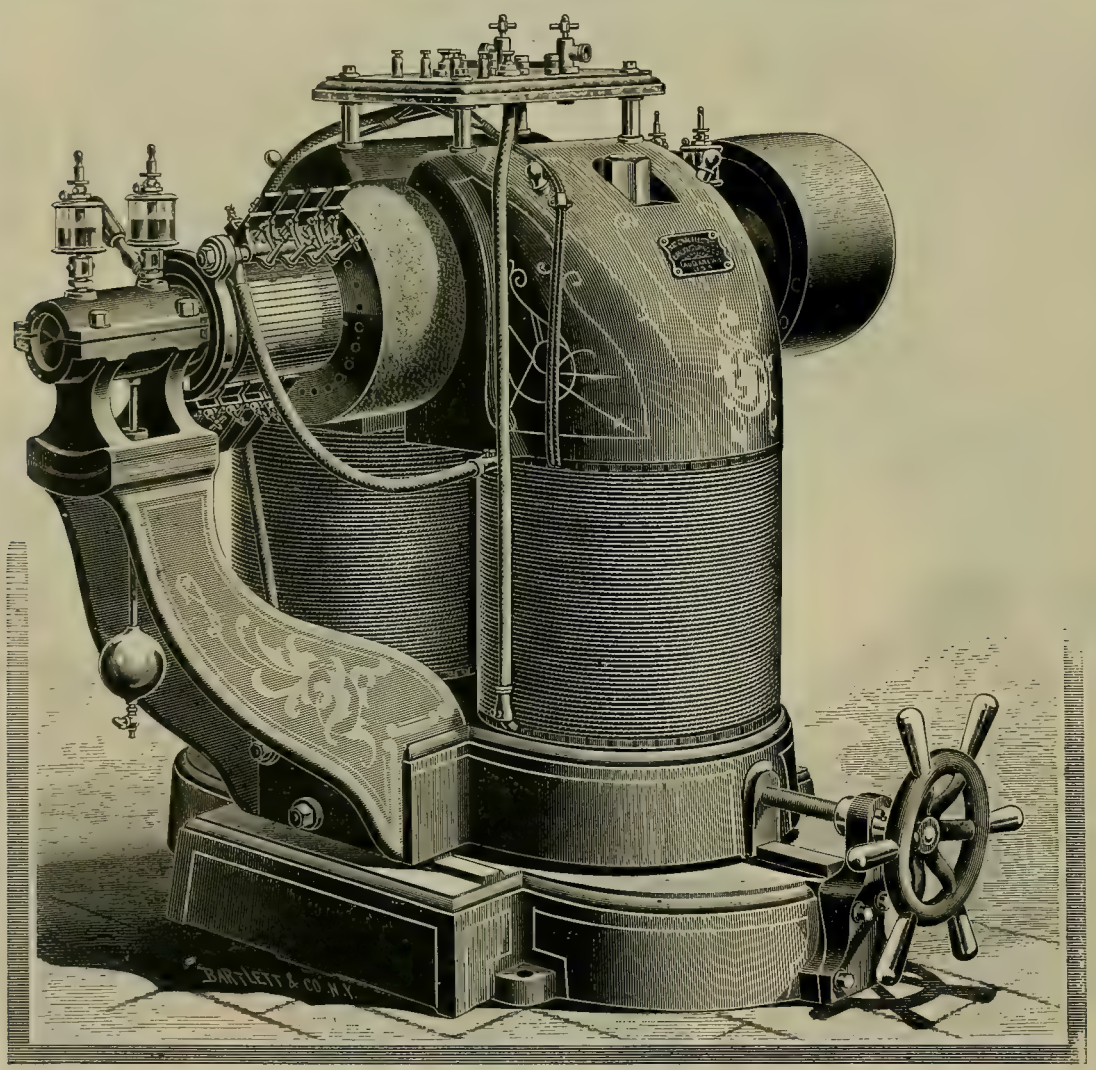
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMOS, CAPACITY 500–16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
— FOR —
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent .....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building, St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Co.

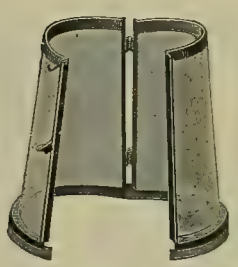
OKONITE TRADE MARK.

GENERAL WESTERN AGENTS FOR

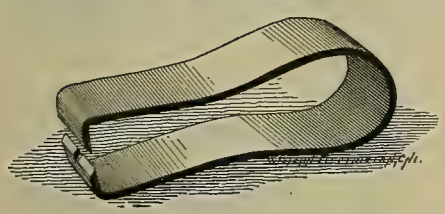
OKONITE AND CANDEE WIRES.

The Central Spark Arrester

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting to the globe.



THE PERRY WIRE PEELER.



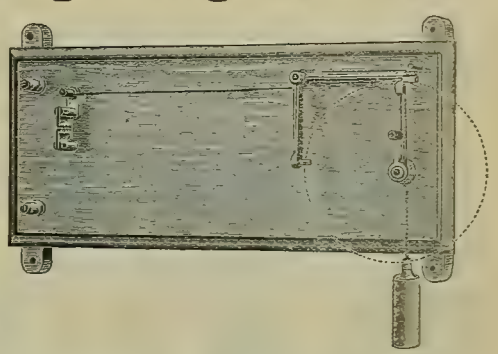
This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs.
Cleveland Switches, Paiste Switches, Branch Blocks,
And all kinds of Electrical Supplies.

THE HOT WIRE

Lightning Arrester.



No Magnet or Self Induction.
Furnishes Absolute Protection,
And is Automatic in its Action.

OUR PRICE ON THESE INSTRUMENTS IS VERY LOW.

ANTI-MAGNETIC WATCHES.

We have completed arrangements with the Electricians' Time Company by which we are enabled to offer to Electrical men a thoroughly first-class watch, absolutely protected from magnetic influence, and at a very low price. Each watch is accompanied by a guarantee, stating first what it is, and in cases where desired, payments are made easy. Send for a descriptive circular.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

W-A-T-C-H-E-S.

The World's Exposition in Paris, 1889, awarded a prize medal to The Giles Anti-Magnetic Shield for watches. It has been proven to be the best practical and permanent solution to the trouble electricians have with their watches.

The shield can be applied to any watch, or is furnished in new watches by

GILES BROS., - CHICAGO.

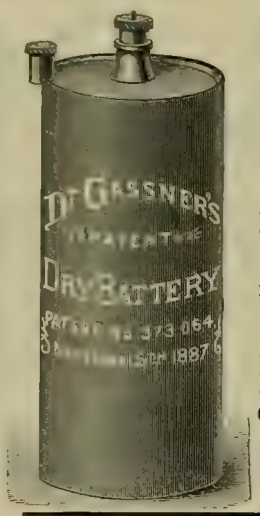
TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,

149 West 18th Street, - - NEW YORK.



DR. GASSNER'S
DRY BATTERY
FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3½ in.
17.	"	7½ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19	Oval,	6⅛ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer.
111 Chambers St., New York.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

OHIO STATE UNIVERSITY,
COLUMBUS, OHIO.
Civil, Mechanical, Mining and Electrical Engineering. SEND FOR INFORMATION.

SAWYER-MAN LAMPS,
Any Candle Power,
To Fit Any Socket.

NEW SERIES LAMP AND SOCKET FOR
ARC CIRCUITS.

SAWYER-MAN ELECTRIC CO
510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

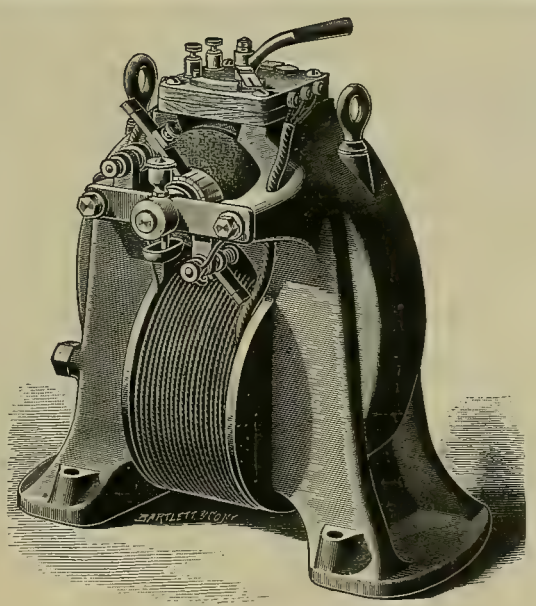
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

HENRY C. EDDY,
MANUFACTURER'S AGENT.
Electrical Goods and Machinery
Room 22 170 La Salle St., CHICAGO.

INCANDESCENT and ARC LIGHTING and MOTORS.
Isolated Lighting a Specialty.
H. H. HUMPHREY,
1034 New York Life Building.
Contracting and Consulting Electrical Engineer. OMAHA, NEB.

THE E. S. GREELEY & CO.,
GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.
ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Consistency. Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments forwarded upon application.
Illustrated Circular of Lamps and Lamp Novelties upon Application.
MINIATURE INCANDESCENT LAMPS.

HAZAZER & STANLEY,
ELECTRICAL HOUSE FURNISHINGS,
32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.
Messrs. Hazazer & Stanley.
GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.
Yours truly, CHAS. E. GOODRICH, Electrician, 503 Eighth Avenue.

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. BETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

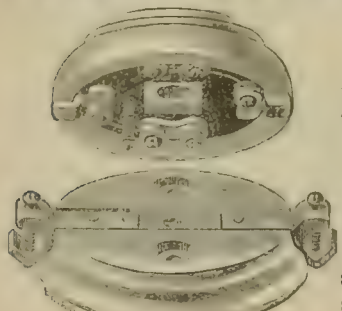
THE IDEAL ENGINE.
Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.
SEND FOR CATALOGUE.
A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.
Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

THE WESTON STANDARD
Voltmeters and Ammeters.
These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.
Send for Illustrated Catalogue.
ADDRESS
WESTON ELECTRICAL INSTRUMENT CO.,
Newark, N. J.

IT KNOCKS THEM ALL!
BISHOP RUBBER COVERED WIRES.
BALATA INSULATED DROP CORD.
Prof. Henry Morton says: "These wires showed no deterioration from exposure to moist air, fresh plaster, damp earth, etc., after several months' exposure. Its insulating power also was unaffected by a like exposure to illuminating gas."
THE "BISHOP" Always Leads the Procession.
THE ILLINOIS ELECTRIC MATERIAL COMPANY, - 341 ROOKERY BUILDING, CHICAGO.

INTERIOR CONDUIT & INSULATION CO.
A NEW DEPARTURE IN INSULATION.
INTERIOR CONDUITS } Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.
UNDERGROUND CONDUITS } Are equally successful and afford Cheapness, High Insulation and Durability.
For Price lists, Samples and General Information, address
INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.
Edw. H. Johnson, President.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.

Patented.
DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.
A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.
H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.
Charles Munson Belting Co.
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.
TRADE MARK.
PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.
28, 30, 32, 34 & 36. S. CANAL ST.
Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

GET THE BEST!
P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY
The Standard Paint Co.,

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, SEPTEMBER 13, 1890. No. 11

Telephone & Telegraph Construction Company of Detroit.

When the National Telephone Exchange association convenes in the city of Detroit, the delegates will be the guests of a company that presents a career of steady growth, successful operation, and of popularity justly earned. The Telephone & Telegraph Construction company was among the first organizations granted a license by the American Bell company. It commenced business August 15, 1878, with 25 subscribers. Its office was located in the rear of the receiving office of the Western Union Telegraph company. These pioneer subscribers' stations were equipped with an electric bell for calling, a magneto transmitter and a wooden hand telephone. They were all on circuit lines, and if the patrons happened to want a subscriber on their own circuit, he was called directly.

This crude system grew; so much so that additional switch-board facilities became necessary and the exchange was moved from the basement to a room on the top story of the Telegraph Block. Girls, as operators, were here first employed; circuit lines gradually began to disappear, and the independent circuits came into vogue.

These quarters were soon outgrown, and in 1880 the exchange with its 450 subscribers was again moved to its present location—the top floor of the Newberry Building. With the commencement of the year 1884, the Detroit exchange had 1,528 subscribers. It was apparent that the old group system would not satisfactorily serve its wants much longer, and arrangements were made to install the Western Electric company's multiple board. This system went into operation in September, 1884, when eight and one-half sections were connected up. Year by year sections have been added until now there are thirteen and one-half sections, with a capacity of 2,500 lines. At this time Detroit subscribers number some 3,700, about 800 being connected with the sub-exchange.

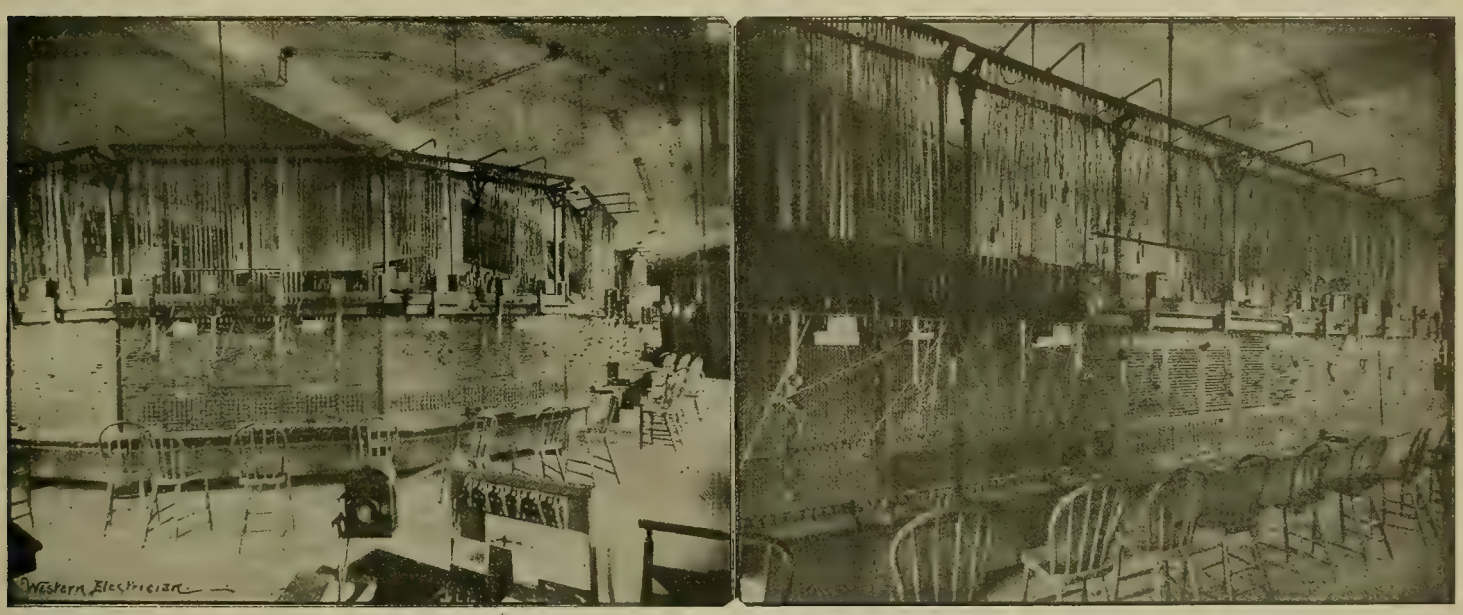
The trunk lines from the central to the sub-exchange number 72.

Last year additional room was needed, and the entire space on the top floor of the Newberry Building was secured. The addition of extra sections of switch-boards made it necessary to re-arrange their position.

The Telephone & Telegraph Construction company operates 70 exchanges. The principal ones outside of Detroit are Grand Rapids, 1,273 subscribers; East Saginaw, 733; Bay City, 528; several others range from 400 to 200. In round numbers it has something over 10,000 subscribers.

The officers of the Michigan Bell Telephone company were early in the field with extra-territorial lines. In 1882 was built a line from Detroit to Port Huron. It was entirely successful. From that time on, extra-territorial lines increased in number, every part of the state having its local interests served. To-day the company has 4,100 miles of wire, 2,600 miles of poles and about 400 stations.

In the accompanying cuts are shown two views in the Detroit Exchange. Fig. 1 is a view of the switch-board looking from the southeast corner of the operating room, north and west. Fig. 2 is a view from the southwest corner of the room looking east.



FIGS. 1 AND 2. TELEPHONE & TELEGRAPH CONSTRUCTION COMPANY OF DETROIT—SWITCH-BOARD.

Convention of the National Telephone Exchange Association at Detroit.

The WESTERN ELECTRICIAN is issued before the regular day of publication this week in order that copies of the present number may reach the attendants at the convention of the National Telephone Exchange association at Detroit September 9. There is every reason for believing that the meeting will be of an unusually interesting character. The literary programme has not yet been decided upon. Gen. C. H. Barney, secretary of the association, reports the following order of proceedings: First day at 10 A. M. an address of welcome will be made by the mayor. It will be followed by a business session. On the second day at 2:30 o'clock a carriage ride and lunch at Belle Isle Park Casino will be a feature, and at half-past 8 in the evening a banquet will be held at the Russell House. The boat ride and lunch on board during the afternoon of the third day will end the convention, and those who desire to leave the city early can do so, as the ride will be over about 5 o'clock.

It is stated that the arrangements for the third day's session will include a morning meeting so that any unfinished business from the previous session can be attended to at that time.

Complete Metallic Circuits in Chicago.

The Chicago Telephone company during the last year has made considerable progress in the work of establishing its complete metallic circuits. The work of transforming the switch-boards has been advanced rapidly, and on Dec. 18 this part of the work will be completed. The switch-board at the Stock Yards has already been changed, and those at the North and West side stations will soon be ready. At the Central exchange, Washington and Franklin streets, the switch-board arranged for 3,000 subscribers, is being enlarged, so that 5,400 connections can be made. When this board was built two years ago, the company was vainly endeavoring to find a practical system of complete metallic circuit, but failing in this it was determined to have the board so constructed that the system could be changed at any time without serious inconvenience. This work is now in progress and will be completed as far as all the switch-boards are concerned, by Dec. 18.

The underground work is also advancing. During the last year nine miles of conduit have been changed to complete metallic circuit, these conduits having over 100 miles of cable. Eventually the entire system will be transformed. The company has devoted much time and money to the solution of the trouble, and it believes it has at last secured a good system.

A petition is before the city council of Ogden, Utah, for a franchise for an electric street car line to be constructed and operated by the Ogden Rapid Transit company. The prime movers in the enterprise are J. H. Minehardt of Denver, backed by the Western Farm Mortgage company of Denver. The petitioners propose to have ten miles of the electric railway in operation by January 1, 1891.

Union Stock Yards Telephone Switch-Board Connections.

The accompanying diagrams represent the circuits on the mixed system switch-board now in operation in the exchange at the Union Stock Yards, Chicago. This system presents a number of novel features which, it is claimed, makes it a strong competitor against the well-known "Thirty-eighth street system" now in service in New York City. It will be remembered that in the "Thirty-eighth street system" a double wound receiving telephone and a split induction coil are used in the operators' circuit. A cam-key for cutting into and out of an operator's telephone connecting cords and two ringing keys are also employed.

In the system represented in the cuts, which is the invention of J. J. O'Connell of the Chicago Telephone company, the ordinary telephone and induction coil are employed, together

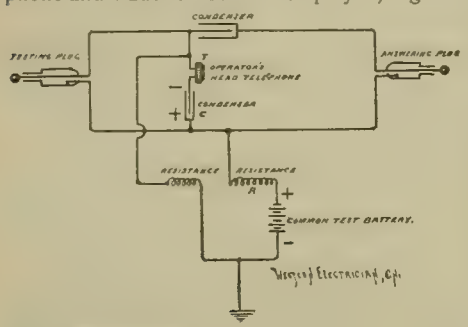


FIG. 2. UNION STOCK YARDS TELEPHONE SWITCH-BOARD CONNECTIONS.

with one combination key of peculiar pattern. This key is shown in detail in the center of Fig. 1. The connections of the local circuit when the operator is ready for an order, are indicated in Fig. 2.

In the Thirty-eighth street system the test for a busy line is made by touching the tip of the testing plug to the line wanted, and if it is busy a click will be heard. This click is produced by current passed into the second or additional coil placed in the special receiving telephone above referred to. In the O'Connell system the work of the operator is very much the same but the connections are simpler from the fact, among other things, that no double wound receiver is required. The test battery, too, is never short-circuited through an operator's circuit. This condition is shown in Fig. 2 where the operator's outfit is represented as cut in on the cords. The test in the O'Connell system is made by discharging a condenser *C* through a receiving telephone *T*. The manner in which this is done is the same as in the Thirty-eighth street system. Bearing in mind that the sleeves or outside metallic portion of all the plugs are all connected through resistances, similar to *R*, with the common test battery, and ground, Fig. 2, the way in which the condenser is discharged to produce the click will be readily understood. One feature of this system which is worthy of notice is the arrangement of the test battery outfit. The connections of this outfit are indicated just above the drawing of the combination key in the center of Fig. 1. The essential apparatus in this portion of the system are a retardation coil, a primary battery and a condenser in shunt to the cells as indicated.

The O'Connell system, it may be mentioned, after a competitive test with three two-cord metallic systems and two single cord metallic systems has been accepted by the Chicago Telephone company for use in all its exchanges.

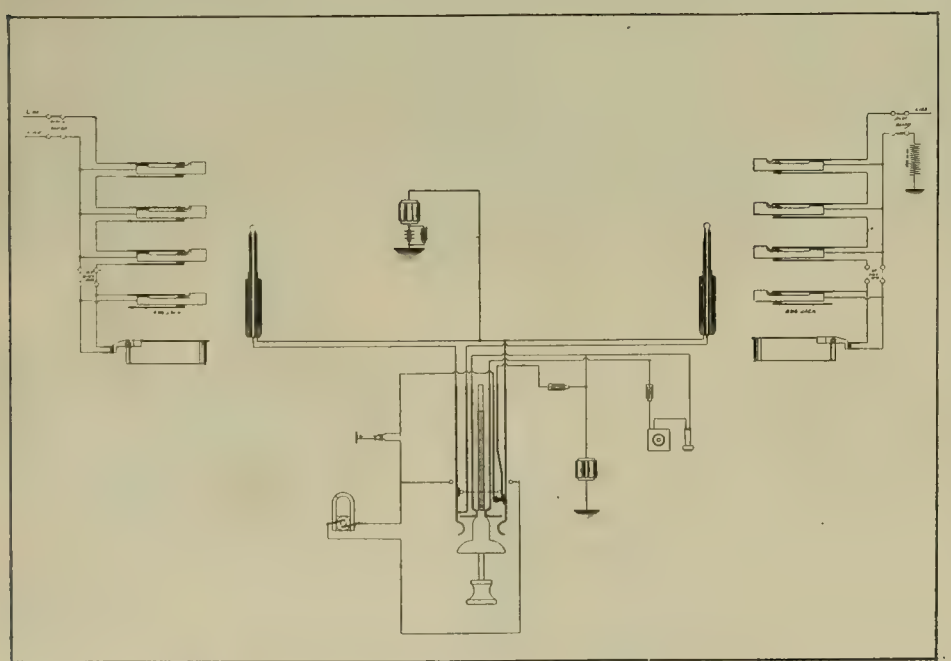


FIG. 1. UNION STOCK YARDS TELEPHONE SWITCH-BOARD CONNECTIONS.

Telephony and Insanity.

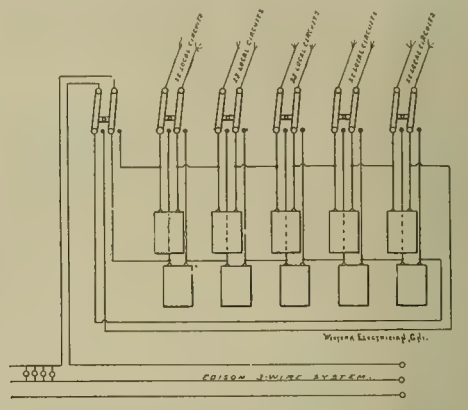
"Nine telephone girls have gone crazy in New York City" says a daily paper. Various causes have been ascribed but no one seems to be conversant with the facts and circumstances. Superintendent Wilson of the Chicago telephone exchange, was interviewed last week on the question. He said he saw no reason why the operators should become insane, but he could realize how a superintendent might become a fit subject for retirement to a quiet resort. The chief operator at the Chicago office assured the superintendent there had been no signs of insanity displayed by the young ladies under her charge. In all her experience she had never seen anything that would lead her to believe the work of an operator would have a tendency to unbalance the mind. Some of the operators were "mad" when the company adopted a receiver that is strapped to the head of the operator, as they deemed this device anything but ornamental, but some device of this kind was found necessary as it was practically impossible for the operator to hold a receiver to her ear all day and make the proper connections with one hand. This was the nearest approach to insanity on record in the Chicago exchange.

The reported display of symptoms of insanity in the New York exchange is not seriously regarded in the Chicago exchange, and there is no fear of a scarcity of applicants for positions.

The Storage Battery in the Chicago Telephone Exchange.

For some months the Chicago Telephone company has been ringing its subscribers' signal bells by means of current from the Chicago Edison company's system. The method and apparatus employed by the telephone company was described in the WESTERN ELECTRICIAN March 15, 1890. The apparatus is very simple, consisting merely of a small commutator driven at about 700 revolutions by a water motor. By this arrangement alternating current necessary for the operation of the bells is obtained directly from the Edison wires. Not satisfied with this improvement which will ultimately result in the abandonment of all the small magneto machines in the exchange, the company is now introducing a system through which the primary batteries working on all local circuits will be replaced by storage batteries charged from the Edison house circuit. The new system is the invention of J. J. O'Connell, electrician of the company, and it is simplicity itself. Ten Anglo-American Storage Battery company's cells are used, and these replace the 125 gravity cells previously in service on the operators' local transmitter circuits.

The arrangement of circuits as employed by Mr. O'Connell, is indicated in the accompanying diagram. The cells are divided into two sets of five each. By means of the switches



THE STORAGE BATTERY IN THE CHICAGO TELEPHONE EXCHANGE.

shown at the top in the illustration, either of the two sets of cells may be cut into or out of the lamp circuit and thrown into service on the local wires. As will be readily seen, the five cells of a set are charged in series at one time and are connected in either the + or − main of the three-wire system. As there are on an average, say, 8 lamps burning throughout the day in the telephone company's building, a charging current of about 4 amperes passes into the cells. The introduction of the 5 cells in the main has been found to make no practical difference in the brilliancy of the lights. The total resistance of the 5 cells was found to be about $\frac{1}{10}$ ohm and the capacity of each cell is rated at 150 ampere-hours. The e. m. f. is the usual 2 and a fraction volts.

By the use of the storage batteries, it is said, the local service is much improved. Much additional and valuable space, too, is saved as the difference in the room taken up by 125 gravity cells and that occupied by 10 accumulators, is considerable.

In addition to the above adaptation Mr. O'Connell also proposes to experiment with the view of employing the storage cell in connection with subscribers' telephones. His plan is to remove the primary battery and install a small accumulator at any telephone where the Edison lighting wires may be tapped. Connections are to be made in such a manner that when the telephone is in use, the released hook-lever will throw the Edison current into the storage cell through a lamp resistance. The accumulator will ordinarily be connected in the same manner as the primary battery was and the Edison current will only be flowing while the subscriber is talking. Hanging the telephone on the hook breaks the circuit to the Edison mains.

Electrical Journals and the Telephone Convention.

"Will the telephone convention be open to representatives of the electric press?" was asked of a superintendent of one of the largest telephone exchanges in the country.

"I don't know any reason why it should not," he replied, and when reminded of the action taken at the last convention, he added: "That should seem as an additional reason for admitting newspaper men. Last year the association undertook to shut out the press. They made a mistake, and as you know, it was impressed on them, too. They all realized it. If they

don't want certain facts published, or if they think the time has not come for letting the public in on plans under consideration they should not discuss these matters in the convention. That is the only safe policy — keep quiet until the matter is ready for presentation to the public. I hope the delegates to the convention will profit by the experience they had last year. I am in favor of admitting representatives of the press."

The Ader Telephone.

In the cuts is illustrated the Ader long-distance telephone which is used in several cities in France. The description of the transmitter is taken from the *Revue Internationale de l'Electricite*. Fig. 1 shows the complete instrument.

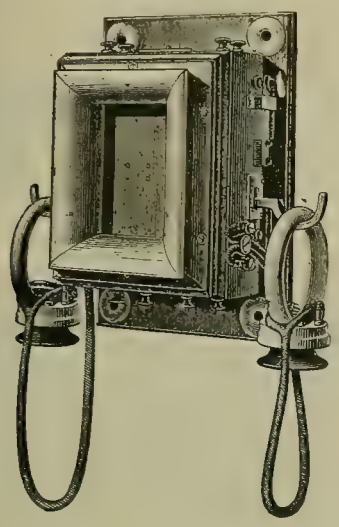


FIG. 1. ADER TELEPHONE.

Upon the spruce microphone board, Fig. 2, are fastened two little wooden brackets *A A'*, which hold in place the two rectangular pieces of carbon *B B'*. To each of the carbons is attached a wire connecting with the battery and the pri-

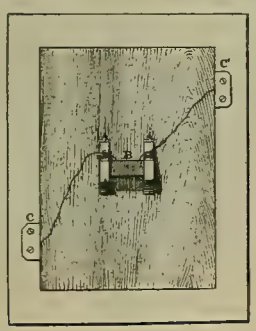


FIG. 4. ADER TELEPHONE.

mary circuit of the induction coil, Figs. 3 and 4. Between the two prisms of carbon is arranged the pendulum, of which the details are shown in Figs. 5 and 6. The little piece of brass *D*, Fig. 6, which has a counterpoise *d* and a hook

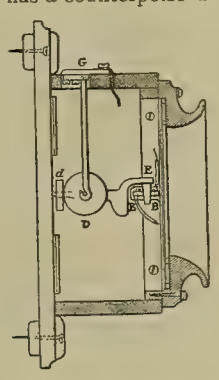


FIG. 5. ADER TELEPHONE.

E, Fig. 5, is supported by the spindle *e e*, Fig. 6. The brass piece weighs 109 grammes, and is carefully balanced. The pendulum frame *F* is suspended at *G*. The vibrations of the microphone plate bring one or the other of the carbons *B B'* into contact with the hook *E*, which, in response to the impulse, vibrates and performs, it may be said, the work of an oscillator. Speaking accurately, there is no undulation of the current but an interruption or break at each displacement of the carbon pieces, *B B'*. This arrangement of the transmitter, it is stated, has necessitated a modification in the winding of the primary of the induction coil. It is

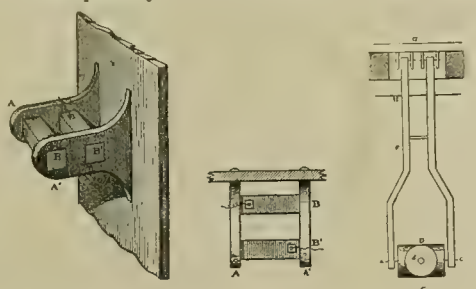


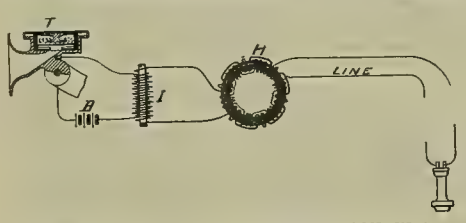
FIG. 2. FIG. 3. FIG. 6.
ADER TELEPHONE.

double. One or the other of the circuits is traversed by the current just as the hook *E* comes in contact with the carbon *B* or the carbon *B'*.

Closed Magnetic Circuit Induction Coil in a Telephone Transmitter.

The accompanying cut illustrates the construction of a telephone transmitter which is claimed by the inventor, Thomas D. Lockwood, Boston, Mass., to be an improvement over the well known form containing the ordinary cylindrical induction coil. The improvement claimed consists in transforming the usual primary current which varies in strength only into a series of currents varying also in direction, the potential being unchanged; and in then transforming these alternating currents, into a second series of alternating currents, and in simultaneously raising the potential under which the last series is developed.

The apparatus employed to bring about these various transformations will be understood by referring to the diagram. In the figure, *T* is a granular carbon transmitter connected in series with a battery *B* and the primary of the induction coil *I*. The secondary of coil *I* has the same number of convolutions as the primary and is wound with wire of the same size. The last named coil, that is the secondary, connects as shown with a second induction coil *H*. This coil or transformer *H* is wound in the manner



CLOSED MAGNETIC CIRCUIT INDUCTION COIL IN A TELEPHONE TRANSMITTER.

indicated, and is constructed upon a circular core so as to have a closed magnetic circuit. The secondary of transformer *H* connects with the line. The operation of the organization may now be described: When sounds are uttered in the vicinity of the transmitter proper, *T*, the current in the local circuit is thrown into vibrations which correspond to the variations of the sound waves. This action causes an induced e. m. f. in the secondary of *I*, but while the strength of the resulting current, on account of the similarity of the windings of the primary and secondary remains unchanged, the currents induced are of an alternating character. Now, as the secondary of the first induction coil *I* is joined up with the primary of the transformer *H*, it is obvious that the reversals developed in the coil *I* necessarily circulate also through the coil *H* and serve as alternating exciting currents for it. These exciting currents, it is claimed, are much more efficient in varying the magnetization of an iron core closed on itself than are simple variations in strength. By employing, therefore, an endless or closed core, in which all of the lines of force are utilized, the waste of energy is very slight, and, it is claimed, induced impulses possessing a superior degree of energy, are generated in the secondary of the second induction coil.

Producing Musical Sounds by Electricity.

The accompanying diagrams illustrate the principle of an invention recently worked out by George Breed of the United States Navy, by which stringed musical instruments may be operated by electricity. In this method sound is produced by the vibration of a stretched wire in a magnetic field. An irregular or non-continuous current, or an alternating current, is passed through the wire and vibrations are set up and continue so long as the irregular or broken current flows. Fig. 1 is a diagram illustrating the principles of the invention. A file is here shown as a portion of the circuit breaker. The inventor states that he finds the best results are obtained by the use of a current which is made and broken unevenly as is the case where connection is made by rubbing a terminal over, say, a coarse file.

The application of the invention to a guitar is illustrated in Fig. 2. In this cut a top view

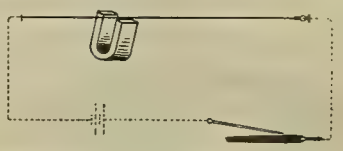


FIG. 1. PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

of the instrument, with a portion removed, is shown at the left. To the extreme right is a side elevation. In the center is a sectional view through the head and also a bottom view.

Referring to this last named figure the general construction of the device will be readily comprehended. Within the hollow head, on the bottom, is placed a brace *B*. This piece forms a support for a magnet *M*. This magnet extends through the top of the case, its poles being arranged one above the other, as shown. The lowermost pole projects slightly above the case, so that the guitar-strings, which are all made of metal, or if of insulating material are wrapped with metal, may pass between the poles of the magnet. In order to decrease the weight of the magnet and at the same time to concentrate the lines of force upon the wires, the poles are made as shown, with projections separated by grooves. The wires are placed between the opposed projections. The strings extend along the stem of the guitar, as usual, and are connected in the ordinary manner with the screws for adjusting their tension. The frets of the guitar-stems are strips of metal, and

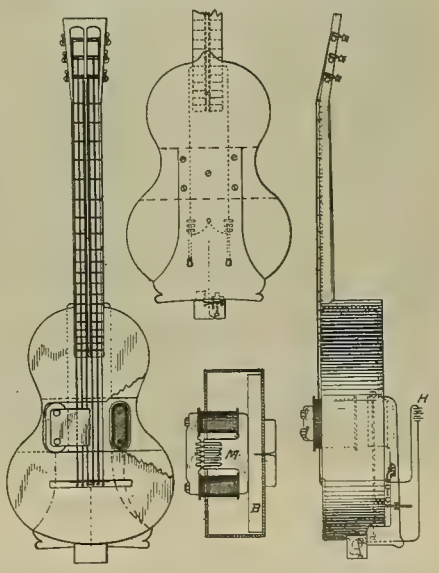


FIG. 2. PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

each is divided, as shown, at the middle of the stem. At the end of the head a small compartment *W* is provided. In this is placed an electrical brake-wheel which is revolved by suitable clock-work, or by a small electric motor run from the battery which supplies current for the instrument. On the lower side of the head is a case, within which are placed the devices for regulating the current for altering the sound. A battery *H*, outside the instrument, supplies current. As all the frets on each side are electrically connected together by a metal strip, whenever a string is made to touch one of the

frets a current will pass through this string. Now, as the brake-wheel is in constant action being driven by the clock-wheel or the motor, the string will produce a musical note, depending first, upon the nature of the wire, and, second, upon the position of the fret against which it is pressed. This note will be prolonged as long as the wire is kept in contact with the fret. It will be seen, therefore, that since the only motion necessary to produce a note is to press the wire against the fret, the facility with which the guitar may be operated is greatly increased.

Mr. Breed also applies his invention in a system of multiple telegraphy and in an electrical piano.

Curve Insulator.

The successful and economical operation of electric railways depends largely upon the proper line construction, that is, on the strength of all the parts subjected to strain, and thorough insulation of the trolley wire from the ground. Owing to the weight of the trolley wire the supporting devices must be strong, yet they must insulate the trolley line from the supporting wires. This is especially true at curves, where the same strain that is too much for an ordinary iron pole is put on the single center curve insulator. In the cut is illustrated the treble center curve insulator designed by Wm. Sharpe. It is made of iron pieces bolted together and insulated from each other by hard rubber washers and bushings. As the illustration shows, the three rubber bushings are in series, giving a treble insulator. A rubber sleeve fitting snugly over the body of the insulator keeps the insulation dry, so that the threefold protection is obtained in all sorts of weather. The sleeve by inclosing the insulation also prevents deterioration.

CURVE INSULATOR.

In the cut the sleeve is not indicated but the disposition of the iron and rubber parts, which are made unusually strong, is shown. The insulator is introduced by the Great Western Electric Supply company, Chicago.

Double Carbon Lamps.

In the suit of the Brush Electric company against the Western Electric company of Chicago for alleged infringement of the Brush double carbon lamp patent, Judge Gresham last week issued an order enjoining the defendant corporation from manufacturing or selling lamps under the patent granted to C. E. Scribner. The Western Electric company, it is stated, has discontinued the manufacture and sale of the lamps made under the Scribner patent, but it is making a new lamp which, it is asserted, does not infringe the Brush lamp. Just at the present time the company is not ready to make any statement in regard to the new lamp. It is the invention of C. E. Scribner of the Western Electric company.

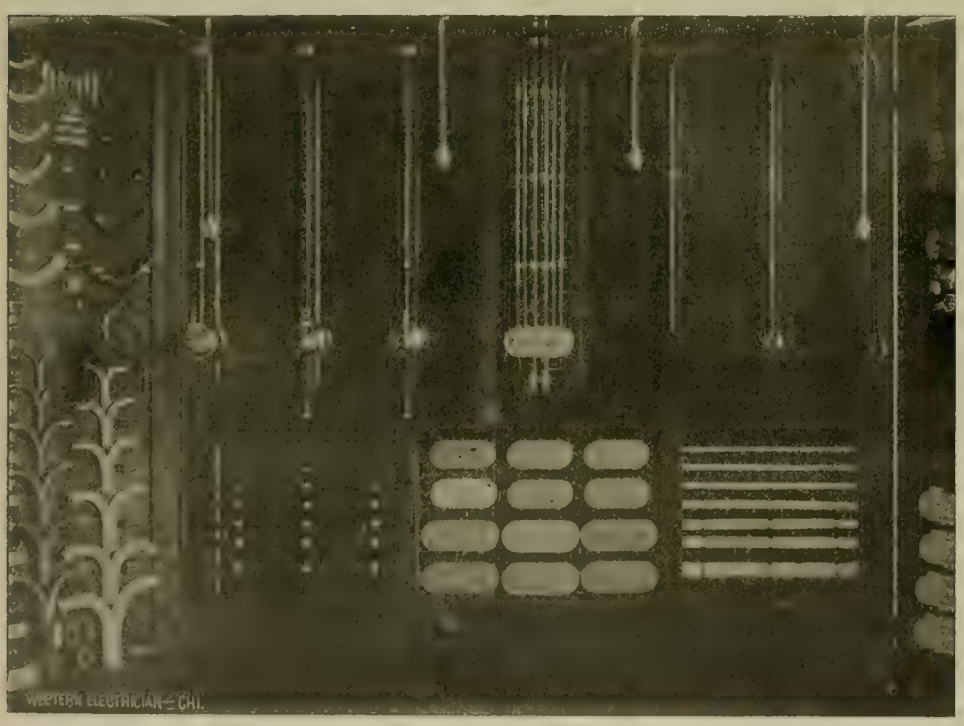
More Electric Railroads for the Holmes Syndicate.

In the last issue of the WESTERN ELECTRICIAN attention was called to the fact that the Holmes syndicate, which controls one of the largest cable railway systems in the country, was investing heavily in electric railway enterprises and building electric roads. The end of these operations has not yet been reached. The Holmes syndicate, it is reported, has obtained control of the Citizens' Street Railroad company of Memphis, Tenn., and has petitioned the council to grant permission to operate electric railways in that city. It is reported in financial circles that C. B. Holmes and the capitalists whom he represents are negotiating for several other important systems.

Interior Conduits.

In the accompanying cut is shown a section of the elaborate sample board displayed by the Interior Conduit & Insulation company of New York at the recent Cape May Electric Light convention. The sample board is fourteen feet wide and eight feet high, and is arranged to stand on the floor like a screen. On the back and top is laid out a complete conduit system for interior wiring.

The two large tubes contain the risers which are intended to pass through the ceiling to other rooms through a junction box on each floor. The junction box contains the cut-out and safety fuses, and from it run all the branches for the floor. From the top or ceiling are suspended a number of flexible pendants, a new and useful fixture recently put on the market by the company.



INTERIOR CONDUITS—EXHIBITION BOARD.

On the left of the three lower panels are a number of samples showing the different size tubes made by the company. On the right of the board is shown a corresponding set of samples of different colors showing the variety of finishes the tube is capable of receiving. Samples were also shown of the tube copper plated, polished and nickel plated. It is hard to realize from exterior appearances that the tube is really not a brass or iron tube as it appears to be. In the center panel a number of different junction box covers are placed, of different styles and finishes. On the two wings were placed the various appliances that are used in conjunction with the conduit system which serve to make it the flexible and complete system that it is. Only the left wing is shown in the cut.

A New Incandescent Lamp Fixture.

Efforts are constantly being made by supply men to bring out novel and simple incandescent lamp fixtures which will increase the convenience of the lights and yet not detract from an artistic effect. The cuts illustrate in general and in detail a novel modification of a well-known form of lamp bracket, Fig 1. The special feature is a ball and socket joint at the base next to the wall. By this simple arrangement the fixture is made movable, and may be swung into almost any desired position, like the ordinary gas bracket. In Fig. 2 the joint is shown in detail. *N* is a milled nut which embraces the balled portion of the joint. The ring *R* against which the ball is clamped, is of spring brass and is slit. By tightening the milled nut the ball is brought against the ring in the socket with any degree of friction. A small set screw in the nut prevents the latter unscrewing.

FIG. 1. NEW INCANDESCENT LAMP FIXTURE.

It may be mentioned that the ball and socket joint is not necessarily attached only in that portion of the bracket next to the wall. It may be placed at the base of the lamp socket.

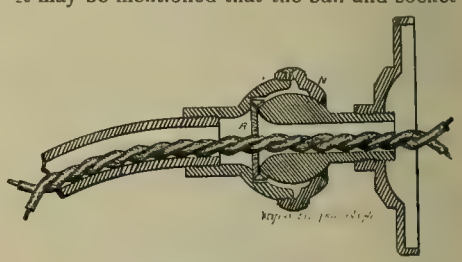


FIG. 2. NEW INCANDESCENT LAMP FIXTURE.

This fixture is the invention of E. C. Bennett and E. C. Freize, who are connected with the Chicago Edison company.

First Thomson-Houston Road in Europe.

The first electric tramway in Europe on the Thomson-Houston system was opened in Bremen two months ago. The length of the line, which forms a double track except in one narrow street, is 1,748 yards. It commences at the town hall in the center of the town, and passing by the new railway station terminates at Exhibition Place just inside the town park, where an industrial exhibition is now being held. The conductors, which are carried overhead, consist of copper wires 8.25 mm, in thickness, and are suspended from insulators attached to steel cables arranged transversely across the streets on steel and cast iron posts. The engine house is situated about 220 yards from the starting point of the tramway and to the left side of the park entrance. It contains at present a Petry-Dereux boiler and a steam engine of 150-horse power, made by Kuchen of Dusseldorf. This drives a dynamo having an output of 62,500 watts at an e. m. f. of 500 volts at the terminals. There is also installed a 70-horse power high speed Armington-Sims engine, and an arc light dynamo. Another dynamo, similar to the first, will shortly be put in place. Current from this generating station is used for several purposes; for the working of the tramway; for operating a 15-horse power electromotor placed in the Vienna bakery in Exhibition Place where the motor actuates several kneading machines, and a dynamo which supplies current to a number of arc and incandescent lamps, and for the lighting of many arc and glow lamps arranged on the tramway route, etc.

There are two 10-horse power motors to each car. Throughout the line there are numerous curves most of which are of small radius, but these are all traversed with great facility. At present there are in service five to six passenger cars, to each of which a separate car can be attached according to the requirements of the traffic. A car depot has been erected in the rear of the gas works and several pits have been dug in order to render the motors readily accessible.

Bloomfield Electric Railway.

The accompanying cut presents a view of the Bloomfield division of the Essex Passenger Railway company's system of street railways at Newark, N. J. This line is three miles in length, has eight turnouts and connects the town of Bloomfield, N. J., with Newark. The line is equipped with the United Electric Traction company's system. It was on this road that many of the early experiments of Leo Daft were made in the electric propulsion of street cars. Previous to October, 1889, the line construction was of the double overhead type, and as extensive alterations were necessary it was decided that the single overhead system should be adopted. V. H. Yarnall of the United Electric Traction company was assigned to the work of reconstructing the plant. A central wire was buried and each of the thirty feet rails connected at both ends to this wire. As new wire was used for this purpose operations under the old system continued while the work of changing was in progress.

When this work was completed the motor connections were changed, single trolley heads substituted during the night and the cars were started out next morning on one of the two overhead wires. On the other overhead wire the single switches were inserted and the cars were then run on the finished trolley wire while the second wire was removed. The entire change was made in a comparatively short time and without any interruption in the service.

BLOOMFIELD ELECTRIC RAILWAY.

The power plant for operating this road consists of 1 150-horse power upright boiler, 1 125-horse power New York safety engine, 2 50-horse power, 440 volt, compound wound generators, and 4 20-horse power standard United Electric Traction company's motors under Stephenson cars. The average work on this line is 113 miles per car per day. For seventeen weeks previous to May 1, 1890, not one trip was lost through the fault of the electric system, though several were lost as a result of accidents to engine and heavy falls of snow when no provision had been made for removing it from the rails. During this time it was necessary to repair but one armature and one field spool.

National Electric Light Association.

A. J. Corriveau of Montreal while in attendance at the National Electric Light convention at Cape May suggested that the next summer convention be held at Montreal. He says the suggestion was received with approval by many members and he is now endeavoring to boom the Canadian city for that purpose. The Montreal newspapers are interested in the subject, and the *Star* says: "In suggesting that this important electrical association should hold a convention in Montreal Mr. Corriveau pointed out that it offers many advantages; it is easily accessible from both eastern and western parts of the United States; the magnificent scenery of the beautiful River St. Lawrence, which could be viewed by the trip to Montreal being made by the River St. Lawrence, which would also allow the party to see the famous rapids. For Canada the holding of this convention in Montreal would be of great interest for the development of electrical business. Opportunity might be had to inspect the magnificent water powers that there are all over the Dominion, most of them not in use, and which could be developed to great advantages for the transmission of light and power by electricity."

South Side Electric Light Company, Chicago.

The South Side Electric Light company, Chicago, recently organized, has installed a temporary plant on State street near Twentieth street. At present there are two 1,000 light alternating machines of the Slattery type, manufactured by the Fort Wayne Jenney company, and one 25-light arc machine of the Wood type. These dynamos are driven by two Bass engines of 100 horse power each. The company is equipping a permanent station which it hopes to have in readiness in a short time. Orders have been given for the steam plant, engines and dynamos. There will be eight boilers aggregating 2,000 horse power and three 450 horse power compound Corliss engines. The engines and boilers will be on the ground floor, and the dynamos on the floor above. The dynamos will be belted directly to the engines after the plan followed in the power houses of the Chicago city plant. There will be 10 alternating incandescent machines of 1,000 lights. The Fort Wayne Jenney company has been awarded the contract for this order.

The company is now supplying current for the lamps in the Alhambra theater, just opened by H. R. Jacobs. This theater is an entirely new structure, handsomely finished and elaborately furnished. It is illuminated by 1,100 incandescent lamps of 16 to 150 candle power. The interior of the theater was wired by the Electrical Construction company, Chicago.

The hotel, which is now nearly complete and which occupies the remainder of the building, will also be furnished with electric lights. There will be 900 lights in this part of the building. The current for these lights will also be furnished from the temporary plant of the South Side Electric Light company.

This plant, including the building of foundations for the engines, dynamos and boilers, placing machinery, flooring, etc., was completed fourteen days after the work was begun. Manager Harding, who had charge of the work, pushed it ahead rapidly, and felt elated over his success in getting the plant in operation on such short notice.

New York Electric Club.

The New York Electric club will open the fall and winter season with a dinner at the clubhouse, 17 East Twenty-second street. The date fixed for the occasion is Oct. 2. It is the intention of the house and entertainment committees to combine an excellent musical and literary entertainment with the dinner, thus insuring an excellent time for all.

Rapid Method of Forming Cores for Gramme Armatures.

A glance at the headline and at the illustrations almost tells the story without further words. This method of facilitating the manufacture of ring cores, and the body of the armature is claimed by Mr. Edison, the inventor, to possess the advantage of being cheap and expeditious, and also to be a plan by which the core produced is of such construction that local currents are greatly diminished in comparison with those in a core formed by winding a single length of wire. The iron wire is wound on a wooden bobbin made in removable segments,

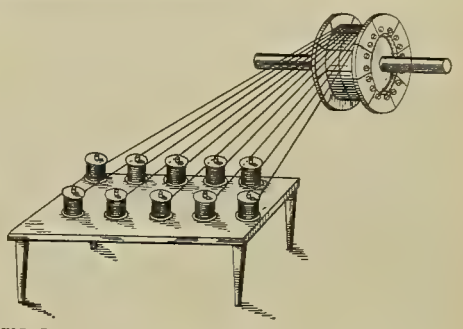


FIG. 1. RAPID METHOD OF FORMING CORES FOR GRAMME ARMATURES.

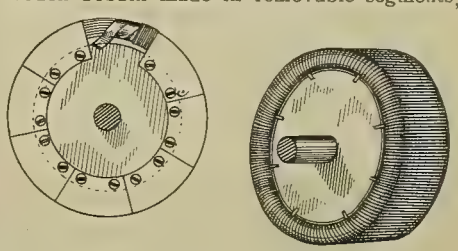


FIG. 2 AND 3. RAPID METHOD OF FORMING CORES FOR GRAMME ARMATURES.

Fig. 1. After the bobbin is full the segments are removed one at a time, and the spaces filled with copper wire at right angles to the iron wire of the core, Fig. 2. The armature thus formed is then forced on a wooden hub, Fig. 3, and the edges secured by slips of vulcanized fiber to prevent the core from turning on the hub. Fig. 4 is a sectional view of the temporary hub with the iron wires in place. The iron wires are insulated by passing them through the vapor of nitric acid or of hydrogen peroxide. By this process the surface of the wire is reduced to ferric oxide. This insulates the wire perfectly.

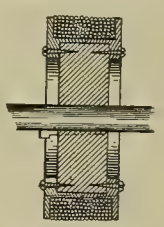


FIG. 4, RAPID METHOD OF FORMING CORES FOR GRAMME ARMATURES.

Telephoning to Ships at Anchor.

Telegraphic communication has been introduced at the naval manœuvres in Sweden, now going on. On board every ship is a telephonic apparatus, and the connecting wires, which are laid out very quickly and taken up along the anchor chains. In the same manner connection can always be obtained with the state telegraphs whereby, of course, the whole country can be communicated with. Altogether, the telephone is used regularly on board ship in Sweden where many of the trading steamers are brought into telephonic connection with the town telephone within half an hour of their arrival, an arrangement which has proved itself eminently useful and practical, and the introduction of which is on the tapis in various places.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:
6 Lakeside Building, - - CHICAGO
Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Telephone and Telegraph Construction Company of Detroit. Illustrated 137
Convention of the National Telephone Exchange Association at Detroit 137
Complete Metallic Circuits in Chicago 137
Union Stock Yards Telephone Switch-board Connections. Illustrated 138
Telephony and Insanity 138
The Storage Battery in the Chicago Telephone Exchange. Illustrated 138
Electrical Journals and the Telephone Convention 138, 139
The Ader Telephone. Illustrated 139
Closed Magnetic Circuit Induction Coil in a Telephone Transmitter. Illustrated 139
Producing Musical Sounds by Electricity. Illustrated 139, 140
Curve Insulator. Illustrated 140
Double Carbon Lamps 140
More Electric Railroads for the Holmes Syndicate 140
Interior Conduits. Illustrated 140
A New Incandescent Lamp Fixture. Illustrated 140
First Thomson Road in Europe 140
Bloomfield Electric Railway. Illustrated 141
National Electric Light Association 141
South Side Electric Light Company, Chicago 141
Rapid Method of Forming Cores for Gramme Armatures. Illustrated 141
Telephoning from Ships 141
Editorial 142
Electrical Apparatus for Physicians. Illustrated 143
New York State Railway Association 143
Electric Light at the Inter-State Exposition, Chicago 143
The Production of Electricity by Chemical Reaction. Illustrated 143, 144
The Hedgehog Transformer, by J Swinburne. Illustrated 144
Alleged Nationalism in Chicago 144, 145

DEPARTMENTS.

Correspondence 145, 146
The Electric Light 146, 147
The Electric Motor 147
The Telephone 147
The Telegraph 147
Electrical Patents 148

AN invention by Edison to produce electricity by chemical reaction is described elsewhere in this issue. The apparatus employed to carry out the process is as simple as it is ingenious. Among various sets of substances suggested as being efficient in producing the reaction from which in turn a current is developed, are the two, iron filings and water. If these two elements are heated in what might be called a retort, the upper portion of which is insulated from the lower, the inventor claims to obtain a flow of current through an external circuit connecting the two halves of the receptacle. Just what the efficiency of the apparatus is we have not learned. As Mr. Edison applied for a patent in 1888 to cover this process it might not be unreasonable to presume that there may be some more recent developments in this line, which as yet have not been published. The fact that Mr. Edison has, for some time, been working upon a variety of apparatus with the view of producing a machine, or a process, which will materially reduce the cost of current, would seem to substantiate this idea.

THE next number of the WESTERN ELECTRICIAN will contain a report of the annual convention of the National Telephone Exchange association held at Detroit September 9, 10 and 11.

THE WESTERN ELECTRICIAN goes to press this week earlier than usual in order that copies of the issue may be in the hands of the delegates to the Telephone Convention at Detroit September 9. A considerable amount of matter prepared specially for the convention will be found in this number. All the information which we have received up to the present time leads us to believe that the meeting will prove one of the most interesting in the history of the organization. Many questions of vital importance to telephone men are to come before the association. Great preparations have been made to entertain the attendants at the convention and those who are present will doubtless find that their stay in Detroit has been full of enjoyment.

IT is more than likely that the National Telephone Exchange association will be called upon to take some action in regard to the World's Fair in 1893. We trust if the matter comes before the body that it will pass resolutions pledging to the authorities of the World's Columbian Exposition the hearty co-operation of the organization. The telephone interest is greatly indebted to a world's fair for the great success which has been achieved during the last fourteen years. The writer of a paper at the recent Electric Light convention said: "It has been stated by competent authority that had it not been for the exhibition of the speaking telephone at the Centennial Exhibition at Philadelphia the telephone would have been ten years later in receiving popular recognition, and becoming a success. * * * Sir William Thomson who was in 1876, as he is now, the recognized authority in electrical science, seeing the telephone at the Centennial Exhibition became enthusiastic over it and indorsed it so warmly, that it directed public attention to the invention and made it an immediate success." If this view of the case is correct, the telephone fraternity owes a great debt of gratitude to an International Exposition and we know of no way in which it can discharge it so satisfactorily as by hearty co-operation with the authorities of the World's Fair. The electrical exhibit will unquestionably be the most popular department of the great exposition, and the telephone section should be one of the largest and most interesting features.

IN another column a description is given of a recently-invented modification of the well-known carbon and induction coil telephone transmitter. The proposed improvement consists of a slight change in the winding of the usually employed cylindrical induction coil and its combination, in addition, with what might be called a form of closed magnetic circuit induction coil. By the use of this last-mentioned coil, the inventor claims to secure in the line circuit induced impulses possessing a superior degree of energy. The explanation of the action of the transmitting device, as given by Thomas D. Lockwood, the inventor, is to the effect that on account of the impracticability of producing reversals of current in the primary circuit of a transmitting telephone induction coil, no reversals of magnetism with "its inherently consequent zero moment" occur. For this reason, then, Mr. Lockwood claims that while it tends to advantage to employ induction coils having closed magnetic circuit cores, such construction necessitates also a practical method of producing reversals in the primary circuit of the coil with the closed magnetic circuit. The arrangement of an organization adapted to effect such reversals and to enable induction coils with closed magnetic circuit iron cores to be practically and advantageously employed, is the purpose of the invention.

On reading the description of this modification, at first glance one is inclined to be somewhat skeptical as to its practical efficiency as compared with that of the other well-known forms of transmitter. Considering the fact that as there occur in the device, strictly speaking, two conversions and consequently two losses of electrical energy, it would seem, therefore, that any gain which might result from the insertion of the closed magnetic circuit coil, would be about balanced. The theory advanced relative to this transmitter, however, is ingenious, and it is to be hoped that the inventor will make public to what an extent it is practically advantageous.

IN another column is reproduced an article in which the fact that Chicago is operating its own electric light system is cited as evidence of practical nationalism in Chicago. The article is presented merely as a matter of news, for we think, few readers of the WESTERN ELECTRICIAN have any sympathy with the communistic principles, which as a disciple of Bellamy, the writer enthusiastically advocates. Most of the statements which the writer, Mr. Weeks, advances in regard to the economy of municipal electric light plants were disposed of very thoroughly by Mr. Francisco at the recent convention of the National Electric Light association. Probably no one would protest more emphatically against the ideas contained in the article than Chicago's city electrician, Prof. Barrett, who would object very strenuously to the statement that the success attending the operation of the municipal electric light system was evidence of the progress of practical nationalism in Chicago.

WORKERS in the telephonic field have had much to occupy them during the last year in solving problems connected with the use of metallic circuits. The rapid multiplication of electric wires of all kinds, but especially railway conductors, has played havoc with many a telephonic circuit. It would be hard to enumerate the cities from which the report has come: "Good service has been rendered absolutely impossible by reason of induction from the electric railway wires." Since the last meeting of the Telephone Exchange association at Minneapolis, a year, ago this matter of freeing the wires from the disturbance resulting from the proximity of railway wires has received marked attention. In a paper read at that convention it was stated: "If a metallic circuit for telephone purposes is constructed upon plans properly laid out, every particle of outside disturbance may be overcome and the service may be made perfect." A good many telephone men believed that statement and during the year have put their belief into practice. Doubtless a number of them will report at Detroit.

During the year a considerable amount of work has been done in perfecting metallic circuit operating apparatus. It has not been showy work and the public has heard but little of it. A great deal of attention has been paid to the improvement of the metallic circuit switch-board. Such imperfections as now exist will be overcome, it is believed, in the natural course of events. A large amount of underground construction has been done, and the work has in the main been of a successful character. It is a noticeable fact too, that the work has been so performed that a metallic circuit system can be introduced when necessary.

One of the topics which will doubtless excite more than ordinary interest at the Detroit convention will be the troubles arising from electric railway wires. The topic last year interested the members of the association as did no other subject. But the sufferings of the telephone men are probably far more acute to-day than they were in September last. A number of suits relating to this subject have come before the courts during the last year. Neither the railway companies nor the telephone corporations can show an unbroken line of victories. The decision of Judge Taft at Cincinnati was an unqualified victory to the telephone interests and the street railway companies as a result of his decision are employing a double trolley in Cincinnati. In one or two other cases the Bell companies had the best of the conflict, but the railway companies have a number of strong decisions in their favor. The matter is not yet settled definitely and the telephone man has many days of vexation still before him.

Electrical Apparatus for Physicians.

The accompanying cut illustrates a collection of electrical apparatus which the Law Telephone company of New York will exhibit at the convention of Mississippi Valley Medical association at Louisville, October 8. The apparatus is designed for the use of physicians. The collection comprises the Bailey current regulator, milliampere meter, Dubois-Raymond faradic coil, polarity switch and electrodes. The Bailey regulator shown on the right of the table is so constructed that the strength of the current administered to a patient may be reduced from the full quantity down to a current so feeble as to be entirely imperceptible, without any breaks in the circuit or sudden shocks. The milliampere meter shown at the left of the regulator is graduated from zero to 250.

New York State Street Railway Association.

The eighth annual meeting of the New York State Street Railway association will be held at the Powers Hotel of Rochester, N. Y., Sept. 16.

This meeting will be specially devoted to electricity. A report on the subject of "An Electric Street Railway Motor" will be presented by John W. McNamara, president of the Albany Railway company. As the subject of the electrical propulsion of street cars is of such interest at present to street railway companies and municipalities, it was decided by the executive committee to invite the representatives of the several overhead electric systems to the meeting to explain to the delegates the merits of their respective methods. They will thus aid in setting forth, as forcibly as possible, the success of electricity as a motive power, and facilitate the work of those companies which have the change from horse power to electricity under consideration.

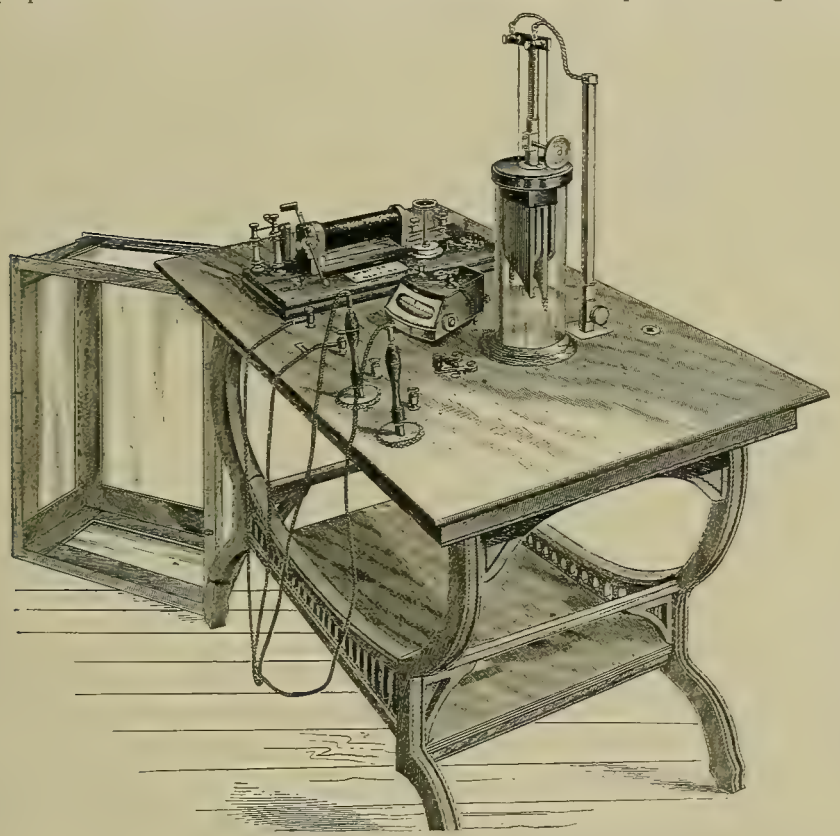
The Rochester Railway company, through J. N. Beckley, vice-president, has invited the gentlemen in attendance to take luncheon at one of the local clubs and dinner at Ontario Beach in the early evening. The delegates will take the new electric cars on State street and Lake avenue to the beach. The delegates have been invited to inspect the power stations and study the system as fully as the time will permit.

The local railway company hopes to see a large gathering of New York state street railway men, and promises to do all in its power to make their visit pleasant. It is quite likely that there will be a Wednesday morning session.

A special buffet sleeper will leave New York on the West Shore in connection with the boat leaving the foot of Jay street, North River, at 5 o'clock, and foot of West Forty-second street, at 5:15 P. M., on Monday, Sept. 15, for the accommodation of New York and Brooklyn delegates, reaching Rochester about 4 A. M. Tuesday. The car will there be detached and the occupants allowed to remain in the car until such time as they may desire to leave it. Special excursion tickets to Rochester and return, including accommodation on the drawing-room car to Rochester, which may be procured from the secretary, William J. Richardson, Brooklyn, N. Y.

Electric Light at the Inter-State Exposition, Chicago, Ill.

The managers of the Inter-State Exposition, Chicago, are evidently determined to make their last exhibition a blaze of glory, and leave a good impression on the minds of the patrons of the eighteenth annual display. The immense halls were brilliantly illuminated with arc and incandescent lamps when the exposition was opened last week, and proved a striking contrast to the dimly-lighted barracks which were closed last year; but at that time gas was used. Above the main entrance to the building is an elaborate sign, "Inter-State Exposition," made of incandescent lamps. In this sign there are 350 lamps, and they make an excellent appearance. Immediately inside the main hall are a number of festoons containing 150 incandescent lamps, and a like display is made at the opposite end of the hall. But the most attractive feature of the display is at the fountain. Above the fountain there appears a ball of fire. It consists of 500 colored incandescent lamps. There are also lamps in the water and in the hands of the statues, making a very pleasing effect. There are many other devices and numerous incandescent lamps scattered through the booths. These lamps receive their current from two Edison dynamos of a capacity of 2,600 lights. The dynamos are driven by a McIntosh & Seymour engine. The installation was made by the Chicago Edison company. In addition to the incandescent plant there is a special arc light plant furnishing current to 175 2,000-candle power lamps, which are distributed about the main hall and the art room. This plant consists of Sperry apparatus, and was installed by the Sperry Electric company, Chicago. The superiority of electric light over gas is fully demonstrated in the lighting of the Exposition building, where, instead of a gloomy wilderness in which nothing could be carefully examined, everything is now shown in all its splendor.



ELECTRICAL APPARATUS FOR PHYSICIANS.

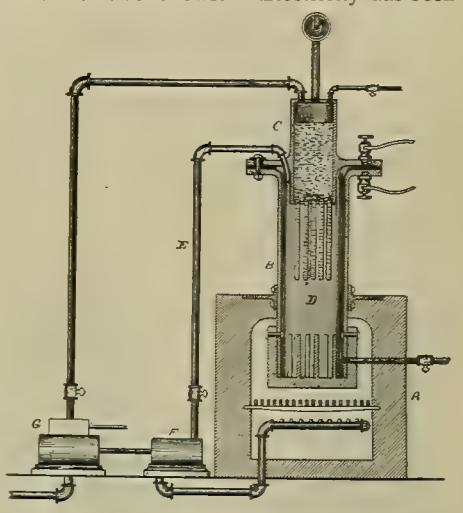
The Production of Electricity by Chemical Reaction.

The realization that the efficiency of the dynamo and the various types of zinc-consuming batteries is now at a point which leaves but little to be expected, has unquestionably turned the attention of scientists and inventors to the problem of the generation of current by other means.

Mr. Edison who, as is well known, has given much thought to this subject, has recently been granted a patent on a process and apparatus through which electricity is obtained by chemical reaction. The cut illustrates the generating machine.

The parts of the apparatus may be described as follows: *A* is a furnace provided with grate bars. *B* is a tubular vessel with a heavy cast-iron bottom projecting down into the furnace. This bottom plate is provided as shown with upwardly projecting iron rods or electrodes. *C* is a steam boiler having water tubes projecting downwardly into the vessel *B*. The vessel *B* and the steam boiler are insulated from each other as indicated. The space *D* is what might be called "the reaction chamber." The pipe *E* connects with the inlet of an air pump *F*. This pump is worked by the steam engine *G* which takes steam from the boiler *C*. The outlet of the air pump connects by pipe, as shown, with the fire box of the furnace.

Mr. Edison explains this process by which he claims through the chemical reaction of salts or their compounds to produce economically electric currents as follows: Electricity has been generated heretofore by chemical reactions in liquid-conducting media. He proposes to generate electricity by dry chemical reactions, and to use as the conducting media of the generating apparatus the gases liberated. This is accomplished by causing the dry chemical reaction to take place in a vacuum chamber in a rarefied atmosphere forming the conducting medium, and in the presence of heat which maintains the chemical reaction, and increases the electrical conductivity of the rarefied atmosphere. Such compounds, or compounds and elements are used that the chemical reaction taking place within the inclosing chamber will produce a solid or liquid non-gaseous product. This remains at the point where the reaction takes place and liberates a gas which rises into the chamber. The inclosing vessel *B* being electrically divided into two parts which form the poles of the apparatus, the non-gaseous product remains upon and charges one pole while the gaseous product charges the other pole. There is kept up a continual exhaustion of the chamber to maintain the proper degree of exhaustion as the reaction takes place. The pole of the vacuum chamber which is not heated externally, may be of great heat-absorbing capacity, so as to absorb rapidly the heat of the chamber, producing a lower temperature than at the other pole of the chamber. The construction to absorb the heat is that of a steam boiler, so that the steam generated can be employed for operating the vacuum apparatus.



THE PRODUCTION OF ELECTRICITY BY CHEMICAL REACTION.

This pump keeps up a continuous exhausting action and the gas which is continually being withdrawn from the vacuum chamber is forced into the fire box below the grate and is burned to assist in heating the chamber. Where, however, generators are connected in series this gas can be admitted into the vacuum chamber of another generator, and utilized to produce dry chemical reaction.

Relative to the compounds required in this process, Mr. Edison states that a great variety of compounds of elements or elements and compound of elements may be used to produce the chemical reactions described, since nearly all chemical reactions produce electricity under the proper conditions. A reducible or oxidizable substance might be employed—such as a metal or metalloid, acted upon by a gaseous liquid or solid compound containing an element with which it will readily combine when the compound is decomposed. A non-metallic material, like carbon, might be employed instead of the metal or metalloid. An efficient method is to use a metal—such, for instance, as iron in a divided condition. This is placed in the chamber and brought up to incandescence. Steam or water is then permitted to enter the chamber. The oxygen of the watery vapor will combine with the metal, and the hydrogen will be liberated, the chemical reaction setting up a powerful current of electricity. During this action rarefied hydrogen charges one pole while the other pole is charged by the iron. The operation is a continuous one until the metal is oxidized, the heat being kept up and the steam or water being permitted to flow into the chamber in a continuous and properly regulated jet.

The Hedgehog Transformer.

By J. Swinburne.

Last year the writer brought forward the theory that an open iron circuit transformer could be made more efficient than any form of closed iron circuit transformer. The loss in a transformer is made up of loss in copper due to resistance and loss in iron due to hysteresis. In calculating the efficiencies of transformers, the loss in

HEDGEHOG TRANSFORMER.

the iron has generally been left completely out of account, and the loss in copper alone considered. Hence the efficiencies of 97 and 98 per cent. claimed for closed iron circuit forms. If the loss by hysteresis is taken into account, allowing the losses as given by Ewing, the loss in iron closed circuit transformers as usually designed, is some 10 per cent. of the full load. As the loss in iron goes on all the time a transformer is in circuit, this is very serious. The proportion of actual to possible output of energy per day varies in different districts, but in most stations the average use of lamps is less than two hours a day, including all the lamps installed. The transformer must be large enough to feed all the lamps installed, so it runs, say, an average two hours of full load a day. If there is a loss of 10 per cent. of full load in the iron, this gives an actual efficiency of 45.5 per cent. even neglecting the loss in copper. In the hedgehog form the proportion of iron is very much reduced. The cross-section of the iron is much less, and the length is about one-third of that of the closed circuit form, as it has not to surround the wire. The result is that even in small transformers the iron loss is under 1 per cent. of the full load. One per cent. of full load gives 89 per cent. all day against the 45 per cent. of the closed circuit. This is neglecting copper, however, and the copper loss is greater in the hedgehog form, so this is an exaggerated comparison. Such a transformer really has an efficiency of about 87 per cent. all day. The theory of the hedgehog form is this: If a closed iron circuit is used the iron circuit must be long to embrace the copper coils. The only way to shorten it is to make the copper coils smaller. This means using a higher current density, which is wasteful, or fewer turns of copper, which demands either a higher induction in the iron or a greater cross-section, and both of these mean greater loss of hysteresis. If the iron circuit is opened three sides of the embracing core can be removed, so the loss by hysteresis is divided by three. As there is now plenty of room for copper, the turns and cross-section can be increased, and the iron reduced still farther.

The object of introducing the closed iron circuit was to reduce the magnetic resistance. An open circuit transformer has much higher magnetic resistance. The question of magnetic resistance is not so important as might at first sight appear. Its increase demands more excitation or more magnetomotive force, and this increases the loss in copper. The best form is thus a a compromise. The hedgehog ends are to reduce the magnetic resistance. In a conductive circuit the resistance is low if the current density is low in all parts where the specific resistance is high. Similarly in a composite magnetic circuit of iron and air, the magnetic resistance is low if there is never a high "magnetic current density" or induction in the air, which has high specific magnetic resistance. The magnetizing current in a hedgehog form is high, but as it is quarter of a period behind the primary current in phase, and as the primary wire has to be large enough to carry the primary current, the loss in watts is small. As this loss goes on all day, however, it is by no means unimportant and has to be included in getting out the efficiencies.

The construction of these transformers as carried out by Swinburne & Co. of Teddington, England, is very simple. A gun metal casting of cross-shaped section forms the backbone. It is spread out at each end, forming legs at one and making circular terminal boards at the other. It also carries insulating flanges which form the ends of the coils. Into the four recesses in the core are put four bundles of soft iron wire. These are taped over and the secondary is wound on. The secondary is then covered with two layers of ebonite and the flanges are also faced with the same material. The primary is then wound on in two compartments separated with ebonite after the manner invented by Gramme, so that both ends come outside and as far removed from each other as possible. The ends of the core are then spread out and the transformer tested under 4,000 or 5,000 volts; the insulation in megohms being read by a peculiar instrument which measures the effective resistance under an alternating current. As iron cases cannot be used as they would be magnetized by the transformer, and as any metal would have Foucault currents generated in it, stoneware jars are used for cases. These have lids bolted down with holes for the leads as shown. The cuts show the general construction of the hedgehog transformer, together with its stoneware case.

Alleged Nationalism in Chicago.

Doubtless there are few readers of the Western Electrican who sympathize with the socialistic ideas of the Nationalists. Bellamy's "Looking Backward" is not read seriously by practical business men. Appended is an extract from an article in the *Nationalist* relating to the Chicago city electric light plant. In view of the controversy concerning the cost of running the Chicago system the article is not without interest, although the socialistic ideas of the writer can only be condemned.

Practical Nationalism in Chicago.

by charles l. weeks.

No better object lesson can be found by which to teach first steps in nationalism than the progress which Chicago is making toward performing its own public service.

Our municipal electric lighting system is now nearly three years old, and none but good results have appeared. Among them are excellence of service, economy of management, and freedom from that corruption which is too often the odious adjunct of public service performed by private corporations. But most gratifying of all is the revelation to the people that, by venturing into this field, they have learned how to apply the true principles upon which to supply their own needs. This discovery has already borne fruit. Our mayor's recent message recommends that the city supply to the citizens light for household purposes, also heat, power and street car transportation, at cost, as it now supplies water; and he predicts that such improvements are among the probabilities of the near future.

Chicago has taught some valuable lessons to other cities which would establish electric light plants, among them that it is not only practicable but advisable to make a small beginning. Our first investment was but about $12,000, and our first plant was fitted up to run fewer than 100 lamps. To this additions of engines and dynamos were made from time to time, and the number of lamps increased. At this time we have three very substantial plants in operation.

They have been built under the direction of our city electrician, Professor Barrett, and are equipped with the latest and best appliances. The capacity for each is for 1,000 arc lamps of 2,000 candle power each. One hundred and sixteen miles of wire have been laid in underground conduits. Many miles of streets in addition have been piped, and are ready for the wire as soon as other construction has been completed.

We have in nightly operation 668 lamps of 2,000 candle power each. The construction is being rapidly pushed, and 500 more lamps will be burning by the coming fall.

Our system is said to be the best extant. No wires are exposed in the streets; all are underground, and the connection with lamps is made by running the wires up through the lamp posts. There has been no instance of injury to life or property, nor can there well be from the safeguards provided.

Our cost of operation, under favorable circumstances, will not exceed $50 per lamp of 2,000 candle power per year. At present the cost somewhat exceeds that; this is because the plants are not yet being run to their full capacity, and because the territory covered is many times greater than would ordinarily be the case with the number of lamps now operated. Economy would bring the present number of lamps into a territory one-fourth that now covered. But Professor Barrett is between two fires; on the one hand the people, through their aldermen, are clamoring for the extension of the system beyond his present means; on the other hand, the Gas Trust and private electric light companies, through *their* aldermen, are throwing obstacles in his way, even to demanding that he perform impossibilities, in the hope of compelling a bad showing. If he could be allowed to do his work free from harassment by those who would purposely make it difficult, he could get better immediate results as to cost of operation.

When the system is complete, the running expenses will be very much less than now. The same buildings and corps of attendants could with slight additional outlay, supply several times the number of lights now produced. The saving over gas in lighting our streets by electricity even under present unfavorable conditions, is enormous. We now pay $20 per year per gas lamp of 20 candle power, or $1.00 per year per candle power. Our present cost per candle power for operating electric lights is less than four cents per year, and when our plants are running to their full capacity it will not exceed 2½ cents as against $1.00 for gas.

Cities have been led into making contracts with private electric lighting companies at enormous prices because of two things: 1st, their entire ignorance of the cost of such service; 2d, the belief that to establish an electric light plant was an undertaking on a par with the putting in a gas plant or building a waterworks system. The facts are becoming known; cities and towns are discovering that it is a very sim-

ple and inexpensive thing to own and operate their own electric light plant.

More then twenty cities in this country have already established electric light plants, and are supplying their street lamps at a cost of $50 or less per year per lamp, while many other cities are paying to private corporations from $150 to $200 per year for the same service. Until recently Boston has been paying $240 per year per lamp.

A plant for 100 arc lamps can be put in full running condition for $15,000, exclusive of land and buildings. Many towns have these latter that can be used without much delay. The cost per lamp for operating a 100 lamp plant would be about $65 to $70 per year. With 300 lamps the cost would be reduced to $60 per year.

A simple beginning, and one within the reach of any town, would be to put a 25 or a 50 light dynamo into the basement of some public building which it was desired to light; then connect with other city buildings, and have a few lamps in the streets between. A commencement of this sort would soon be extended by popular demand. Started in this way a plant for 50 arc lights need not cost over $8,000.

A favorite objection to the extension of such service as this is that it would increase the danger of corruption. Chicago's experience has been that the corruption has come chiefly from corporations operating its public service. It is true some of our statesmen thought they could steal; but we were able to *go over their accounts*, and they are now serving the state in a capacity more in keeping with their ability.

A most striking instance of the corrupting influence of corporations in Chicago has been within the experience of this same Professor Barrett. Eight or nine years ago he made an attempt to establish an electric light plant. As a beginning he procured a small dynamo and connected it to an engine in the waterworks pumping house. He established a number of lamps in the building and on the water tower. The gas company began to fight the enterprise at once, and an order was soon forthcoming from the city council, directing the professor to sell that dynamo, which he did, and his lights had to come down. Had he been permitted to go ahead, he would have saved Chicago two or three million dollars before this time on street lighting alone.

The chief opposition to our present undertaking comes from the gas trust and private electric lighting companies here. But, thanks to the perseverance of Professor Barrett, our system is daily being put on a more secure basis, and is now in no danger of being overturned.

There is no reason why every city in the land should not follow Chicago's example, and provide its own service of this character. If private corporations can pay taxes, insurance, water rates, fancy salaries, and big dividends out of such service, then surely the people can perform it for themselves when they have none of these things to pay.

For the Edison Companies' Convention.

A special train from New York will convey the delegates of the Association of Edison Illuminating company to Minneapolis where the annual convention will be held September 16. The train will reach Chicago at 10:10 A. M. Monday, September 15. The delegates will have an opportunity to call at the Edison headquarters in Chicago and visit points of interest in the city. The train will leave at 5:30 P. M. by the popular Burlington line. Western delegates can join the party in Chicago. Accommodations on the train can be secured by application to W. W. King, city passenger agent of the C., B. & Q., Clark and Adams streets, Chicago.

New Electrical Supply House.

P. H. Alexander, Gen. C. H. Barney and Charles F. Chapin have associated themselves in the formation of a new electrical supply house at 20 Cortlandt street, New York city. These gentlemen have so long been identified with the electrical interests that it is scarcely necessary to refer to their achievements. They have all been connected with the Sawyer-Man company, occupying the positions of general manager, treasurer and purchasing agent, respectively. In the new firm they will continue the same line, Mr. Alexander as general manager, Gen. Barney treasurer, and Mr. Chapin purchasing agent. Their experience well qualifies them for their new undertaking. Mr. Alexander has had practical experience in several departments. He began his career in electrical fields, installing central station plants for the Thomson-Houston, Sawyer-Man and Westinghouse Electric companies in New England. He has been general manager of the Sawyer-Man Electric company during the last few years, and the phenomenal success of that company has been due largely to his efforts. Mr. Alexander has also been interested as president of the New England Electric exchange in harmonizing the insurance and electrical interests in New England, and thereby greatly benefiting the electrical interests. At present he is engaged in the work of the National Electrical Insurance bureau, which is framing rules governing the installation of apparatus for electrical purposes throughout the country. Gen. C. H. Barney became interested in the telephone in 1879. After two years' experience in Providence and Boston, during which time he constructed the first long-distance telephone line between those cities, he was called to the management of the New Jersey Telephone company. He resigned this position in 1886 to engage in the organization of the Sawyer-Man Electric company, of which he is now the treasurer. He was one of the charter members of the New York Electric club, and is now a member of the board of managers. He has been since 1885 the secretary of the National Telephone Exchange association. Charles E. Chapin entered the electrical field as secretary of the Waterhouse Electric & Manufacturing company of Hartford, Conn. On the sale of that company to the Westinghouse Electric company, and the removal of the works to Pittsburgh, Mr. Chapin was transferred to New York, and became the purchasing agent of the Sawyer-Man Electric company. The rapid growth of the business of that company, both in the supplies furnished to central stations and the innumerable wants of a large factory, has required activity in the purchasing department, and Mr. Chapin has proved himself to be a successful buyer. Messrs. Alexander, Barney and Chapin will occupy the same positions in the new firm as they filled in the Sawyer-Man company, and start with a large experience in their respective departments. The new store will be ready about Oct. 1, and the firm will represent manufacturers in goods adapted to the electric trade, as well as keeping in stock a line of general electrical supplies. The new insulating material, which is now receiving great attention, called "Alexite," will be under the control of Alexander, Barney & Chapin. This material can be made into any shape, and has the properties required for cut-outs, switches, etc., etc., being fire-proof, water-proof and acid-proof. Any color of wood, paper or marble can be imitated, so that harmony of the attachments in wiring with the color of the materials in the room is attained.

CORRESPONDENCE.

New York Notes.

NEW YORK, Sept. 6.—Much interest is manifested here in the proposed action of the government in fixing telephone rates at Washington. The fact of the matter is that the opponents of the Bell Telephone company have adopted this means of fighting that corporation. Senator Morgan was induced to introduce a bill providing that "hereafter it shall be unlawful for any officer, agent or employe of the United States Government to pay a greater sum than $30 per annum or $7.50 per quarter for the rental or use of any telephone instrument for or within any of the departments, bureaus or offices of the United States Government within the District of Columbia and if any telephone company or other corporation operating or furnishing telephone service within said District of Columbia shall refuse to accept such amount as compensation in full for such service, then said company or corporation shall be prohibited from running its wires or lines on or within any government building, over or through any government reservation or along any public street or alley bordering on such reservation." The amendment was agreed to by the senate after very little debate, and the point of the pending controversy will be whether the government can dictate telephone rates. The suit of the Western Union company against the government will probably settle the interesting question. The Western Union has refused to accept the compensation for government business based on the rates fixed by the postmaster-general and will await the decision of the courts.

There seems to be some misunderstanding in the defense of the Japanese murderer, Schiok Jugigo, now confined in Sing Sing prison awaiting the death penalty, The case was conducted on behalf of the condemned man by John R. Heintzelman and Jacob Berlinger. Roger M. Sherman appeared in the case last Thursday securing an order from Recorder Smythe authorizing and directing Warden Brush to permit Mr. Sherman and the Japanese vice-consul to confer with the condemned man. When the attorneys who had represented the prisoner during the trial learned this they became indignant and immediately applied to the judge for a dismissal of the order. This petition was granted and the warden at the prison notified by telegraph not to honor the order in Mr. Sherman's possession. The attorneys who thus showed their spite evidently hoped to secure all the notoriety they could through their connection with the case. They were appointed by the court, whereas there is every indication that Mr. Sherman was employed by the representative of the Japanese government in this country If the attorneys for the prisoner were anxious to save their client's life they might have exerted their efforts in another direction to much greater advantage than endeavoring to stop Mr. Sherman The case will no doubt be followed with interest. Mr. Sherman will probably insist upon his right to see the prisoner and secure the power of attorney from him. If this is done it will effectually dispose of the two legal lights who have heretofore had charge of the case. Mr. Sherman will undoubtedly raise the question of "cruel and inhuman punishment," citing Kemmler's experience in proof of his assertion.

The Edison Electric Illuminating company of this city announces a reduction of price, taking effect Oct. 1, to the rate of 1 cent per hour for each 16-candle power lamp, and proportionate rates for larger lamps and for motors. The company is now largely extending its connections. It is also increasing its facilities by installing a new plant at its annex station in the Produce Exchange building, and is erecting a large station near the City Hall and dry-goods district, making its capacity 150,000 lamps.

Lower Broadway was the scene of a merry commotion one morning this week. Whenever a horse was driven between the street car tracks at Broadway and Cedar street, it would shy and become unmanageable. The cause of the trouble was found to be a leak in the Edison subway. The necessary repairs were made before any accidents occurred.

Men disguised as linemen are making a business of wire cutting and appropriating the copper. The Hudson Electric Light company of Jersey City asserts that about $500 worth of its wire has been stolen in this way.

The overhead wire question in Newark is being hotly debated and ex-Congressman Halsey's application to the courts for an injunction staying the further erection of poles for overhead electric wires until the validity of the ordinance granting the street car companies permission to put them up shall have been decided, was refused by Judge Magee. The case will be tried during the November term of the Supreme court. W. H. T.

Nashville, Tenn.

NASHVILLE, Aug. 28.—A. M. Young of Waterbury, Conn., has secured exclusive franchise for an electric street car line in Johnson City, Tenn., and binds himself to begin work within thirty days, and to complete two miles of road within twelve months. Work has begun on the power house and contracts for poles, ties, etc., are offered under a verbal guarantee that two miles of the line will be in operation within four months. B.

Des Moines, Ia.

DES MOINES, Ia., Sept. 6.—It has been a good many years since the pioneer settlers of Des Moines came together and built the dam which stretches across the Des-Moines river at the foot of Center street. When the Belt road was built three years ago, to obtain a right of way through the mill property it became necessary to acquire the whole property, and it was purchased by enterprising capitalists. Two of the gentlemen, Dr. E. T. Likes and Lowry W. Goode, realized that there was a fine water power running to waste, and they went to work to develop that power. Work was commenced on the west bank of the river, which was made secure by building a retaining wall of stone 115 feet long, with two thirty-foot wings and finished with piling. Coffer dams were constructed, and the water pumped out, and a large enough space dug out for the race or fore-bay. A solid concrete floor several feet thick was put in. From this foundation the supports of the power house rise, and consist of a number of 12x12 feet uprights. Adjoining the power house east is a very massive and solid crib which adds additional strength to the dam. From this point starts the dam proper, somewhat in the shape of an inverted capital K. It is 460 feet across and is being reconstructed in a most substantial manner.

The turbine wheels, furnished by the Leffetts Water company, of Springfield, Ohio, and guaranteed of 100-horse power, rest in the bottom of the wheel pits. There are five wheels in the building on the west bank and the structure will be duplicated on the east bank at the convenience of the builders, after the first five wheels are in operation. As each wheel is 100-horse power, that will give 1,000-horse power for the dam when completed.

The heavy timber structure above the wheel pits, now being constructed, is for carrying the main shafting. This will connect with dynamos, and the power sold in the form of electricity, in the daytime for power in factories and at night for lighting purposes.

If good weather continues, it is expected the work will all be completed within the next six weeks. A line of thirty-foot piling has been driven where the bank will be

reclaimed, and a retaining wall 700 feet in length has yet to be built there. It will extend from the ice house to Des Moines street.

The cost of it is not yet computed, but not less than $100,000 will be required to bring the enterprise into condition for profitable working.

C. K. Mead, an experienced electrician, has had charge of the construction.

In many respects the finest factory building in Des Moines is the one just completed and now occupied by the Des Moines Edison Electric Light company. The building has been going up almost in the heart of the city, but on account of its being set off a little out of the way, the public has paid little attention to the improvement. The new power house of the Edison company is located at the foot of Chestnut street, on the Des Moines river bank, an admirable location for it. The building is 160x118 feet with a truss roof covering the whole, except the office part, which is two stories high. It is all of brick and iron, and is of neat architecture. The offices on Chestnut street are large and roomy, and are finished in polished wood. There are, also, storerooms and commodious workshops for the convenience of the employes. The boiler room is on the east side overlooking the river and when the river front is filled in, as it is intended to be, a little park will be located there. Water is obtained from a tunnel under the river and is passed a series of filter wells, from which it is pumped into the feed water cleaning tanks. The present battery is composed of three Heine safety tubular boilers making a total of 200-horse power. There is room for as many more. A smokestack 125 feet high furnishes the draft through a seven foot opening. The boiler room is separated from the engine room by a brick partition.

Two Williams compound condensing high speed engines, 100 and 150-horse power respectively, have been placed, and a 150-horse power Buckeye will be put in, also one from Arlington & Sims a 150-horse power engine. These will drive four No. 29 Standard dynamos and two No. 12. These machines will furnish about 5,000 lights. The station however, is designed for 12,000 lights.

The officers of the company are J. H. McClement, president; J. S. Clark, vice-president; J. G. Rounds, treasurer; J. A. Colby, secretary and manager. The plant was constructed by the United Edison Manufacturing company of New York, under the direction of August Hansen, and the line work is in charge of William H. Bauder. In the erection of the building, the placing of new machinery and the construction of costly lines all over the city, the company has expended some $75,000 or $80,000. R.

Pittsburgh, Pa.

PITTSBURGH, Sept. 6.—The East End Electric Light company of this city has been awarded the contract for illuminating the streets of the borough of Brushton with arc lights, and the company is putting up the poles. Brushton is a small suburb of this city, and when the East End company has completed its contract of lighting that borough, it will have a continuous line of arc lights from the lower portion of Pittsburg to Edgewood and Swissvale, a distance of eight miles. The East End company operates the Westinghouse system of alternating current incandescent and arc lighting.

How great the demand for mining machinery has become in the Western Pennsylvania coal fields is aptly illustrated by the number of mining machines already brought out. As all of these are operated by electric motors there is no doubt that electricity will find a very extensive field of operation in the production of appliances suitable for the mining of this fuel.

The last machine invented for mining coal is the Lechner mining machine. This machine was tried a few days ago in the coal works at Boston, near McKeesport, Pa. The test was witnessed by Capt. Sam Brown, the owner of the mine, a number of experts on coal-mining machinery, and it is satisfactory to know that it was a great success.

A new police and fire telegraph and telephone system is to be put up in Allegheny City.

The fight between the great traction companies of this city is going to be fought more fiercely than ever. The contending parties are the Pittsburg Traction Road, operating a cable road, and the Duquesne Traction Road, operating an electric line.

The latest phase in the warfare is the cutting of passenger rates, and the Pittsburg Traction company proposes to carry its passengers for 3 cents over the entire road, which is nearly five miles long. The Duquesne Traction company will not commence to operate its lines until the fall, and it will be interesting to see which will come out ahead, the cable or the electric motor.

The Birmingham Traction company has decided to extend its electric line from the south side, this city, to Knoxville and Beltzhoover Borough, a distance of seven miles.

The Pleasant Valley Electric Railway company is now experimenting with raw hide pinion wheels, so as to do away with the noise made by the cars.

An appliance, called the automatic guard, has been brought out in this city for the purpose of lessening the danger to pedestrians of being run over by an electric or cable car. The guard is formed like a scoop or shovel, is composed of light gas pipes, and it is attached to the front of the car like a cow-catcher. Several tests have been made with the guard, and all have been successful. E. H. H.

Louisville, Ky.

LOUISVILLE, Sept. 6.—It is stated that electric cars of the largest size made will run over the new Louisville & Jeffersonville bridge as soon as it is completed. The cars will be about the size of those on the ordinary suburban railroad trains. Transfers will be arranged for the street cars on both sides of the river, and by that time, it is said, all the Jeffersonville street railway lines will be electric lines. The poles are being placed in position along the Walnut, Nineteenth & Bank street line, as well as on lower Walnut street, for stringing the overhead wires of the electric system. The Portland, Nineteenth & Bank street line will be put in operation about the same time as the Fourth street line. J. W. L.

Kansas City, Mo.

KANSAS CITY, Sept. 6.—C. K. Sherman, the superintendent in Kansas City of the Edison General Electric company of Chicago, says: "You can say right now that the time is coming, and in the near future too, when Kansas City and its suburbs will be connected by electric roads radiating in all directions. I cannot tell you all of the plans proposed but in a general way I will say that Argentine, Armourdale, Westport, Independence, Centropolis, Sheffield and Harlem will soon have electric cars running to them. Every section of Kansas City will also be reached by electric roads. We have found by actual experience that it only costs from one-half to two-thirds as much to operate electric roads as other forms of street railways. The cost of construction is far less. Then our wires will last for an indefinite period of time while the cables of the cable roads require changes every few months. In construction the electric road is much cheaper, since we don't have the tearing up of the streets that is required in building the cable roads.

"The two electric roads projected through Kansas City, Kan., will be built without delay. The roads will secure an outlet into Kansas City, Mo., probably entering this city somewhere in the vicinity of Twentieth street. They will secure the right of way to the heart of the city, but the route selected I cannot now tell. Another electric road being discussed is an extension out to Westport and from there to Argentine, opening up a new section of the city. Then a new park is to be constructed near where the Quindaro boulevard crosses the city line of Kansas City, Kan. Another project being discussed is the changing of the Broadway line to an electric line, doing away with the present unpopular system of mule cars. Still another project is the changing of the dummy line running from the corner of Fifth street and Grand avenue out to the Heim brewery into an electric line. If this is done the line will probably be operated in connection with the new Winner bridge, and the opening of the Winner bridge means the inception of an extensive electric system in that part of the city, since W. E. Winner is taking an active interest in electric roads, and has several projects on foot. The exact course that these lines will take I cannot say, but I can say that they will be constructed as certain as electricity remains a success as a motor power, and that success is assured. Electric roads are no longer an experiment."

The electric motor cars, machinery and appliance for the new South Side electric line, Kansas City, Kan., have arrived at the car house of the L company, North Fifth street, and are being placed in position for use as soon as possible. A large force of men is engaged in the construction of the line, and it is proposed to have it in operation as soon as possible.

Lincoln, Neb.

LINCOLN, Sept. 6.—General Superintendent T. E. Calvert of the Burlington & Missouri company, was fined $200 and E. Bignell, division superintendent, $50 for contempt of court for the part they took in the fight against the electric road mentioned in the last number of the WESTERN ELECTRICIAN. An appeal was taken at once to the Supreme court.

An effort will be made to require the street car company to take up its crossing. The companies interested are Burlington, Missouri Pacific and Elkhorn. F.

St. Joseph, Mo.

ST JOSEPH, Sept. 6.—Manager Van Brunt of the People's Street Car company, was on hand at the last council meeting with his statement in regard to poor service on his lines.

Alde. men Lancaster and Hall, to whom has been referred the petition of certain property owners asking that the company's Wyatt Park franchise be taken away unless it gave better service, reported back to the council that they had considered the matter and recommended that the company be given until January 1 to put its lines in shape.

Mr. Van Brunt stated that in view of the number of improvements his company had in contemplation, four months was a very brief period in which to perfect them. The new motors which the company was waiting for were expected every day, and when placed on the cars would do away with all the noise and give the cars almost twice the power they now possess. With these new motors it would be possible to run the cars on regular time, and as soon as they were introduced he intended to publish a regular time table by which all the lines would run, and passengers could by this means tell at what minute they could catch a car at any point.

Mr. Van Brunt was granted until January 1 to get all his lines in perfect order. F.

THE ELECTRIC LIGHT.

An electric light plant is wanted at Florence, S. C.

The Land & Improvement company will erect a plant at Shenandoah, Va., for electric lighting.

Among the improvements contemplated at Hopkinsville, Ky., is an electric light plant to be built by the city.

The Westinghouse Electric & Manufacturing company is now installing a 25 light arc plant at Galveston, Tex.

El Paso, Tex., has awarded the contract for lighting the streets of the city to the Gas, Electric Light & Power company.

The Consumers' Electric Light company, of New Orleans, has petitioned for a franchise to erect a plant for commercial lighting.

A special election has been called at Water Valley, Miss., for Sept. 29th, to determine whether bonds for $10,000 be issued for the erection of an electric light plant.

The Buckhannon, W. Va., Electric Light company has decided to install an Edison plant. The officers of the company just elected are: President, G. M. Fleming; secretary, D. B. Bailey.

The Salt Lake City council has granted the electric light company an extension of 30 days in which to complete the installation of its apparatus for furnishing the city 150 street lights.

A new central station plant of the Westinghouse alternate current incandescent system is now being installed in the town of Milford, New Hampshire. Five hundred lights is the initial capacity of this plant.

The Thwing Electric company has been formed at Chicago, to manufacture and deal in electric lamps and supplies; capital stock $1,000,000; incorporators, Wilbur J. Andrews, Charles B. Thwing and Charles E. Piper.

The Sunset Hill Electric Light, Water & Power company was incorporated at St. Louis last week; capital stock $100,000. The incorporators were Herman Tuhalske, Marcus Bernheimer and S. M. Lederer.

The Westinghouse Electric & Manufacturing company is adding two new central station plants in the State of Missouri. The plants have each a capacity of 500 lights and they are being put up in Joplin and Carthage.

The Light & Power company of Three Rivers, Mich., is erecting a plant consisting of a 750-light incandescent dynamo, of the National type, a Westinghouse machine for arc lights and a Schuyler generator for power purposes.

The city of Marquette, Mich., is increasing the capacity of its central station plant of electric lighting. The Westinghouse Electric & Manufacturing company has been awarded the contract for alternating current apparatus for 1,500 lights.

The Seattle Gas & Electric Light company, capital stock $60,000, has been incorporated by Dexter Horton A. A. Denny, amd John Collins. The objects of the corporation are to establish and maintain gas and electric light plants in Seattle.

The Carpenter Electric Light & Power company of Catlettsburg, Ky., is installing an electric light plant, consisting of a Continental dynamo of 650 lights' capacity, driven by a 70-horse power Buckeye engine. H. Wellman is in charge of the plant.

The Home Electric company has been incorporated at Seattle, Wash., capital stock $500,000. The incorporators are C. P. Stone, Isaac Dobson, E. C. Kilbourne, D. B. Denton, A. C. Balch, and A. Mackintosh. The object is to engage in electric lighting and furnishing electric power.

The Cumberland, Md., Electric Street Railway company has been granted the privilege of laying its tracks through the principal streets. It is to begin work within 90 days, and have three miles of track built within one year. The company has a capital stock of $100,000.

The publication of rates for city lighting in several municipalities has induced many large cities to inquire into the

cost of electric lighting. A movement is advocated in Salt Lake City, where $180 is paid for street lamps on the moonlight schedule plan. A reduction in the price is demanded.

The Sedalia Electric Light company of Sedalia, Mo., which has been operating an alternating current electric light plant of the Westinghouse system for over a year, is about to enlarge its capacity. The company has just contracted for a 750 light alternating current machine. This will give the plant a total capacity of 1,500 lights.

The Westinghouse Electric & Manufacturing company has received the contract for a 500 light alternate current plant from Traverse City, Mich. The electric light company at that place has been employing the Westinghouse alternate current incandescent system for some time, but the demand for lights has grown so rapidly that this increase has become very necessary.

The proposition from W. S. Heger of the Edison company, San Francisco, to make an electric light exhibition in the pavilion during the fair, has been accepted by the Mechanics' Institute trustees. There will be a pillar of light similar to that exhibited at the Lenox exposition by the company, to be placed on the main floor of the pavilion, opposite the entrance. It will be twenty feet high, and will rest on a base six feet high.

L. N. Cox, Washington agent of the National Electric Manufacturing company of Eau Claire, Wis., reports that he has closed contracts for electric light plants at the hotel Arno, Washington, D. C.; Globe Cotton Mills, Rock Hill, S. C.; and Chester Manufacturing company's cotton mill at Chester, S. C. The company has also arranged with Philadelphia gentlemen to form a company to build and operate water, electric light and gas works and street railroads.

The Lyric theatre, London, has a complete electrical installation including everything designed for theatrical effects. The arrangements on the stage are excellent, and the light from the battens can be varied both in intensity and color. No limelights are used, the necessary effects being produced by portable arc lamps. There is not a single gas jet anywhere on or near the stage, and the plant has run for 21 months without the slightest breakdown. All of this is considered wonderful in England, though in this country equally good plants can be found in all the theaters in large cities.

About two years ago a number of prominent capitalists of Havana organized the Spanish American Light & Power company with the intention of establishing a small electric light plant for their own immediate use. Westinghouse apparatus, consisting of two 750 alternate current dynamos, was at once installed at the company's central station in Havana, and the operation of the plant was hurried as quickly as possible. But even before all the wiring had been completed the Havanese became convinced of the great boon afforded them by a general introduction of the novel system of illumination. The result was that the Westinghouse company received a telegraphic communication asking whether it were possible to ship at once by express alternating current apparatus, exciters, switches, etc., for a capacity of 3,000 incandescent lights. The Westinghouse people at once replied in the affirmative. The following day the entire plant, an express package of many thousand pounds, was shipped to Havana and immediately upon arrival the plant was put up, giving the company a lighting capacity of over 4,500 incandescent lights. Since then the company has been doing a very profitable business and electric lighting has constantly increased its popularity The demand has steadily grown until it has now again become larger than the company is able to supply, and again enlargements have to be made. The Westinghouse Electric & Manufacturing company is now preparing for early shipment an increase to the plant of alternating current apparatus for 1,500 lights. This will give the central station in Havana a capacity of 6,000 lights.

The suburban village of Hollis, L. I., a mile east of Jamaica, has electric lights. The remarkable thing about this display, says the New York *Sun*, is that the light is produced by no dynamo or other machinery, but by a system of primary and secondary batteries on the same principle as in telegraphy. This is the invention of William P. Kookogey of 97 Pulaski street, Brooklyn, superintendent of the electric signal system of the West Shore Railroad. The plant occupies a space 16x3 feet in an outhouse attached to the premises of Superintendent F. W. Dunton, known in New York as the President of the Corbin Banking company. Hollis has about 300 inhabitants and forty houses. Streets and dwellings are both lighted by the new system. There are twenty-three street lights at present in operation, each of about 25-candle power. Thirty more street lamps have been ordered. "It is the first practical attempt to light the streets of a town with electricity without a dynamo," said Mr. Kookogey. "I believe it will revolutionize the lighting of small towns. My system is advantageous only for lighting a thousand lamps. In cities requiring more lamps than this, I would recommend the dynamo, as the cost of labor with the batteries would be too great. We can put in a plant for 300 lights at a cost of $1,000. The labor of only one man is necessary to look after such a plant burning only part of the night. We pay $18 a month for labor. We have already got 219 subscribers for such a system at Bergen Point. If we can get 500 subscribers we shall put in the system there. Mr. Dunton is also making arrangement to light some of the streets of Jamaica from this plant. He will charge them about $1.12½ a month a light and make about 15 per cent. In exchange for his putting up this plant, I have given him the whole territory of Long Island." To run the lights at Hollis two rows of fifty jars are required, and if the lights are increased to 300 to light Jamaica three more rows of fifty jars will have to be added. Ordinarily the lights will give 16-candle power for houses and more than 20-candle power for streets.

THE ELECTRIC MOTOR.

A franchise for an electric road at Oakland, Cal, has been granted John W. Colman, W. D. English and others

An electric street railway company is organizing at Fort Payne, Ala. Subscriptions for stock are now being received.

The South Heights Rapid Transit Street Railway company, San Antonio, Texas, will build an electric railroad 2½ miles in length.

The Newport, Ky. Electric Street Railway company has been organized with H. M. Healy, president, and H. Buchanan, secretary and treasurer.

The Santa Clara, Cal., supervisors have granted a franchise for an electric road, which will be begun within six months, and must be completed in 18 months.

The Citizens' Electric Street Railway company has been formed at Uniontown, Pa., for the purpose of establishing and maintaining electric street railway lines in that city.

The West Lynchburg, Va, Land company has completed arrangements for building an electric road. Power will be furnished at present from the Piedmont Electric Illuminating company's station.

The Electric Railway Supply & Construction company has been incorporated at Chicago, to manufacture and sell electrical goods; capital stock, $100,000; incorporators, I. M. Berenston, M. A. Berg, and others.

The bills authorizing the Northern Central Railroad company, the Union Railway company and the Cass Avenue and Fair Grounds Railroad company to change their motive powers to electricity, were adopted by the city fathers of St. Louis last week.

The North Lincoln, Neb., Street Railway company has been notified by the Westinghouse company that the dynamos and attachments for the electric railway plant have been shipped from the factory, and they will probably be in Lincoln within a very few days.

J. H. Henry, who owns the electric railway at San Jose, Cal., has purchased the Central street railroad of Sacramento, conditional, however, upon the council granting a franchise for an overhead electric system. It is believed there will be no trouble about securing the desired franchise.

In relation to street railway securities the London *Financial News* says: "It is possible to select securities in tramway companies which will yield a comfortable 5 per cent. In the time to come, when tramway directors have cut down their working expenses at least one-half by substituting electricity for horses, the return must be proportionately greater."

A few days ago the Lansing & North Lansing Railway line of Lansing, Mich., commenced operations, and according to all accounts the electric system was entirely successful. The company adopted the Westinghouse electric railway system. A gentleman who was present at the starting of the cars, stated that although the motor men were all green hands, the cars ran without a hitch. The opening of the line was quite an event in Lansing.

The Beatrice, Neb., Rapid Transit & Power company filed articles of incorporation last week, and the council passed an ordinance calling for a special election, granting the company a franchise over the streets of the city. The purpose of the corporation is to build and operate an electric street car line over South Sixth street, and thence through the South Beatrice additions. If the franchise is granted, the company promises to begin work within sixty days.

The electric apparatus of the Knoxville Street Railway company, Knoxville, Tenn., comprises eight Thomson-Houston railway generators and the usual appliances for their operation. Each generator is arranged so as to be thrown in or out of action without interfering in the least with the operation of the remainder of the plant. The plant is rapidly nearing completion, and will be in operation some time at an early day. The electric railway for which this plant is designed is 3.40 miles in length, and five motor cars will be operated.

The Willamette Bridge Street Railway company, which owns all the electric and steam motor lines on the east side of Portland, Ore., except the road to Vancouver, and whose lines cross both bridges to the Portland side of the Willamette, has purchased the Transcontinental Street Railway, Portland, which comprises seventeen miles of double-tracked road, connecting with both bridges, and the most complete system in the city. This will give the Willamette Bridge company a system of forty miles, reaching the north and south and east and west limits on both sides of the river, and connected by electric lines across both bridges. It is intended to run the lines to Vancouver when the bridge across the Columbia is completed, and also to Oregon City.

The Detroit car of the Rae system which has been in operation in Kansas City during the last few weeks, has been giving satisfaction It has attracted considerable attention, and has been thoroughly tested. The result is satisfactory to both the company and the public. A feature of the system is the absence of noise in operation. An electrical engineer of Kansas City gave the following report of an examination of the system: "The single motor of 30 horse power with its armature shaft running lengthwise of the car, geared into the countershaft which in its turn communicates the motion to the axles by means of bevel gearing at its ends, presents valuable features and shows progress in the right direction. The load being evenly distributed on both axles, the danger of stripping the gearing is lessened, and the usual working strains are equalized."

THE TELEPHONE.

The Bear Valley Land & Water company, of Redland, Cal, has decided to build a telephone line from Redland to Bear Valley Dam.

The Bell Telephone company has 1 052 subscribers in Rochester, N. Y. Although greatly hampered on account of the trouble experienced in that city a few years ago, the company is regaining public favor. The service is excellent.

The Washington District Telegraph company has been formed at Seattle, Wash.; incorporators, A. T. McCargar, E. A. Strout and R. B Albertson, of Seattle. The object of the corporation is to construct and maintain a district telegraph system, and its capital stock is $30,000.

The Cincinnati papers are talking about the peculiar actions of a young man of that city who is said to have become insane on account of the telephone. He was always excessively nervous, and when a telephone was placed in the office in which he was engaged, the constant ringing irritated him, and finally drove him mad. His eccentric habits called public attention to him. He rushes into drug stores, rings up the central and calls for his departed sweetheart. Not securing any satisfactory response he hurriedly leaves the place and visits the next public telephone, repeating the scene.

THE TELEGRAPH.

It is reported that the telegraph operators of the country are endeavoring to organize another union. For several weeks representatives of the Knights of the Key have been holding secret sessions in New York. Those telegraphers who promised not to join another labor organization when they were reinstated after the great strike in 1883, will be obliged to adjust their consciences in order to take advantage of the new movement.

The Chambers of Commerce of Hong Kong and other large cities of China and Japan, have petitioned the government to reject applications which will emanate from the pending convention between the Chinese government and the Eastern Telegraph company and the Eastern Extension, Australasia and China Telegraph company, Limited. The petition complains that the convention has for its object the monopoly of telegraph business between China and the outer world, and that the continuance of present extreme rates for the transmission of messages must prove detrimental to commercial and other interests generally.

Miscellaneous Notes.

The rules of the Pacific Insurance union for the installation of electric light and power, approved July 15, have been printed in neat pamphlet form.

During a thunder shower, the front of the Washington hotel, Galconda, Ill, was struck by lightning, severely injuring several persons, last week. Several others were badly shocked, as well as some horses that were hitched near by.

The New York *World* advocates the adoption of the electric system of voting by legislative bodies by means of which the members would only have to touch a button on their desks and their votes would be recorded in the presence of the assemblage on a tablet in a conspicuous position. This would save much time, and would greatly expedite the work of legislative bodies.

An exchange publishes the following: "The electric cane is in reality a beneficent invention. It consists of a cane in the interior of which is stored a large quantity of electricity. Until a spring in the handle is pressed the cane is as harmless as any other cane, but if this spring is pressed, and at the same moment a person is touched with the ferrule of the cane he receives a shock that will stun him for the next twenty minutes without doing him any permanent harm. The same apparatus is also placed in the handles of umbrellas and ladies' parasols. With this invention a man can protect himself, not only from assault but from casual bores. A robber demands your purse as you are walking home at night. You simply touch him, accidentally, as it were, with the end of your cane, and then proceed slowly and peacefully on your way, leaving him stretched on the pavement. Or a bore buttonholes you, ignorant that you carry an electric umbrella. Presently the bore drops insensible on the pavement, and you leave him to the curious inspection of the public, knowing that presently a policeman will appear to arrest him on a charge of drunkenness or apoplexy. The name of the inventor of this inestimable weapon is not yet known, but he is sure to reap the gratitude of every intelligent man and woman in civilized lands." Joe Mulhatton may be able to furnish additional information.

Business Mention.

R. J. White has opened an office at 52 Wall street, New York, where he is prepared to display his chair for street car rails, and demonstrate its many advantages.

Henry C. Eddy, Western agent for the Consolidated Electric Storage company, 170 La Salle street, Chicago, has decided to handle general electrical supplies.

J. H. Bunnell & Co. of New York, report very large orders for the Burnley dry battery, which is proving a great success. Mr. McLaughlin will represent the company at the Detroit Telephone convention.

It is stated that the Abendroth & Root Manufacturing company, 28 Cliff street, New York, has just received an order from the Edison Electric Light company of Philadelphia, Pa., for 1,000 horse power Root boilers in addi-

tion to the large number of these boilers already installed in this well-known electric light station.

The Lower & Bal. Electric Light company, New York, is already receiving unsolicited orders for its electric cars. Some of the largest street railway capitalists have visited the exhibition road at Fort Hamilton, and expressed their great interest in the system. Six storage battery cars were ordered for a western city after the trial last week.

F. O. Rusling has been appointed special agent of the Connecticut Motor company of Plantsville, Conn. Mr. Rusling will represent the company at the Edison convention at Minneapolis. The company, having increased its capital stock, intends to increase its facilities for manufacturing constant potential motors and generators for which it already has a large trade.

The Law Telephone company of New York reports an unprecedented business. It claims to have sold more batteries during last month than in the entire year of 1887, which was one of its best years. Mr. Childs will represent the company at the Telephone meeting at Detroit. The company will have an exhibit at the Mississippi Valley Medical association convention at Louisville, October 8, 9 and 10.

E. S. Thomassen of London, has written an interesting letter relating the observations and experiments of Capt. John Ericsson on the question of hot bearings, as reported by Captain Ericsson. After many years of study, the captain announced that he had found an alloy for bearings. He had tried it and, as a result, pronounced it "just the thing." Walter W. Evans, who had been associated with Captain Ericsson in his researches, declared it "a boon that would enable us to get more revolutions out of an engine, and attain greater speed without drawbacks." These experiments resulted in the discovery of Magnolia, which has since attracted so much attention in engineering circles.

The Western Electric company has issued the following circular: "We solicit your orders for double arc lamps. Our double lamp has no finely-geared clock work; no close fitting sliding solenoid cores; no steel pinions or pivots to rust and stick; no gearing to clog with dust. It is practically and theoretically the simplest and best constructed double arc lamp, and the only double arc lamp manufactured for both high and low tension currents. We offer to furnish companies using low or high tension systems with new double arc lamps guaranteed to work satisfactorily, and will guarantee against loss on account of suits for alleged infringement of patents."

The assortment of testing instruments shown by the Great Western Electric Supply company, Chicago, is steadily growing. During the past week a number of Wheatstone bridge sets mounted in compact cases, were added. These have sensitive galvanometers with arrestment for the needles, and are carefully calibrated. The detector galvanometers, portable magnetos and speed indicators in stock and the voltmeters and ammeters under way, form a fine collection of apparatus. Judging from the popularity of the Cutter E. L. insulator sold by the company, the blackening of ceilings by arc light wires should be less frequently met with than heretofore. This unsightly effect decreases rapidly as the distance between the wires and the ceilings becomes greater. In many cases the saving in calciminer's bills will entirely pay for the insulators where Cutter's E. L. form is used.

The Novelty Electric Supply company of Cincinnati, Ohio, is one of the younger companies which have embarked in the electrical supply business during the past year, but its business has grown steadily, and has already reached very large proportions. The factory is now running time and a half, and still the company finds itself unable to keep up with orders. It is making a specialty of rewinding armatures and fields for electric light and electric railway plants, and has on hand now over twenty armatures for rewinding and more are arriving at the factory daily. Mr. George B. Edgar, formerly connected with the Hawkeye company, has accepted a position with the Novelty Electric Supply company as traveling salesman, and is receiving very large orders daily. Among a number of very large sales recently made by the Novelty company it has closed a contract with the White Line Street Railway company of Dayton, Ohio, for electric railway equipments, as well as its combination pole-tops and iron poles. One of the recent orders, received a few days ago, aggregated $12,000.

The Ball Engine company reports that its shop is crowded with orders, aggregating 10,000-horse power, largely compounds. Among the orders are the following: Rochester, N. Y., Street Railway company, 3 300-horse power triple expansion, 3 150-horse power standard and 1 60-horse power standard; Buffalo Street Railway company, 6 300-horse power double compound; Southern Railway company, St. Louis, Mo., 5 150-horse power tandem compound; Edison Electric Illuminating company, Brooklyn, N. Y., 3 250-horse power double compound; Newark Electric Light & Power company, 2 250-horse power double compound; Harlan & Hollingsworth, Wilmington, Del., 1 150-horse power standard and 1 100-horse power standard; Central Passenger Railway company, Louisville, Ky., 3 150-horse power standard; Walla Walla Gas & Electric Light company, Walla Walla, Wash., 1 100-horse power compound; American Waltham Watch company, Waltham, Mass., 1, 300-horse power double compound; Naugatuck Electric Light company, Naugatuck, Ct., 2 100-horse power compound; Schuylkill Electric Railway company, Pottsville, Pa., 1 150-horse power standard; Columbia Electric Light company, Philadelphia, Pa., 2 100-horse power tandem compound; M. J. Shields & Co., Moscow, Idaho, 1 60-horse power tandem compound; Essex Street Railway company, Salem, Mass., 1 100-horse power standard and 1 100-horse power tandem compound; Amsterdam Street Railway company, Amsterdam, N. Y., 1 125-horse power standard; North West Electric Supply & Construction company, Seattle, Wash., 4 35-horse power standard and 1 150-horse power tandem.; City Gas Light company, Norfolk, Va., 1 125-horse power standard.

Electrical Patents.

Issued September 2, 1890.

435,421. Battery Compound. Ernest M. G. Hewett, Newton, Mass.

435,424. Electric Switch. Charles W. Huntington, Baltimore, Md.

435,438. Telephony. Thomas D. Lockwood, Melrose, Mass.

435,440. Automatic Electric Annunciator. John W. Luthe and Alfred E. Jeavous, Cleveland, Ohio

435,447. Electric Conductor for Street Railways. Luther M. Perkins, St. Louis.

The invention relates to improvements in electric conductors and means for transmitting the current therefrom to the motors employed for propelling street railroad cars. Its object is to protect the undergrnund wires and prevent leaking of the current.

435,471. Electric Railway Closed Circuit System. Malone Wheless, Nashville, Tenn.

435,482. Block Signal System. Mahlon S. Conley, Chicago, Ill.

The prime object of this invention is to utilize the static discharge of one local circuit caused by the breaking thereof for operating instruments for controlling the current through said circuit, and also through another corresponding local circuit at the opposite end of the block, whereby upon the breaking of either local circuit the signaling devices contained in both of them will be operated so as to become alternately visible and invisible.

435,486. Conduit for Electric Railways. William R. Elliott, Kansas City, Mo.

The invention consists of a casing having flexible pieces in one side, a conductor within said casing, and metallic bars passing through and held in place by said flexible pieces, the inner ends of the bars being normally below and out of contact with the conductor.

435,487. Electric Conduit. William R. Elliott, Kansas City, Mo.

This invention relates more especially to that class of electric conduits having a slot through which projects a device similar to a trolley carried by a moving car, and by means of which one or more currents are carried upward to the car.

435,490. Automatic Electric Switch. Theodore M. Foote, Boston, Mass.

435,503. Commutator. Charles A. Lieb, New York, N. Y.

435,504. Commutator and Process of Making the Same Charles A. Lieb, New York, N. Y.

435,505. Suspender or Support for Overhead Wires. Charles A. Lieb, New York, N. Y.

435,516. Electric Signaling Apparatus for Preventing Collisions between Railway Trains. Theodore Perls, Wurzburg, Germany.

435,518. Apparatus for Preventing Incrustation in Boilers. John Pollock, Belfast, Ireland.

435,525. Regulator for Dynamo Electric Machines. Charles E. Scribner, Chicago, Ill.

The invention consists in mechanism whereby the brushes are moved backward and forward automatically upon the commutator as the strength of the current varies so as to maintain the current at approximately a given strength.

In the regulator employed, the power for doing the work is not dependent upon the strength of the current or of any electro-magnet, an electro-magnet merely serving by the change in position of its armature to control the operation of the regulator, which is driven continuously by well-known mechanical means.

435,526. Regulator for Dynamo Electric Machines. Charles E. Scribner, Chicago, Ill.

This regulator consists of a screw, a nut upon the screw, and mechanism for driving the screw and nut alternately or both together in the same direction, whereby the brushes upon the commutator are moved back and forth or held at rest, in response to the variations in the resistance of the lamp circuit.

435,527. Regulator for Dynamo Electric Machines. Charles E. Scribner, Chicago, Ill.

The first claim follows:

"The combination, with the revolving trigger devices, of the nut and screw carrier driven thereby, adjustable arms and an electro-magnet for actuating the same, and the dogs carried upon the adjustable arms, whereby the position of the dogs may be adjusted and brought alternately into the paths of the triggers to trip the said triggers as the strength of the current rises above or falls below the normal."

435,536. Electric Conduit. Herbert N. Curtis, New York, N. Y.

435,545. Automatic Regulation of Electric Circuits. George B. Prescott, Jr., Newark, N. J.

435,550. Electrical Measuring Instrument. George W. Walker, New York, N. Y.

435,558. Railway Signal. William F. Z. Desant, New York, N. Y.

435,559. Upward Pressure Contact for Electric Railways. John A. Duggan, Quincy, Mass.

The invention consists of a trolley or wheel for conducting an electric current from an overhead wire or cable to the motor of a vehicle to be propelled by electricity, means for supporting the trolley so that it shall adapt itself to the variation of the position of the vehicle with reference to the wire or cable, and a reversing mechanism whereby the arm supporting the trolley may be readily reversed.

435,578. Switch for Incandescent Lamp Sockets. Waldo C. Bryant, Bridgeport, Conn.

435,582. Workman's Time Recorder. Frederick L. Fuller, Norwich, Conn.

435,629. Apparatus for Covering Electric Wires. Alfred G. Holcombe, Long Island City, N. Y.

435,639. Electric Motor. Harry H. Blades, Detroit, Mich.

435,640. Means for Supporting Storage Batteries on Railway Cars. Harry H. Blades, Detroit, Mich.

The object of the invention is to provide a means for supporting secondary batteries from the body of a car in such a way as to obviate the necessity of altering the car body or of employing a special truck adapted to support the batteries

Of the twelve claims the tenth is given:

"The combination, with a railway car, of a frame for supporting secondary batteries, said frame removably attached to the car body and provided on each side with a longitudinal side bar having cushions adapted to rest on the saddles."

435,641. Electric Railway Car. Harry H. Blades, Detroit, Mich.

The invention consists in the combination, with the car wheels, of a series of car wheel brakes, a worm gear connected with the brakes, a rod having a worm engaging the worm gear, and a vertically arranged rod at the car platform for simultaneously applying the brakes to the car wheels.

435,642. Electric Railway Car. Mark W. Dewey, Syracuse, N. Y.

435,643 Method of Electric Welding. Mark W. Dewey, Syracuse, N. Y.

The invention consists, essentially, in electrically heating the material at the junction to soften the same, as by passing a heavy electric current from one side to the other of the joint, and then, when the material is properly heated, subjecting the joint to a force tending to compress and twist the same.

435,644. Method of Electric Welding. Mark W. Dewey, Syracuse, N. Y.

435,660. Manufacture of Filaments for Incandescent Lamps. Vincent M. Hobby, New York, N. Y.

435,662. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

435,668. Electric Cigar Lighter. John Roberts, Pittsburg, Pa.

435,679. Method of and Apparatus for Producing Musical Sounds by Electricity. George Breed, U. S. Navy.

435,687. Means for Charging and Using Secondary Batteries. Thomas A. Edison, Menlo Park, N. J.

The invention consists in the combination, with secondary batteries and translating devices supplied thereby, of a dynamo electric machine provided with means for regulating its electromotive force for reenforcing said batteries as their electromotive force decreases.

435,688. Process of and Apparatus for Generating Electricity. Thomas A. Edison, Menlo Park, N. J.

435,689. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

The object of this invention is to utilize sections of the line only or independently of other sections for the induction signals, while the entire line is employed, as heretofore, for the ordinary Morse signals.

435,690. Method of Making Armatures for Dynamo Electric Machines. Thomas A. Edison, Llewellyn Park, N. J.

435,695. Electric Current Indicator. Albert B. Herrick, New York, N. Y.

The invention consists in an electric current indicator, of a coil, a pivoted ring movable therein and a plate armature carried by the ring.

435,700. Device for Controlling the Current of Electric Generators. Harry W. Leonard, Chicago, Ill.

The last claim is:

"9. The combination of a storage battery, a motor connected therewith, and a generator in series with the storage battery and driven by said motor."

435,744. Electric Motor. Henry Groswith, Philadelphia, Pa.

The invention consists of a field magnet having inner and outer cores respectively, wound with coils connected in opposite directions, an armature having two sets of windings, separate commutators and brushes therefor.

435,801. Railway Signal. Michele Cortese, Philadelphia, Pa.

435,851. Telegraphy. Alexander Muirhead, London, England.

435,866. Push Button. George H. Streichenberg, Pueblo, Colo.

435,870. Suspending Device for Overhead Electric Conductors. Elihu Thomson, Lynn, Mass.

435,872. Pole for Electric Wires, Edmund Verstraete, St. Louis, Mo.

435,879. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

435,893. Electrical Signaling Apparatus. Adin A. Hatch, Kansas City, Mo.

435,894. Electrical Signaling Apparatus. Adin A. Hatch, Kansas City, Mo.

435,896. Electrical Indicator. John W. Howell, Newark, N. J.

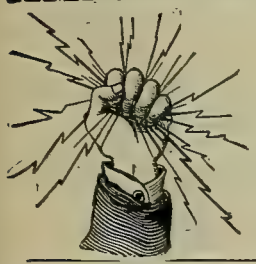
435,897. Electrical Controlling and Operating Apparatus. Edward H. Johnson, New York, N. Y.

435,898. Electrical Controlling and Operating Device. Edward H. Johnson, New York, N. Y.

435,899. Electric Current Regulator. Edward H. Johnson, New York, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

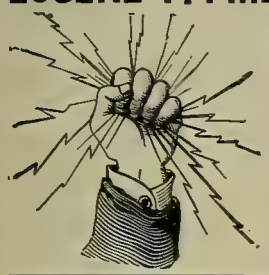
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

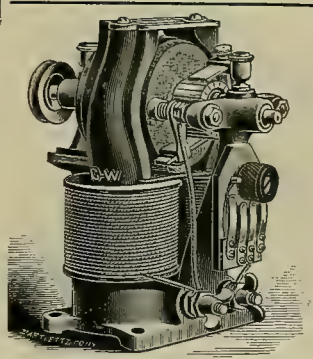
THE TURNER BRASS WORKS
4 LASALLE AVE
CHICAGO.
MAKE ANYTHING IN BRASS.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE
Crocker-Wheeler
PERFECTED MOTORS

Develop Full Power at Half the Speed of other Makes and are, Therefore, Noiseless.

WORKS:
14th, Washington and 13th Streets,
NEW YORK.

WILL A CONSTANT 16 C. P. LIGHT, DURING GUARANTEED LIFE OF LAMP, IMPROVE YOUR SERVICE?
NEW CATALOGUE READY.

The Sunbeam Incandescent Lamp Co., Cor. Randolph and Canal Sts., Chicago.

TRADE
FIBRONE
MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Belt Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

OKONITE
TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

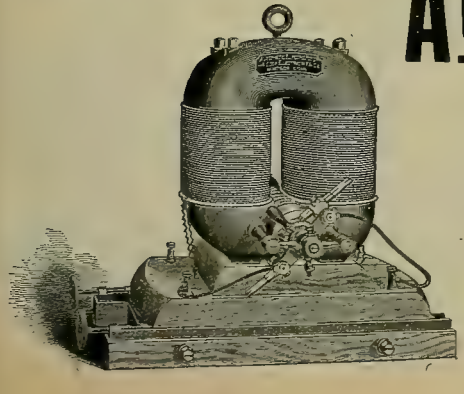
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 78 Customhouse St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

—— Electric Light and Street Railway Goods a Specialty. ——

SEND FOR CATALOGUE AND SPECIAL PRICES.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

Office of CHIEF OF POLICE,
POLICE DEPARTMENT.
MONTGOMERY, ALA., Sept. 2, 1890.

The City of Montgomery, Ala., contemplates putting up a Police Alarm and Signal Telegraph, and invite correspondence from manufacturers and patentees of the different systems. Address

E. B. JOSEPH,
Chairman Police Committee,
Montgomery, Ala.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FRANK T. BROWN, Late
PRINCIPAL EXAMINER ELECTRICITY,
U. S. PATENT OFFICE, NOW OF
Butterworth, Hall, Brown & Smith,
Patent Attorneys,
25-26 HONORE BUILDING, - - CHICAGO.
Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 15-light	50 volt	Dynamo
One 25-light	50 volt	Dynamo
One 50-light	50 volt	Dynamo
One 75-light	110 volt	Dynamo
One 100-light	110 volt	Dynamo
One 150-light	110 volt	Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,
FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

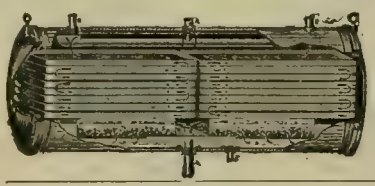
Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

Cleverly
1018 CHESTNUT ST.
PHILA.

"Improved" Automatic Burner.

PATENT LIFT-OVER PENDANT BURNER.
AUTOMATIC BURNER KEYS.
SPARK COILS.
DESK PUSH BUTTONS

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue **1--66** of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

ELECTRICAL BOOKS.

Send For New and Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

Binders

FOR THE Western Electrician **$1.00.**

GEORGE P. BARTON,

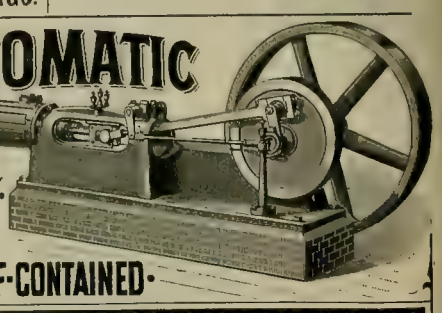
LAW OFFICE,

225 DEARBORN STREET,

CHICAGO, ILL.

Patent and Trademark Cases

THE RICE AUTOMATIC



GUARANTEED
ECONOMY·
REGULATION·DURABILITY·
SIMPLICITY·SELF-CONTAINED·
8 TO 300 H.P.
PAIR & TANDEM·COMPOUNDS·

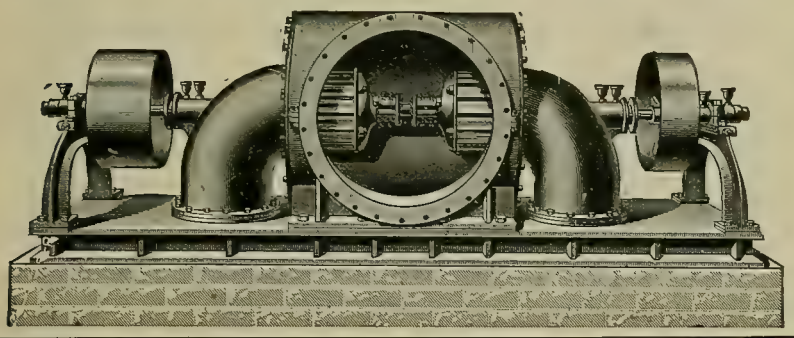
THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its diameter, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

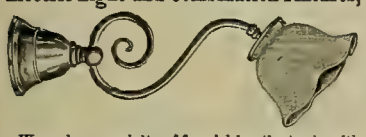
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO.

1221-1223 Union Ave.

KANSAS CITY, MO.

WM. S TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

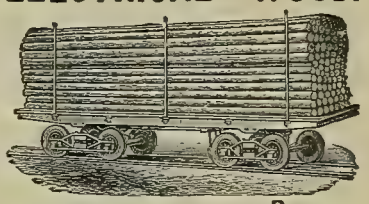
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

DOUBLE ARC LAMPS.

No finely geared clock work. No close fitting sliding solenoid cores.
No steel pinions or pivots to rust and stick. No gearing to clog with dust.
Practically and Theoretically the simplest and best constructed Double Arc Lamp.

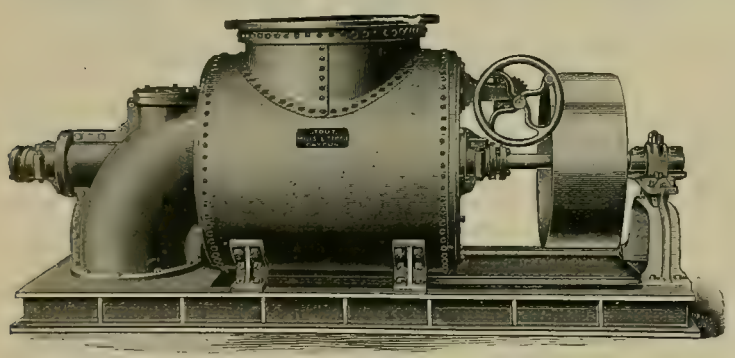
The ONLY DOUBLE ARC LAMP MANUFACTURED for both High and Low Tension Currents.

We offer to furnish Companies using high or low tension systems with new double arc lamps, guaranteed to work satisfactorily, and with guarantee against loss on account of suits for alleged infringement of patents.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

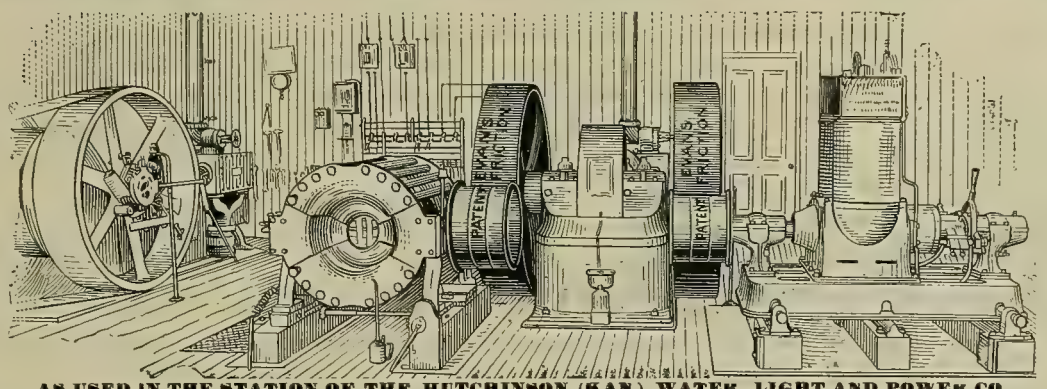
ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

The EVANS SYSTEM OF DRIVING DYNAMOS.

Has been in constant operation since January, 1890.



50 Full Arc Light T.-H. 7.0 Incandescent Edison Dynamos.

AS USED IN THE STATION OF THE HUTCHINSON (KAN.), WATER, LIGHT AND POWER CO.

Write for Catalogue "D" to **THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.**

E-D-I S-O-N

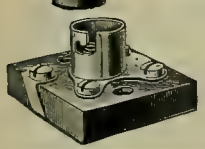
Miniature Incandescent

ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions



How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

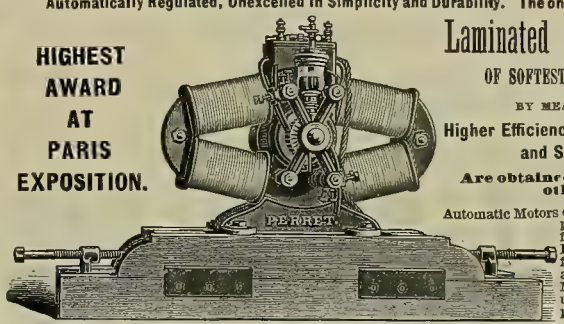
79 and 81 Washington St., Brooklyn, N. Y.,

MANUFACTURERS OF THE

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets

OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD W LKINS

— TRADING AS —

PARTRICK & CARTER,

Manufacturers of and Dealers in Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

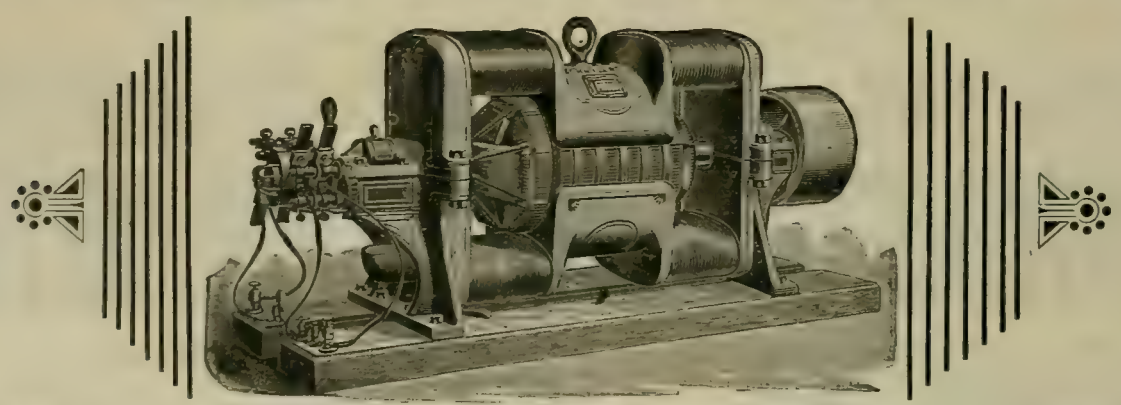
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, **CHICAGO, - ILL.**

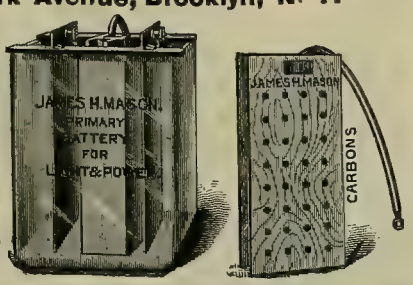
PRIMARY BATTERIES
—FOR—
Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

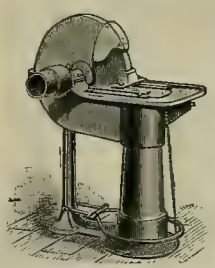
COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



THE BARNES WATER EMERY Tool Grinder.



It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.

Sold subject to approval. Send for full description and price.

W. F. & John Barnes Co., Rockford, Ill.,
Address No. 761 Ruby Street.

Barnes' Patent
UPRIGHT DRILLS,
20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.

Barnes' Patent
ENGINE LATHE,
15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.

They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to **W. F. & JOHN BARNES CO., Rockford, Ill.,** Address No. 761 Ruby st.

SAFETY SEAMLESS RUBBER COVERED WIRE
IS THE BEST.

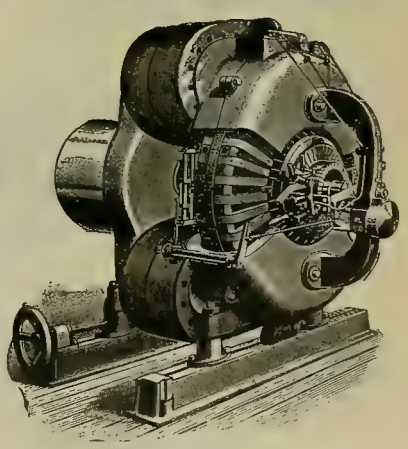
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

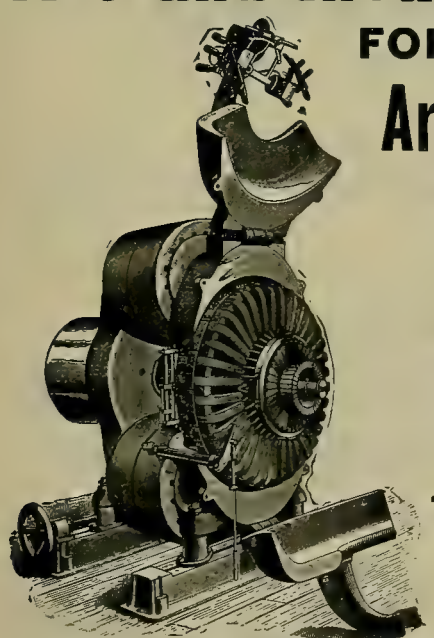
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

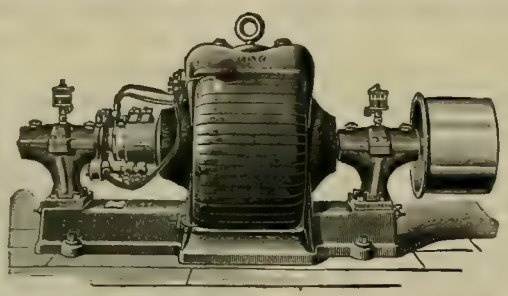
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

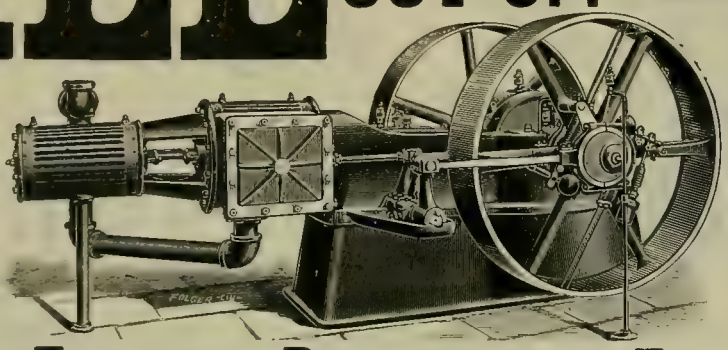
BALL AUTOMATIC CUT OFF ENGINE

Standard.

Cross Compound.

Triple Expansion.

Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO., 15 Cortlandt Street, NEW YORK.

J. W. PARKER, 38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER, 224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON, Room 403 Home Insurance Build'g, CHICAGO, ILL.

OMAHA ENGINEERING COMPANY, Sheeley Building, OMAHA, NEB.

KANSAS CITY ENGINEERING CO. KANSAS CITY, MO.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"

ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,

ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,

ANNUNCIATORS AND BURGLAR ALARMS

AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

OK-O-NITE
TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

JOHN STEPHENSON CO.,

LIMITED,

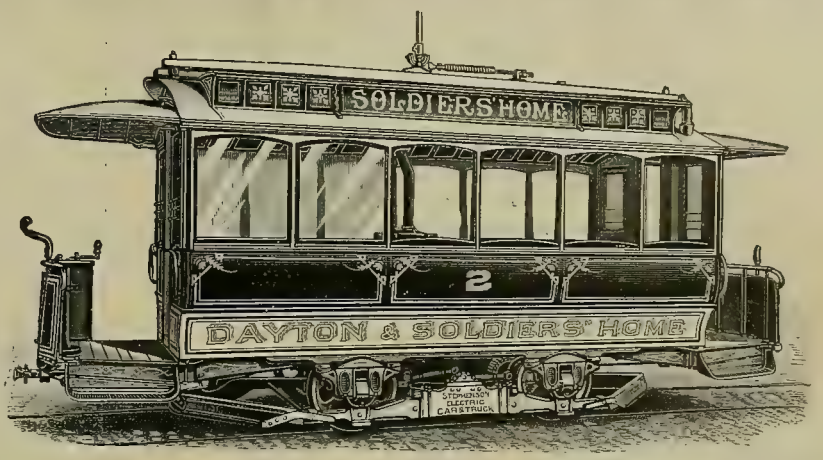
NEW YORK.

STREET CARS

FOR

ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.



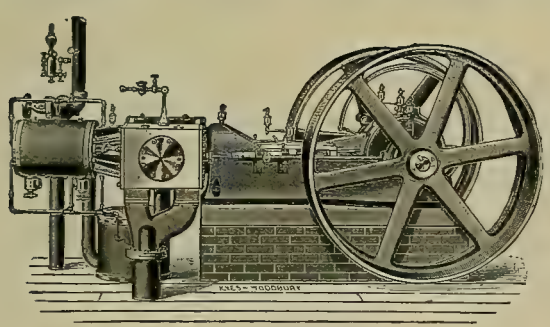
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

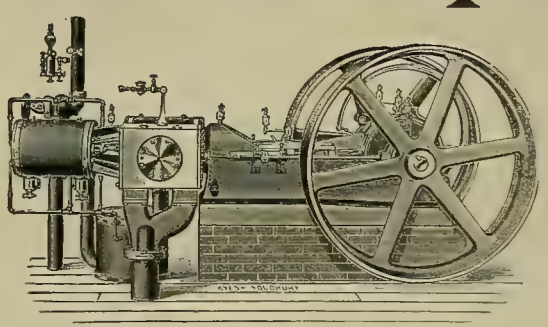
SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

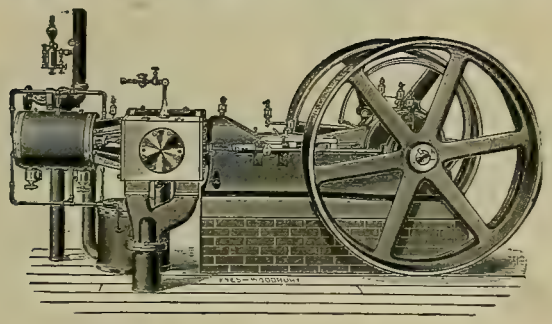
None so Good, None to Equal.



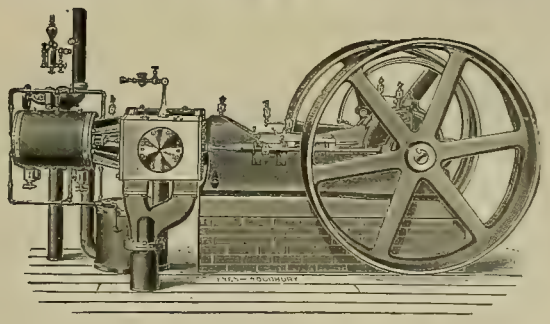
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st	Edition	2,500	Copies.	Incandescent Wiring Hand-Book,	2d	Edition....(Just ready.) 2,500 Copies
" " " "	2d	"	2,000	"	Bell Hangers' " "	1st	" 2,500 "
" " " "	3d	"	(Just ready.) 2,000	"	" " " "	2d	" 1,000 "
Incandescent Wiring "	1st	"	2,500	"	Total within Eighteen months.		15,000 "

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel-Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System,
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1.00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

250 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

WHIPPLE'S

Electric, Gas & Street Railway

FINANCIAL REFERENCE DIRECTORY

FOR 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

THE MONON ROUTE

Affords choice of Four (4) Fast Trains each way, commencing June 1, 1890.

EVERY DAY AND SUNDAY, TOO

In Pullman's Patent Perfected Safety Vestibuled Buffet Sleepers and Chair Cars between

CHICAGO and the OHIO RIVER.

These are all solid Pullman trains of latest design and improvements, consisting of Elegant Day Coaches, Chair Cars, Composite Cars, Dining Cars and the very finest of Buffet Sleeping Cars, equipped with Pullman's Perfected Safety Vestibules.

Trains from Cincinnati and the Southeast, and from Louisville and the South, arrive at Chicago in ample time to connect with the morning and evening fast trains for Milwaukee, Minneapolis, St. Paul, Omaha and all points in the Northwest.

Morning and evening connections made both at Louisville and Cincinnati with the Fast Express Trains of connecting lines for Memphis, Knoxville, New Orleans, Jacksonville and all points South.

At Indianapolis connections are made with all diverging lines.

Special Features: Steam Heat, Electric Light, Perfected Safety Vestibules.

For rates, through and local schedules, address any Ticket Agent of the Monon Route.

Wm. F. Black, General Manager.
W. H. McDoel, Traffic Manager.
James Barker, General Passenger Agent.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.

THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

C., M. & ST. P. R. R.

The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. **Compound and Valveless.**

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

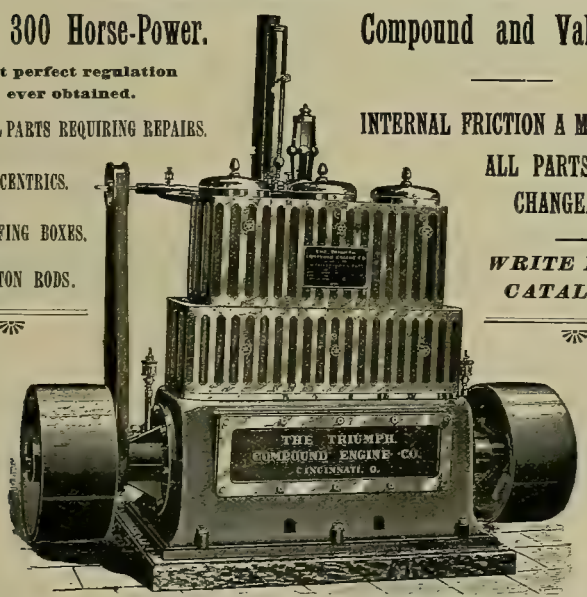
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

Over 105 Roads operated under Our System, and that Successfully, both Financially and Electrically.

EDISON GENERAL ELECTRIC COMPANY,

Edison Building, BROAD STREET, NEW YORK CITY.

ELECTRIC STREET RAILWAYS.

Our Electric system for Street Railways has been found to be the most durable, reliable, economical and convenient.

New roads in course of construction going on in all parts of the country.

Railroad Managers and Others interested in this business are earnestly requested to correspond with us, to *get facts* and *data* showing the advantages and possibilities to be obtained by Electric Traction over any other existing methods.

DISTRICT OFFICES:

NEW YORK, Edison Building.
SAN FRANCISCO, 112 Bush St.
PORTLAND, ORE., Fleischner Bldg.
TORONTO, CAN., Bank of Com. Bldg.
CHICAGO, Rialto Building.
NEW ORLEANS, Cotton Exchange.
DENVER, Masonic Building.
BOSTON, 38 Pearl St.

C. H. & D. R. R.

BEST ROUTE

From CINCINNATI to the North and North West.

C., B. & Q. R. R.

—IS THE—

Best Appointed Line

—FOR REACHING THE—

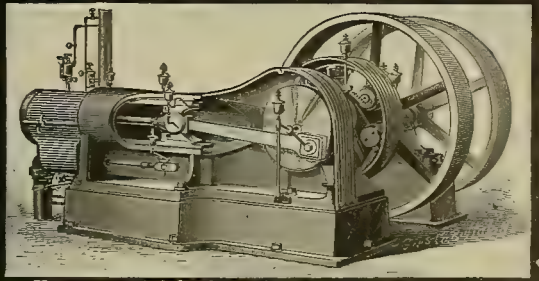
West, Northwest and Southwest.

MATERIAL AND WORKMANSHIP OF THE BEST.

BECK AUTOMATIC ENGINE.

ECONOMY UNEXCELLED

REGULATIONS PERFECT



HOT BEARINGS UNKNOWN

PRICES MODERATE

TAYLOR MFG. CO. CHAMBERSBURG, PA.

COMPLETE STEAM PLANTS A SPECIALTY

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

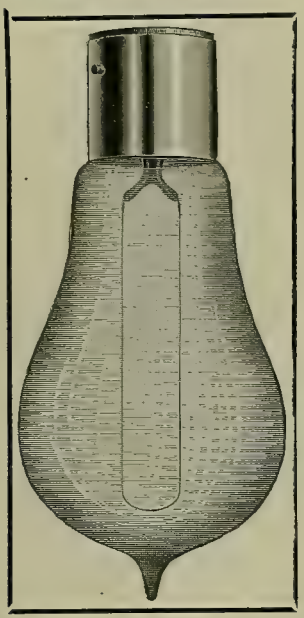
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

—THE—

Perkins Electric Lamp Co.

ALL CANDLE POWERS.

TO FIT ANY SOCKET. ANY VOLTAGE,

ANY EFFICIENCY.

GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

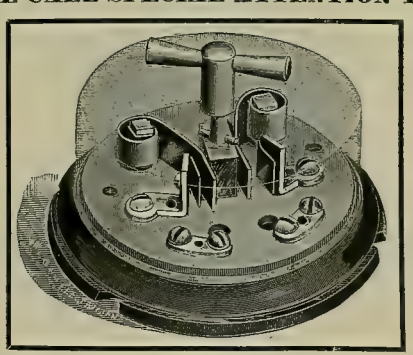
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

—WE CALL SPECIAL ATTENTION TO—

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

—FOR—

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

WESTERN AGENTS.

HABIRSHAW WIRES, CABLES AND CORES.

A HIGH GRADE OF RUBBER INSULATION.

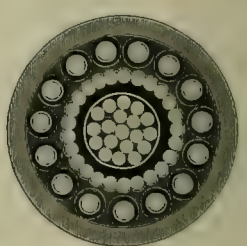
[CONTINUED FROM LAST WEEK.]

In our advertisement of August 30th we referred to the quality of Habirshaw Insulation. Last week we gave a list showing a few places where it had been used. Below we illustrate by full sized cuts some of the cores used in the insulations referred to.

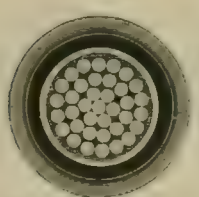
BROOKLYN EDISON E. L. CO.
(UNDERGROUND.)

N. J. CENTRAL RY. DEPOT.
(UNDERGROUND.)

BROOKLYN THEATRE.
(FLAME PROOF.)

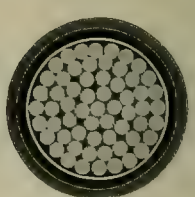


HARRISBURG, (Pa.) E. L. CO.
(UNDERGROUND.)

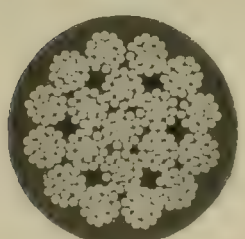


GOVERNMENT CRUISERS.

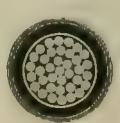
EDISON ELECTRIC LIGHT CO., Easton, Pa.
(LAID UNDER DELAWARE RIVER.)



BROOKLYN THEATRE

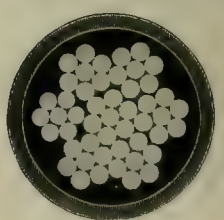


BROOKLYN EDISON E. L. CO.
(FEEDER CABLES.)



INTERIOR DEPT., WASHINGTON.

GOVERNMENT CRUISERS.



BROOKLYN EDISON E. L. CO.
(FEEDER CABLES.)

NOTE—The evenness and systematic arrangement exist in the originals, and are attained by the superior methods employed in its manufacture.

The Habirshaw insulation fulfills all requirements in places demanding the "BEST," and in that field finds no successful competitors.

THE BRUSH ELECTRIC COMPANY

STILL CLAIMS THE EXCLUSIVE RIGHT TO MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

AGAIN SUCCESSFUL

THE BRUSH ELECTRIC COMPANY
vs.
THE WESTERN ELECTRIC LIGHT & POWER COMPANY, et al.
(Western Electric System.)

Opinion by Judges Brown and Ricks in the United States Circuit Court for the Northern District of Ohio, filed August 15, 1890:

"Any dissimultaneous arc forming separation by mechanism resulting in the suc-"cessive burning of the carbons, is an infringement of the Brush patent."

So called double fixed carbon, three carbon or flat carbon lamps are crude and unsatisfactorv.

The Court say:

"Defendants experts are constrained to admit, not only that Brush was the first to "invent the principle of substitution in his double carbon lamp, but that the Western "Electric Company could not successfully compete with the companies using his patent, "in furnishing all night electric lighting plants unless it could provide double carbon "lamps to its customers."

"We should have felt fully justified in disposing of this case by a simple reference to "the opinion of Judge Gresham in the Brush Electric Company vs. The Ft. Wayne Electric "Light Company, in which the same construction was placed upon the Brush patent, but "in view of the importance of the questions involved, and of the elaborate preparation of "counsel, we have deemed it proper to give it an independent consideration."

"We are clearly of opinion that complainant is entitled to relief in this case, and a "decree will, therefore, be entered for an injunction, and the usual reference to a Master "to assess and report its damages."

BRUSH APPARATUS ALWAYS RELIABLE.

ARC AND INCANDESCENT LIGHTING SYSTEMS, ELECTRIC MOTORS, GENERATORS, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

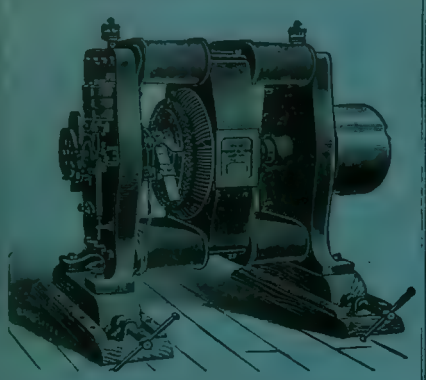
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



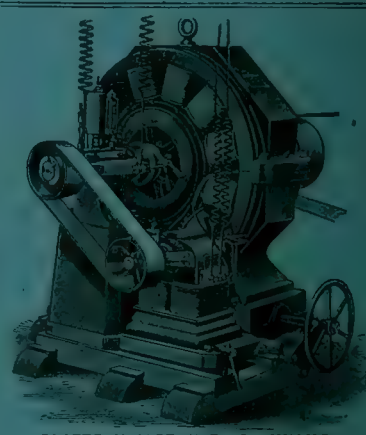
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK,	115 Broadway.
CHICAGO,	185 Dearborn St.
PHILADELPHIA,	907 Filbert St.
PITTSBURGH,	533 Wood St.
DETROIT, MICH.,	57 Gratiot Ave.
SAN FRANCISCO,	35 New Montgomery St.
TORONTO, CAN.,	138 King St. W.
DALLAS, TEX.,	McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

To Arc and Incandescent POWER COMPANIES.

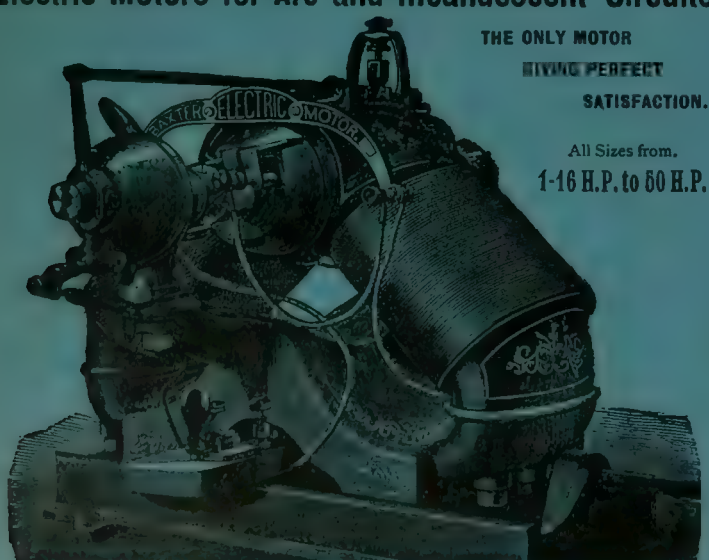
THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.



The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

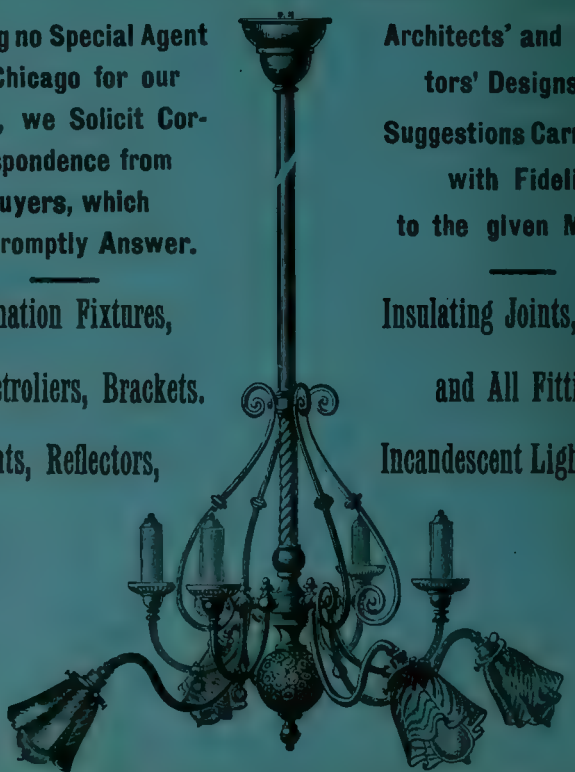
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

THE MITCHELL VANCE CO.,

(Successors to MITCHELL, VANCE & CO.)
DESIGNERS AND MAKERS OF
ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.



Combination Fixtures,
Electroliers, Brackets,
Pendants, Reflectors,

Insulating Joints,
and All Fittings for
Incandescent Lighting.

MANUFACTORY,
24 and 25th St. and 10th Ave.,

SALESROOM,
836-38 Broadway and 13th St.,

NEW YORK CITY.

Western Electrician.

$8 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, SEPTEMBER 20, 1890. No. 12

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

To Make YOUR TELEPHONES TALK

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.

ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

ELECTRIC PLANT BOILER.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff Street, New York.

BRANCHES: BOSTON, PHILADELPHIA, NEW ORLEANS, DALLAS and CHICAGO.

(3143)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

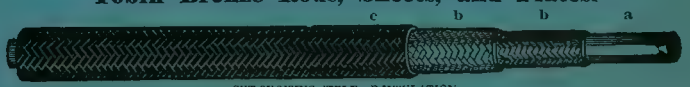
ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.



CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

For Addresses of DISTRICT OFFICES SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave., CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment.

Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	285
Waterhouse	222	.....	222
Heisler	.....	500	500
Remington	159	300	459
Sperry	130	.....	130
Excelsior	90	.....	90
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc	Inc
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,067
Edison	.....	13,853
American	1,537	175
United States	632	6 141
Schuyler	1,166	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	800
Van Depoele	450	.....
Waterhouse	237	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	110	.....
Excelsior	205	30
Hochhausen	80	...
Weston	138	.....
Fuller	10	.....
Reliance	30	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Ansonia Brass & Copper Co.. i
Allis, E. P. & Co..... xxiv
American Electrical Works.. xv
Abendroth & Root Mfg. Co.. i
Ball Engine Co..... xvi
Baggot, E..... xvi
Barton, Geo. P..... —
Bernstein Electric Co..... xix
Brush Electric Co..... xxix
Butler Hard Rubber Co..... xx
Bain, Foree..... xvi
Brown, Frank T..... xvi
Barnes, W. F. & Jno..... xxi
Baxter Electric Motor Co..... xxx
Bleckert & Nelson..... xvii
Bunnell & Co., J. H..... xiv
C. B. & Q. R. R..... xxv
Cleverly Electrical Works... xvi
Colburn & Co., I. W..... xvi
C. & C. Electric Motor Co... xxii
Central Electric Co..... xi
Continental Dynamo Co..... —
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... vii
Consolidated Electric Storage Co..... —
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... —
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xviii
Electrical Supply Co..... xxviii
Empire City Electric Co..... xviii
Eastern Electric Cable Co..... xv
English, Morse & Co..... xvii
Excelsior Electric Co..... xxi
Elektron Mfg. Co..... xix
Eddy Electric Mfg. Co..... xv
Eddy, Henry C..... xvi
Electric Construction & Sup. Co iv
Edison Mfg. Co..... xxii
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Railway Dept... xxv
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co..... —
Eureka Tempered Copper Co.. xvii
Easton Electric Co..... iv
Electric Merchandise Co..... xvi
Electrician Publishing Comp'y, xxiii, xxiv
Evans Friction Cone Co..... xix
Empire China Works..... xvi
Fibrone Mfg. Co..... xv
Forest City Electric Works.... vii
Fort Wayne Electric Co..... xxx
Fletcher & Fletcher Electric Co xvi
Globe Carbon Co..... xvii
Gréeley & Co., E. S..... xiv
Gibson Gas Fixture Co..... xviii
Giles Bros..... vii
Great Western Electric Sup. Co. v
Hazelton Tripod Boiler Co.... xxv
Heisler Electric Light Co..... xxii
Hill Clutch Works..... —
Holmes, Booth & Haydens..... xvii
Harmount, G. A..... xvi
Hazazer & Stanley..... xiv
Holtzer-Cabot Electric Co..... i
Hawkeye Electric Mfg. Co.... iv
Holmes & Co., C. H..... xvii
Humphrey, H. H..... xvi
Ireson, Chas. L..... i
Interior Conduit & Insulation Co. xiv
India Rubber & Gutta Percha Co. i
Ide & Son, A. L..... xiv
Illinois Electric Material Co.... xiv
Jewell Belting Co..... xv
Jones Bros. Electric Co..... vii
Knapp Electrical Works..... xxvii
Law Telephone Co..... xv
Leclanche Battery Co..... vii
Laminar Fibre Goods Co..... xvii
Mitchell Vance Co..... xxx
Monitor Electric Co..... xvi
Munsell & Co., Eug..... xv
Munson Belting Co., Chas..... xiv
Mason, Jas. H..... xxi
Magnolia Anti-Friction Metal Co i
N. Y. Belting & Packing Co... xiv
National Carbon Co..... iv
National Conduit Mfg. Co..... xii
National Electric Mfg. Co..... x
Noye Mfg. Co., Jno. T..... xvi
Northwest Thomson-Houston Co. vi
Ostrander & Co., W. R. xviii
Okonite Co..... xv
Partrick & Carter..... xx
Phoenix Glass Co..... xxx
Paiste, H. T..... xiv
Pond Engineering Co..... xvi
Powell Co., Wm..... —
Pumpelly Storage Battery Co. vii
Phillips Electrical Works, E. F xv
Page Belting Co..... —
Queen & Co..... xvi
River & Rail Elec. Light Co.. ix
Roeblings' Sons Co., Jno. A... xix
Shultz Belting Co..... —
Stilwell & Bierce Mfg. Co. xvi, xvii
Standard Carbon Co..... xx
Stephenson & Co., Jno..... xxiv
Schuyler Electric Co..... xx
Southern Electrical Supply Co. xxi
Sperry Electric Co..... xviii
Sawyer-Man Electric Co..... xii
Schoverling, A..... —
Standard Paint Co..... xiv
Standard Underground Cable Co. i
St. Louis Electrical Supply Co. xxi
Standard Electrical Works.... xvi
Sunbeam Incandescent Lamp Co. xv
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxvi
Taussig, S..... xvi
Taylor Mfg. Co..... xxv
Triumph Compound Engine Co..... xxv
Turner Brass Works..... xv
Union Hardware Co..... xiv
United Electric Traction Co.... vii
United States Electric Lighting Co..... xiii
Van Nuis C. S..... i
Woodbridge & Turner..... xvii
Westinghouse Electric Co..... xiii
Wollensak, Jno. S..... xxi
Western Electric Co..... xviii
Weston Electrical Instrument Co..... xiv
Western Power Construction Co. xxiv
Wanted..... —

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co.
Pumpelly Storage Battery & Elec. Motor Co.
The River & Rail Electric Light Co.

Aluminum.
Aluminum Brass & Bronze Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Aluminum Battery Electric Light & Power Co.
Bunnell & Co., J. H
Central Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Hazazer & Stanley
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Weston Electrical Instrument Co.

Electric Railways.
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Mitchel-Vance Co.

Electroliers and Combination Fixtures.—Continued.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
American Electrical Works.
Ansonia Brass & Copper Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Mitchell-Vance Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.

Lamps, Incandescent—Contd.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

J. H. REID, General Manager,
411 & 412 Royal Ins. Bldg. CHICAGO.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR

INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE.

SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.
MADE IN ALL SHAPES AND SIZES.

—o(FOR)o— TELEPHONE ONE DOES THE WORK FOR LONG OR SHORT DISTANCE

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES
IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

THE HAWKEYE

ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station AND ISOLATED PLANTS, ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps,*** Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192
FIFTH AVE.,
CHICAGO.

Makers of the Choicest Electrical Supplies.

General Western Agents:

K. W. CUT-OUTS,

Gas Lighting Apparatus,

Samson Batteries,

Tested Fuse Wire.

PETTINGELL, ANDREWS & CO.

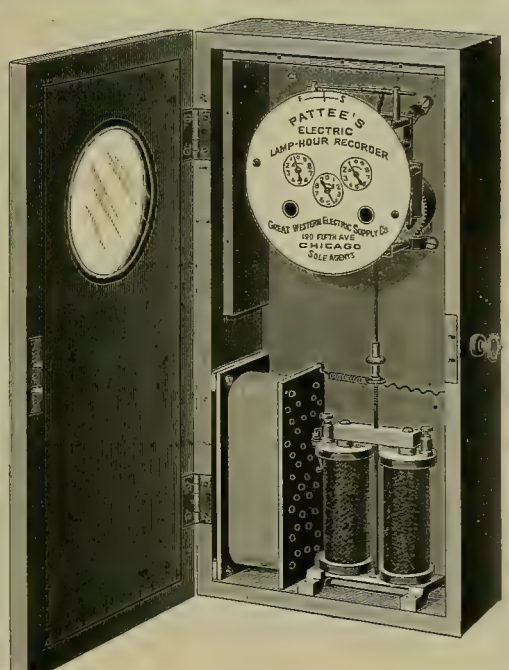
THE ELECTRIC GAS LIGHTING CO.

Massachusetts Electrical Engineering Co.

VERSTRAETE POLE TOP.

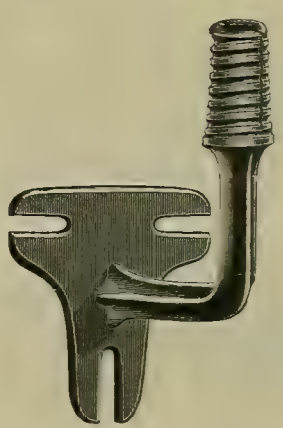
ALL THE MOST DESIRABLE FEATURES ARE COMBINED IN IT.

[SEE SPECIAL CIRCULAR.]



PATTEE'S LAMP-HOUR RECORDER.

[SEND FOR SPECIAL CIRCULAR.]

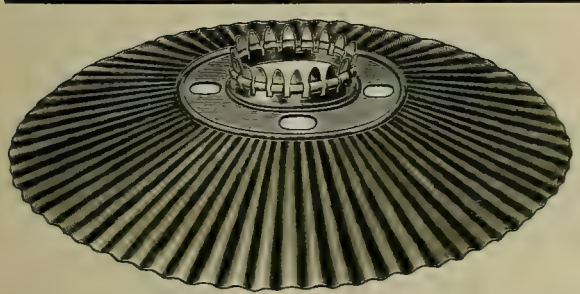


CHUBBUCK BRACKET.
PATENT ALLOWED.

STRONGEST.
LIGHTEST,
TOUGHEST.

WALL BRACKET.
Made of Malleable Iron.

[SPECIAL CIRCULAR.]



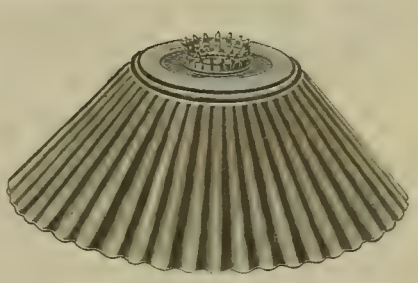
COMBINATION TIN SHADE.

CUTTER'S COMBINATION SHADE.
PATENT ALLOWED.

FIT WESTINGHOUSE, SAWYER-MAN, OR T-H. SOCKETS DIRECTLY.

NO TREMBLING.
NO TOOLS.
NO HOLDER.

The Most Economical Shade Made.



COMBINATION CONE SHADE.

Our Sketch-Catalogue is out. Send business card for a copy.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

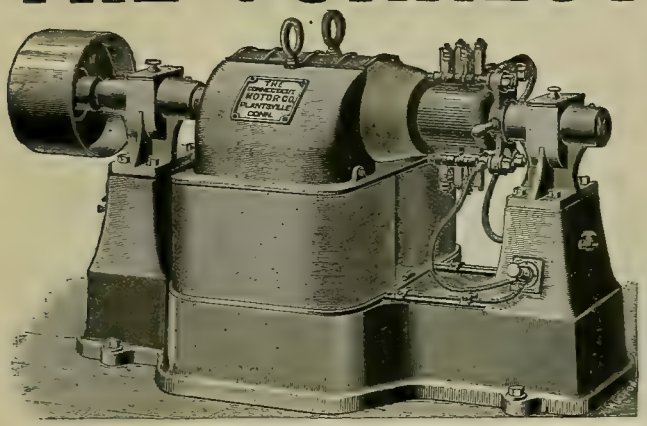
We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

W-A-T-C-H-E-S.

The World's Exposition in Paris, 1889, awarded a prize medal to The Giles Anti-Magnetic Shield for watches. It has been proven to be the best practical and permanent solution to the trouble electricians have with their watches.

The shield can be applied to any watch, or is furnished in new watches by

GILES BROS., - CHICAGO.

TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,

149 West 18th Street, [illegible] - NEW YORK.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

ARMATURES COMMUTATORS

REPAIRED and REWOUND
TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING

the JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

EDISON GENERAL ELECTRIC CO.,

EDISON BUILDING, Broad St., NEW YORK CITY.

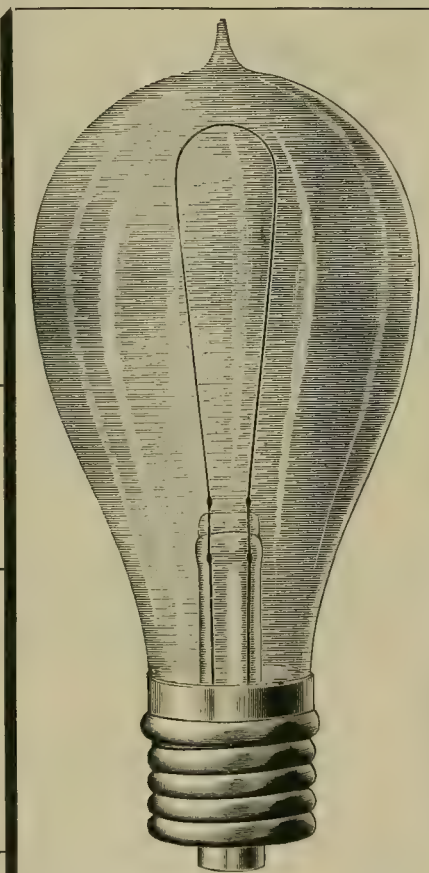
MANUFACTURERS AND CONTRACTORS.

INCANDESCENT, ARC AND ELECTRIC POWER PLANTS OF ALL DESCRIPTIONS AND SIZES, DYNAMOS, INCANDESCENT AND ARC LAMPS, FOR

ELECTRIC LIGHTING.

EDISON LAMPS.

No. 1.
No. 1 is the Standard Edison Base.



The Edison Incandescent Lamp.

No. 2.
No. 2 is the Thomson-Houston.

No. 3.
No. 3 is the Westinghouse.

No. 4.
No. 4 is the United States.

BASES. Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

DISTRICT OFFICES:

NEW YORK, Edison Building.

CHICAGO, Rialto Building.
DENVER, COLO., Masonic Building.
NEW ORLEANS, Cotton Exchange.
SAN FRANCISCO, 112 Bush St.
PORTLAND, ORE., Fleischner Building.
TORONTO, CAN., Bank of Commerce Building.

☞ Please address all communications to nearest District Office. ☜

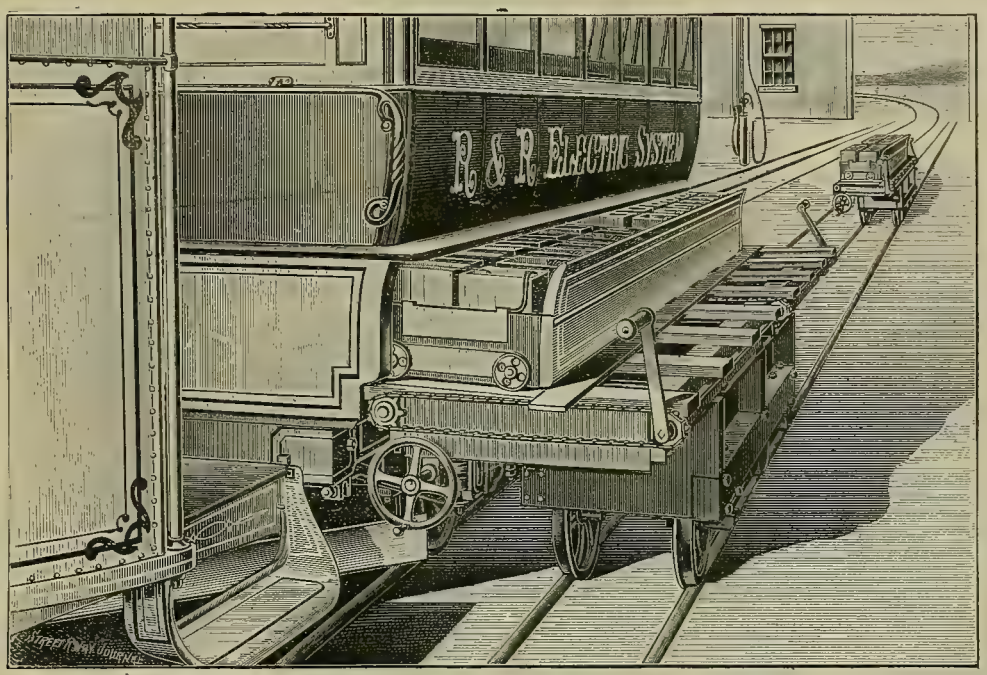
FACTORIES:—New York City. Schenectady, N. Y. Harrison, N. J. Hamilton, Ontario. Sherbrooke, Quebec.

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



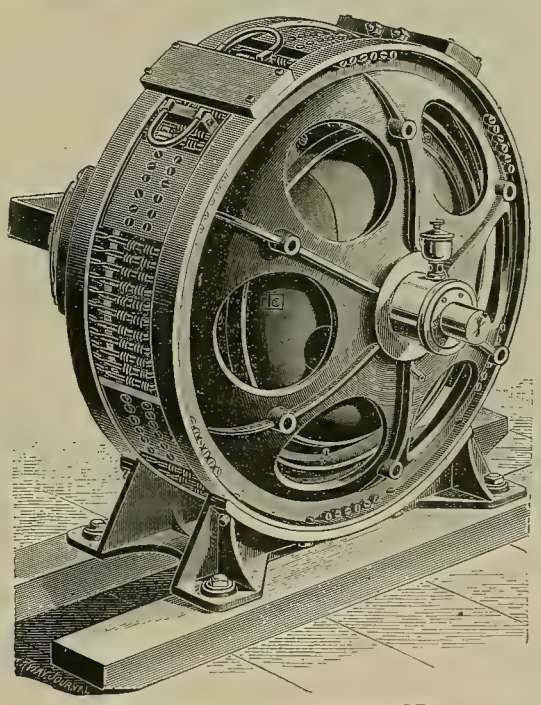
METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

Cars are Lighted by Batteries That Propel The Motor.

THE MAIN Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

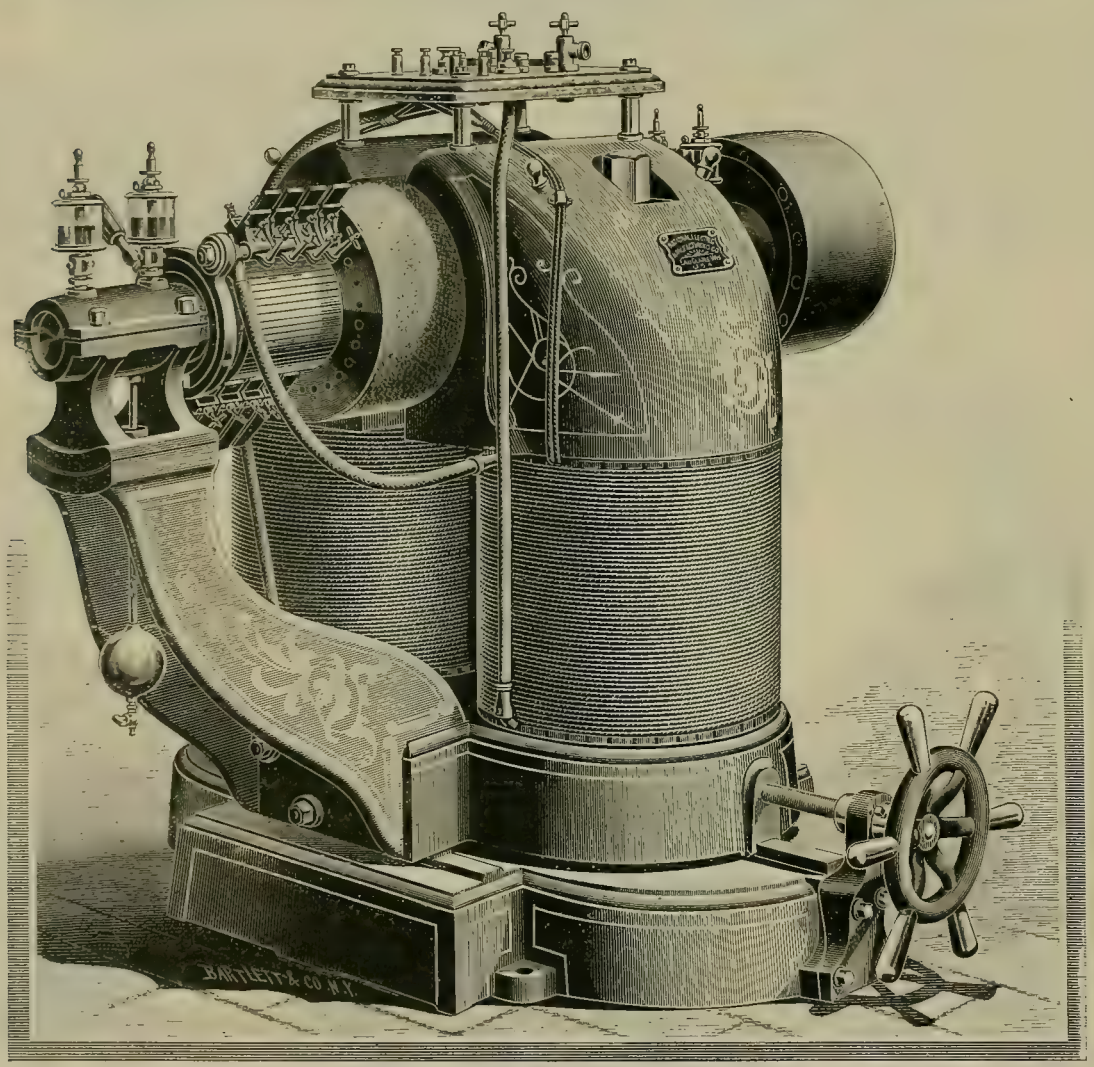
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMOS, CAPACITY 500–16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building, St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Co.

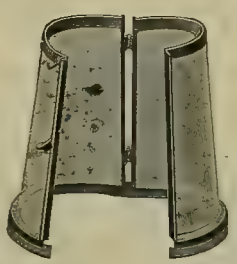
OKONITE TRADE MARK.

GENERAL WESTERN AGENTS FOR

OKONITE AND CANDEE WIRES.

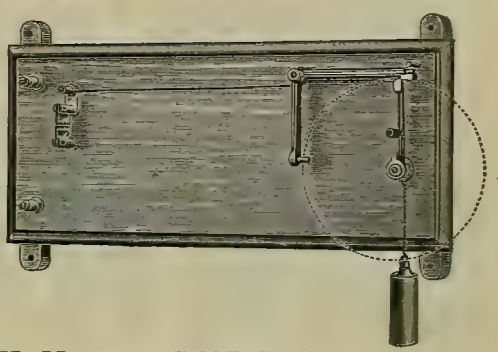
The Central Spark Arrester

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting to the globe.



THE HOT WIRE

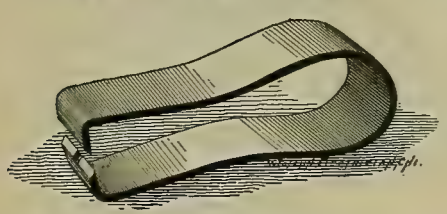
Lightning Arrester.



No Magnet or Self-Induction.
Furnishes Absolute Protection,
And is Automatic in its Action.

OUR PRICE ON THESE INSTRUMENTS IS VERY LOW.

THE PERRY WIRE PEELER.



This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs.
Cleveland Switches, Paiste Switches, Branch Blocks,
And all kinds of Electrical Supplies.

ANTI-MAGNETIC WATCHES.

We have completed arrangements with the Electricians' Time Company by which we are enabled to offer to Electrical men a thoroughly first-class watch, absolutely protected from magnetic influence, and at a very low price. Each watch is accompanied by a guarantee, stating first what it is, and in cases where desired, payments are made easy. Send for a descriptive circular.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

THE

NATIONAL CONDUIT MFG. CO.

ARE FURNISHING THEIR

CEMENT-LINED PIPE

FOR ALL THE

PRINCIPAL ELECTRIC LIGHT AND TELEPHONE SUBWAYS.

ESPECIALLY RECOMMENDED FOR STREET RAILWAY USE.

2,000,000 FEET in ACTUAL USE.

CONTRACTS TAKEN FOR COMPLETE SUBWAY SYSTEMS.

"TIMES" BUILDING, NEW YORK.

SAWYER-MAN LAMPS,

Any Candle Power,

To Fit Any Socket.

NEW SERIES LAMP AND SOCKET FOR

ARC CIRCUITS.

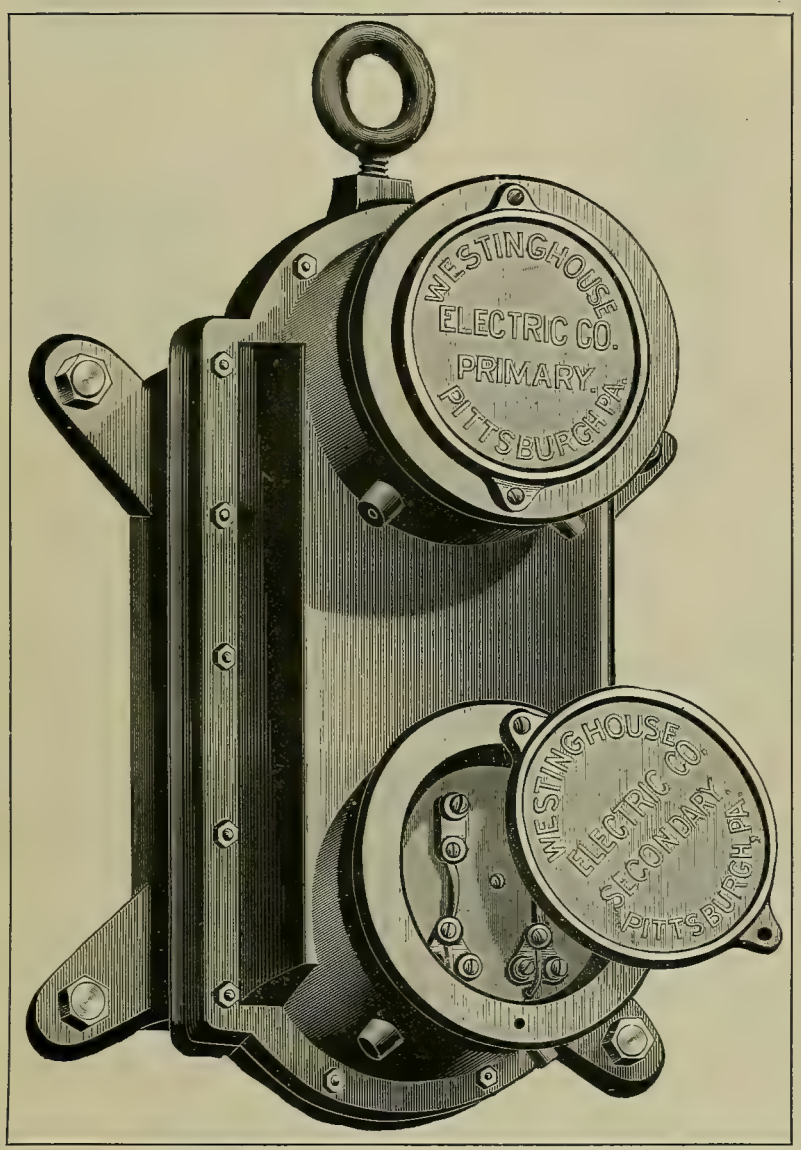
SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.

CONVERTER EFFICIENCIES.

It Will Pay You to Throw Out Your Present Converters and Substitute Our Make.



COMPARISON OF CONVERTERS.

	Total Efficiency.	Converter Capacity Tested.
Thomson-Houston,	87.50 Per cent.	25.
Ft. Wayne Jenney,	87.	25.
National,	88.	20.
WESTINGHOUSE.	95.	20.

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

Incandescent Alternating Current Dynamos, Converters, Meters, Motors.

325 Central Stations and 600,000 Lamps.

Alternating Current Arc Lighting Apparatus.

Lamps burn 40 hours without renewal of carbon.

Arc Lighting revolutionized.

Send for Special Circular.

55 PLANTS, AND 5000 LAMPS SOLD WITHIN A FEW MONTHS.

CORRESPONDENCE SOLICITED.

WESTINGHOUSE ELECTRIC & MFG. COMPANY,

PITTSBURGH, PA., U. S. A.

BOSTON, NEW YORK, CHICAGO, CINCINNATI, ST. LOUIS, SAN FRANCISCO, PORTLAND.

BURNLEY DRY BATTERY

PATENTED January, 1890.

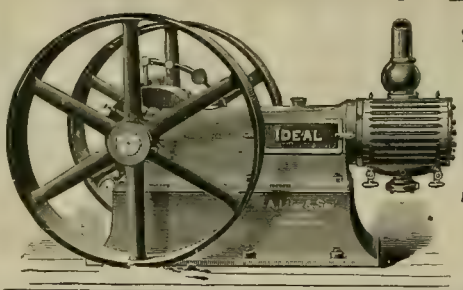
STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:--Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,

32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

Messrs. Hazazer & Stanley.

GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

Yours truly, *CHAS. E. GOODRICH, Electrician, 503 Eighth Avenue.*

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

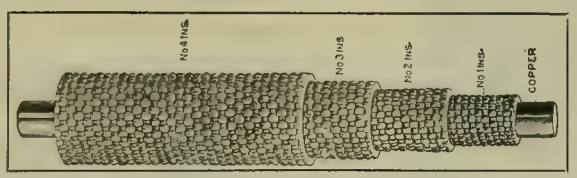
Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.

W = A = N = T = E = D.

An insulation which will be reliable,
Moisture proof, tough and pliable,
Long lived and of great tensile strength,
Adamantine in resistance to abrasion—
☞ YOU will find this combination
In the "Canvas Jacket" insulation.



Address,
ILLINOIS ELECTRIC MATERIAL CO.,
ELECTRIC LIGHT and RAILWAY SUPPLIES,
339-341 Rookery Building, - - CHICAGO, ILL.

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.

Edw. H. Johnson, President.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co.

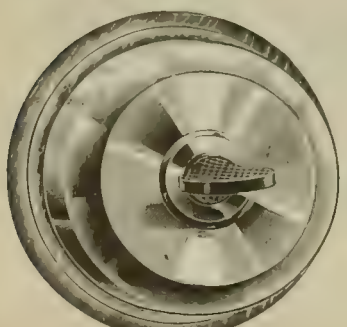
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH



FOR INCANDESCENT WORK

Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,

12th and Market Sts.,

Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

GET THE BEST!

P. and B. INSULATING COMPOUNDS,
ARMATURE VARNISH,
INSULATING TAPE.
INSULATING PAPERS,
MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, SEPTEMBER 20, 1890. No. 12

John I. Beggs, President of the Association of Edison Illuminating Companies.

John I. Beggs, whose portrait is herewith presented, has been identified with the Edison interests many years and has been at the head of the Association of Edison Illuminating companies for five years, taking the position of president six months after the formation of the organization. Mr. Beggs has been successful and his success has been due to his own exertions. At the age of seven years he was thrown upon his own resources and he has relied solely upon his own exertions in securing the position he now occupies in the electrical field. Mr. Beggs, early in life, received an excellent mechanical training at his home in Philadelphia. Later he entered Bryant & Stratton's business college and secured a thorough business education. When he had finished his course he was employed as an instructor at the college and remained in that capacity until he removed to Harrisburg. There he entered the office of the sales agents of the Philadelphia & Reading Coal & Iron company as bookkeeper, but was soon given an interest in the business. In 1882 Mr. Beggs purchased an interest in a large insurance agency in Harrisburg, a year later he became sole proprietor, and at the same time added to it a real estate agency. He was special agent and adjuster for several large fire insurance companies for the state of Pennsylvania.

In the latter part of 1884, Mr. Beggs was induced to purchase a few shares in projected Edison company at Harrisburg. He soon realized that unless an aggressive policy was pursued, the enterprise would prove a failure, and he accordingly invested more money in the project and assumed personal supervision over its operations. He was treasurer, secretary and general manager and devoted his time and money to the development of the business. The plant was in readiness May 1, 1885, and has since been in operation continuously, never shutting down. It is pronounced the most profitable electric light plant in the United States. Mr. Beggs here inaugurated a business policy which he strictly adhered to and which is still operative at the Harrisburg station which, by the way, he still controls. His success was so marked in the management of the Harrisburg station that the Edison Illuminating company of New York induced him to become vice-president and general manager of that corporation. The same policy which he adopted in Harrisburg was enforced in New York with equally good results. On his arrival in New York Mr. Beggs found the business limited, the Pearl street station being the only one in operation. There are now three central stations, the Pearl street and two new ones at West Twenty-sixth and West Thirty-ninth streets. A new station on Elm street will shortly supplement this work. These figures of the period from January, 1887, to July, 1890, bring out the growth very clearly. At the date named, the beginning of 1887, the company's gross earnings were at the rate of $157,000 per year. Now they are about $750,000, or $2,000 per day the year around. There were then 500 customers, now there are 1,500. The number of lamps connected up was 12,439; now the number reaches 50,000, with the addition of 250 arc lamps, a branch of the business untouched in 1887. At the beginning of that year the company did no motor business; now it furnishes daily 600 horse power of current and finds new work for motors every day. The number of employes has grown from thirty-two to no fewer than 532. Mr. Beggs also installed 25,000 lamps in isolated plants throughout the city. A regular supply department, as large as an ordinary supply house, has been established and conducted profitably, and the company has done its own wiring with marked success.

On the reorganization of the Edison-Sprague interests and the formation of the Edison General Electric company, it was recognized that the Central District, comprising eleven States, controlled from the Chicago office, was the most important field in the country. Mr. Beggs was selected as manager of this district and took possession of the Chicago office Aug. 1st. Since his arrival in Chicago the territory has been enlarged, comprising thirteen states at present.

JOHN I. BEGGS, PRESIDENT OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

Mr. Beggs has taken an active part in the affairs of the Association of Edison Illuminating companies, and to his efforts largely is due the success which it has achieved.

Col. Clowry and the World's Fair.

At a recent meeting of the directors of the World's Columbian exposition, Director Nathan resigned the chairmanship of the committee on electrical apparatus and machinery. Col. R. C. Clowry was appointed in his place. The selection will receive the warm approval of electrical engineers and manufacturers.

Chicago Edison Company.

Many of the Eastern delegates to the Edison convention at Minneapolis will undoubtedly visit the Chicago Edison company's central station, as it is considered one of the most important and best appointed stations in the country. It has been pronounced the most complete electrical plant in the country. Although the plant has been operating only two years it has more than doubled the original installation. At present there are eighteen dynamos of 1,300 lights each. The company started with eight machines. The first increase was of four machines, and the last, which has just been completed, raises the number to eighteen. This is probably one of the most striking instances on record of the development of electric lighting. It should be remembered that the company covers only a small portion of the down town business district. It has 18 miles of conduit at present and is contemplating further extensions. The recent addition to its electrical equipment necessitated the installment of three 200 horse power McIntosh & Seymour engines, and two new 375 horse power boilers. The company has also been obliged to put in a 2,000 horse power feed water heater.

The demand for incandescent lamps in printing offices is increasing. Nearly all the Chicago printing offices have electric lights as well as the newspaper offices. Last week the *Evening Post* placed an order with the Chicago Edison company to wire its new building on Washington street, for 615 lights. The Wellington Hotel which was opened last week is illuminated by incandescent lamps, and current is furnished from the central station of the Chicago Edison company. This company also wired the building and designed the special fixtures which adorn the principal rooms of the house. There are 1,400 lights in the hotel, and so brilliantly are the dining room, cafe, and offices lighted that they attract the attention of passers. The principal commercial buildings of the city receive their current for incandescent lighting from this station, and in many of them there are more lights than in some pretentious towns which boast of their electric lighting. Most of the down town theaters are connected with the Edison station; even those having their own plants have taken this precaution so that in case of an emergency they can call on the station for an extra supply of current. This is frequently done in the production of spectacular shows where much depends on the brilliant lighting effects.

In the motor line the company has been particularly fortunate. Owing to the pressing demands for the extension of their lighting system the company made no attempt to develop the motor department, yet orders were constantly coming in and to-day the company is supplying current for operating motors aggregating over 900 horse power. Many of these motors are in large printing establishments, the Chicago *Tribune* and the Chicago *Inter-Ocean*, each having 75 horse power in its press rooms.

While the company has been supplying light and power in the business district it has not been unmindful of the wants in other quarters. There has long been a desire on the part of many wealthy residents of the South side to secure electric lights for their handsome homes and the

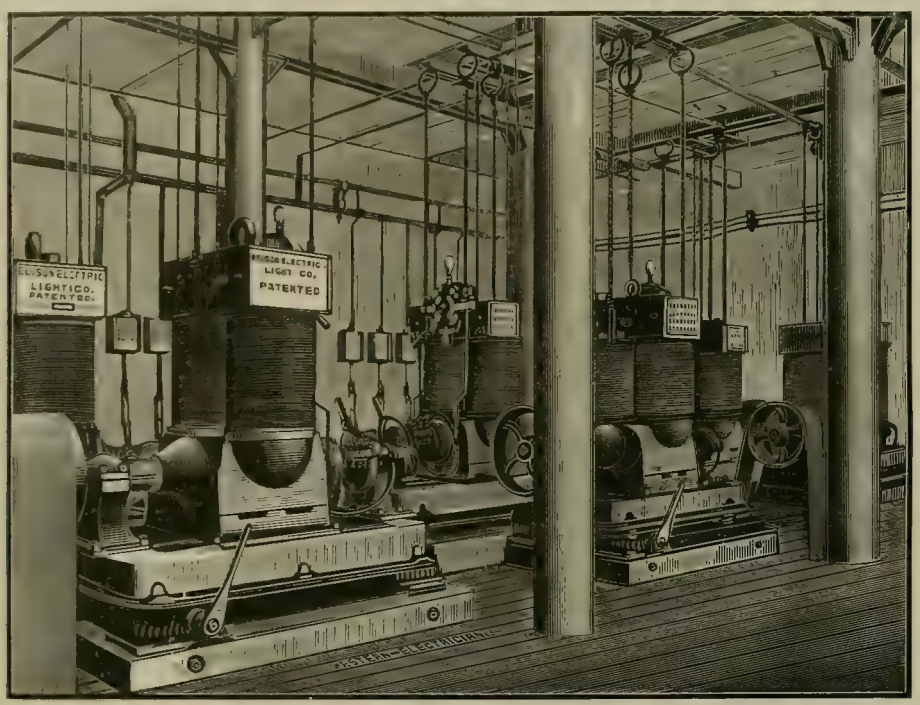
Edison company accordingly decided to install a plant on Wabash avenue. The building is now well under way, the underground mains are progressing rapidly and many of the handsome dwellings and apartment houses are being wired by the Edison company for the introduction of electric light. The company last week received an order to wire the Skinner apartment house, 35th street and Wabash Ave., for 1,600 lights. This building is not yet completed, but it will be one of the finest apartment buildings in the country. The company has received numerous orders for lighting residences ranging from seventy-five to 350 lights.

The South side generating station is on Wabash Ave. about 200 feet south of Twenty-sixth street. Six dynamos will be installed, four of 1,300 lights capacity each and two of 900 each. So rapidly are the orders being received that it is quite probable the capacity of the station will be increased immediately.

The street railroad companies in Seattle, headed by the Seattle Electric Railway company, propose establishing car shops in that city. Cars for local use and outside work will be constructed.

Edison Light & Power Company's Plant at Minneapolis, Minn.

The Edison Light & Power company of Minneapolis, was formed less than two years ago, but it has already installed an excellent plant, an extensive underground system, and has 7,000 lights connected with the station besides 160 horse power in motors for manufacturing purposes. In the accompanying cut is shown an excellent view of the dynamo room in the new building just completed by the company. It is a twelve story structure adjoining the lumber exchange, and is in the heart of the city. Its dimensions are 60x100 feet.



ELECTRIC LIGHT & POWER COMPANY'S PLANT AT MINNEAPOLIS.

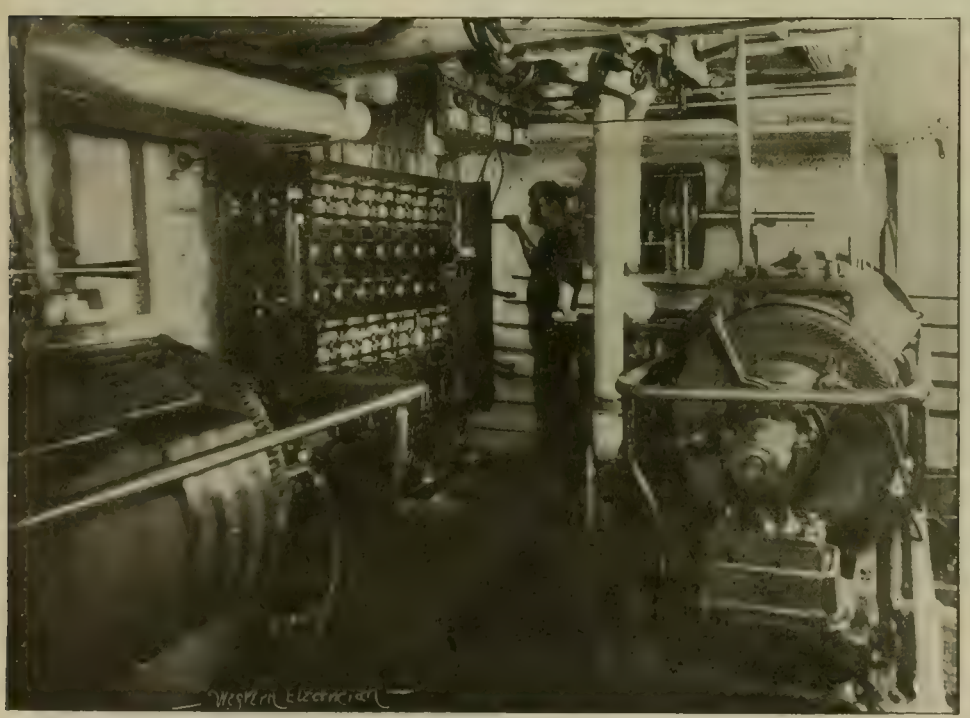
On the first floor are the steam plant and engine room, while on the floor above, the dynamos are arranged. The remaining ten stories will be fitted up for manufacturing establishments, and will be furnished with electric power.

At present there are six 1,000 light Edison dynamos. These are belted directly to the engines on the floor below. The power plant consists of three New York safety engines, each of 160-horse power. Each of these is built upon a separate foundation. The steam plant which consists of six tubular boilers, aggregating 1,000-horse power, was installed by the Haxton Steam Heating company, Kewanee, Ill. The company burns shavings for fuel, finding that this effects a saving of 40 per cent. as compared with coal.

The company adopted the Edison tube system of underground construction and has ten miles in operation at present. Its service extends through the business district, and includes many of the larger buildings. Among them is the Masonic Temple, which has 1,500 lights; the Public Library, 800 lights; Lumber Exchange, 1,000 lights; Bank of Commerce building, Commercial Exchange, Wright Block and several others. The Edison building in which the plant is located is wired for 1,200 lights and many of these are now in use. The meter system has been adopted. The company also furnishes power for several large motor installations. The presses of the Minneapolis *Tribune* are operated by a 15-horse power Sprague motor, which receives current from this plant, and in the job printing department of the concern the installation is duplicated. The "Electric Bath" has a 15-horse power Eddy motor. There are many other installations throughout the city, aggregating 160-horse power, and the demand for motor service is rapidly increasing.

The company contemplates introducing arc lights on its incandescent circuits. It has arranged with an Eastern manufacturing house for a special type of lamp adapted to its system, and these will be introduced when there is a demand for arc lamps.

The officers of the company are: President, H. C. Akeley; vice-president, C. H. Chadbourne; treasurer, S. G. Cook; secretary, C. H. Maxcy.



EDISON PLANT ON THE STEAMER BALTIMORE.

Edison Plant on the Steamer Baltimore.

A view of the electric lighting plant on board the United States steamer Baltimore is given in the accompanying illustration.

This plant is practically a duplicate of those on the cruisers Philadelphia, Charleston and San Francisco, and consists of 3 80-volt, 200-ampere Edison compound marine dynamos, driven by a special double cylinder engine. The dynamos run at 400 revolutions, and it is claimed, have a commercial efficiency of 89 per cent., heat about 40 degrees Fahrenheit above the temperature of room, and have an output of more than four watts per pound weight. This combination of results was required in the government specifications for these boats.

The vessel is wired for 475 incandescent lights and four search lights. All wire is lead covered, and is run in extra heavy moulding. Fourteen mains lead from the switch-board, each controlling from 29 to 45 lights. All the lamps with the exception of those in the officers' quarters, are inclosed in steam tight globes controlled by water tight switches, and in the majority of cases are protected from mechanical injury by wire guards. At various points about the ship water tight attaching receptacles are located for the use of deck lanterns, "hand portables," etc.

There are no soldered joints, all taps being taken off by water tight junction boxes. The controlling idea in the designing of this installation was to make the system beyond the dynamo room perfectly water tight.

The ship is entirely dependent for light on this plant, the running, signal, and all other lights being electric.

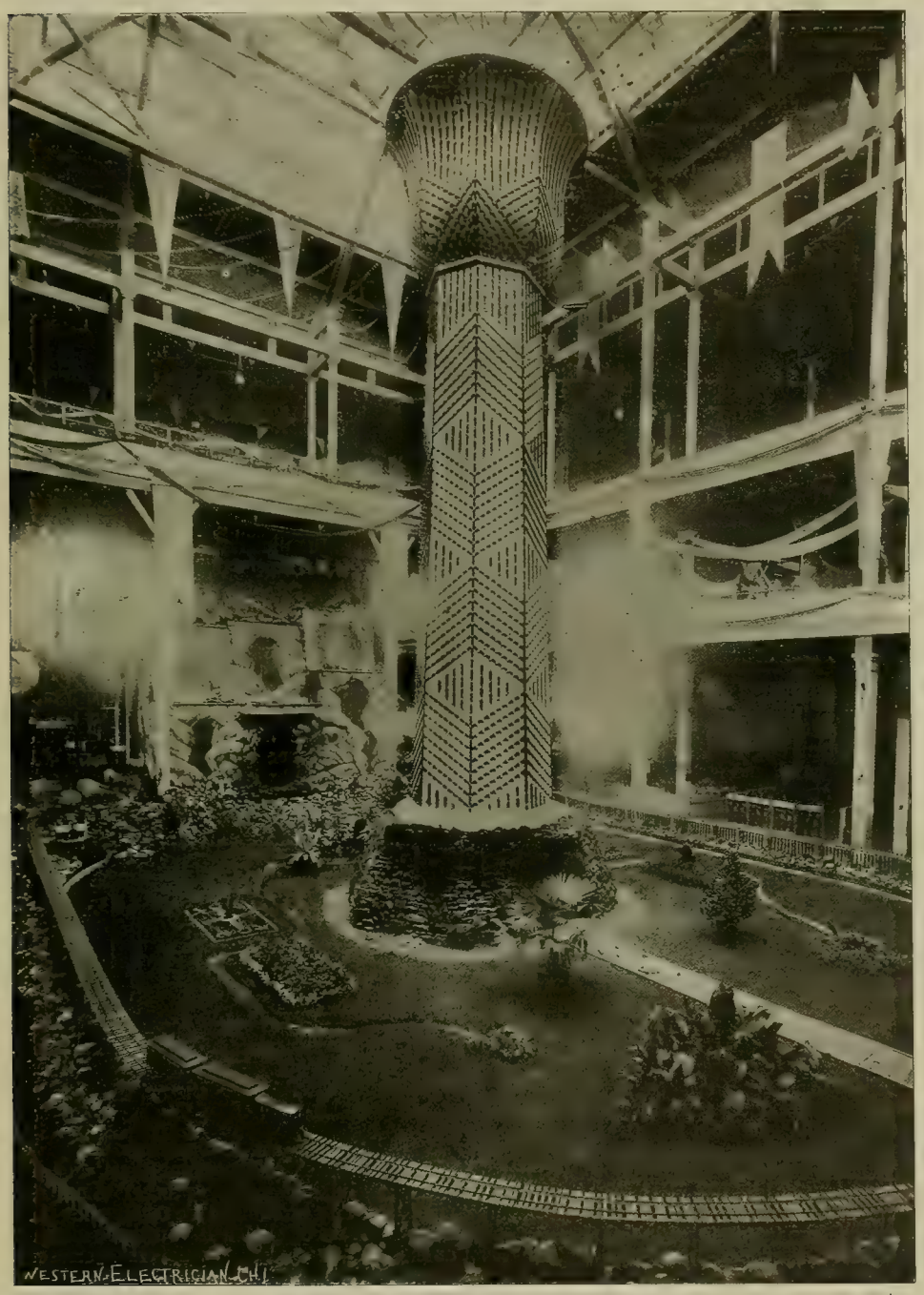
The search lights are four in number, and each takes 50 amperes of current.

The switch-board in the dynamo room is very elaborate, and permits all of the dynamos to be thrown in multiple on the incandescent and search light circuits, or any one of the dynamos can be thrown on the search lights, with the remaining two running in multiple on the incandescent circuit, or the incandescent system can be divided so that each dynamo will run one half of the lights, thus allowing the three machines to run at one time on independent circuits.

Each of the plants above referred to when turned over to the government was given a complete outfit of testing instruments, consist-

ing of Wheatstone bridges, batteries, tachometers, steam engine indicators, etc., and in addition a sufficient number of spare lamps, sockets, wire and wiring devices, parts of engines, etc., are taken aboard, it is estimated, to keep the lights going for three years.

The plants were put in by the Edison General Electric company while the ships were under course of construction, and the amount of labor involved in making these installations can be readily appreciated when it is learned that on the Philadelphia's plant just completed, a force of men has been working since September, 1889.



TOWER OF LIGHT AT THE MINNEAPOLIS EXPOSITION.

During a large part of the time as high as twenty men were employed, and there was never a smaller force than ten at work.

Convention of Edison Companies at Minneapolis.

The convention of the Association of Edison Illuminating companies at Minneapolis will have unusual interest this year for central station men. There have been many changes in the last year, the consolidation of the Edison and Sprague interests, the formation of the Edison General Electric company and many changes in management making the present convention the beginning of a new era in the history of the association. Moreover in the last year the Edison interests have extended and developed far more rapidly than heretofore, and the outlook is exceedingly favorable.

Another inducement is offered in the announcement that Mr. Edison will be present and will participate in the proceedings. The fact that the convention will be held during the Minneapolis Exposition of which the Edison exhibit is the principal attraction, will induce a larger attendance than before. The Edison exhibit will be in the main, a reproduction of the display at the Lenox Lyceum and the Paris Exposition, but will be even more elaborate than these. The exhibitors have profited by their experience, and the Minneapolis display is the crowning feature of the exposition.

Special trains for the accommodation of delegates and their friends will be run from New York and Chicago. During the convention papers on the following topics will be read and discussed: Lightning Protection, Results of Experiments; Insurance of Edison Central Stations; A National Code of Insurance Rules; Edison Patent Litigation; Central Station Steam Piping; Re-organization of Edison Interests; Grounding the Neutral Wire in Three Wire Systems.

The present officers of the association are: President, John I. Beggs; vice-president, C. P. Gilbert; secretary, W. J. Jenks; treasurer, Wilson S. Howell; executive committee, A. L. Smith, Appleton, Wis.; C. L. Edgar, Boston, Mass.; Thos. P. Merritt, Reading, Pa.; E. R. Weeks, Kansas City, Mo.; C. J. Field, Brooklyn, N. Y.; J. I. Beggs, Chicago, Ill.

The Electric Tower at the Minneapolis Exposition.

One of the most striking features of the Minneapolis exposition is the electric tower, which is illustrated in the accompanying cut. This tower was designed by Luther Stierenger of the Edison General Electric company for the Minneapolis exposition. It admirably illustrates the adaptability of the electric light to decorative purposes and theatrical effects. The first display of this kind in this country was at the Lenox Lyceum in New York, and was considered a great achievement in the way of producing effects by electric light. The tower at Minneapolis is far superior, it is claimed, to that at the Lenox Lyceum, and in design represents an Egyptian lotus. The pillar is the stem with its purple ribs at every angle of the octagon; the swelling top is the flower, with its petals and sepals strongly defined; the slender festoons of parti-colored light are the stamens—the whole a wondrous lotus flower. Many thousand incandescent lamps are used in producing wonderful effects. One of the most popular was seen on the opening night when the operator, during the playing of the "Red, White and Blue," threw on the lights in quick succession, bringing the entire assemblage to their feet with a cheer. Of course, the manner of producing this effect was wholly unknown to the spectators, who looked upon it as almost supernatural. Many other beautiful and wonderful effects are produced.

It will be observed that an electric railroad, with a train in operation, is also seen in the view. There is also a complete display of Mr. Edison's inventions, similar to that shown at the Paris Exposition, together with the perfected phonograph. The electrical exhibit far surpasses all other features of the exposition.

The Improved Schoop Accumulator.

Readers of the WESTERN ELECTRICIAN are already familiar with the construction of Dr. Paul Schoop's storage cell in which a gelatinous electrolyte is employed. Since the publication of the description of this battery, a number of capitalists have been looking into its merits and a syndicate has undertaken to furnish capital for its exploiture.

The Pullman company, through its electrician, A. H. Bauer, is conducting experiments with

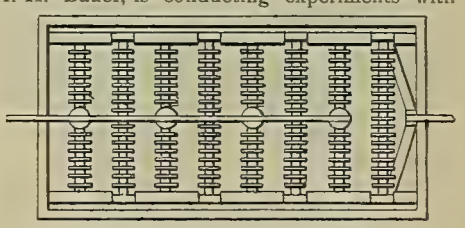


FIG. 1. THE IMPROVED SCHOOP ACCUMULATOR.

the Schoop cell with the object of testing its efficiency for train service.

While Dr. Schoop has from time to time in a general manner, described his cell, a number of the details of his most improved type of accumulator have not been published. With the view of presenting reliable information on the construction of the Schoop plate in the most improved form, the WESTERN ELECTRICIAN has prepared the following description and accompanying illustrations. The description here presented refers merely to the construction of the plates and their arrangement in the cell proper. The electrolyte is not considered.

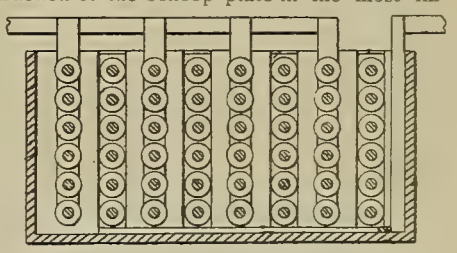


FIG. 2. THE IMPROVED SCHOOP ACCUMULATOR.

It is well known that in storage cells made up of large plates as they are commonly constructed

great difficulty is experienced on account of buckling and the unequal expansion of the plates in the different directions incident to their peculiar shapes and their large masses. The form of device illustrated in the figures is claimed by Prof. Schoop to be calculated to obviate these difficulties.

Referring to the cuts the construction of the accumulator may be readily comprehended. Figure 1 is a plan of the cell complete. Figure 2 is a sectional view. Figures 3 and 4 show the plates as they appear when removed from the electrolyte. In Figure 3, representing one of the plates, there is a central conducting stem formed with arms or branches projecting horizontally

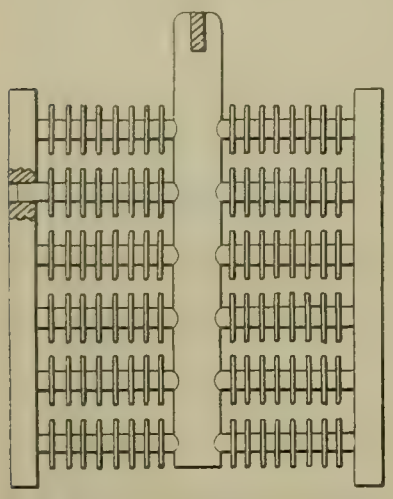


FIG. 3. THE IMPROVED SCHOOP ACCUMULATOR.

as indicated and connected at the ends by non-conducting side bars. Each of these horizontal conducting arms carries a series of disks. These disks, arms and stem, and side bars constitute a plate—for example, a positive plate. The several plates of this character in the cell are electrically connected at the upper ends of their central stems. The other plates, say the negatives, Fig. 4, have lateral conducting bars. These bars rest upon conducting strips at the bottom corners and in that way are electrically connected. By thus furnishing the

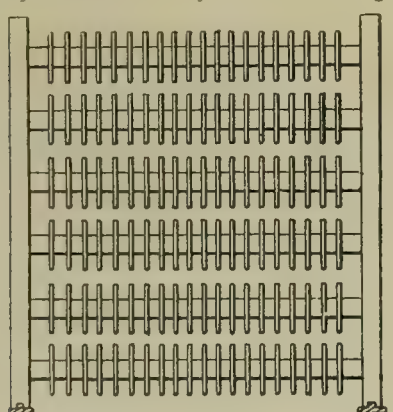


FIG. 4 THE IMPROVED SCHOOP ACCUMULATOR.

active portion of the plate, with a strong and firm supporting stem and having the plate broken up into a series of small parts, a structure is obtained which is not deformed by unequal expansion or contraction.

Prof. Schoop has also invented a process by which he claims to produce an electrode for secondary batteries without the use of paste or plastic material of any kind. His process is one in which a lead electrode is produced by electro chemical means. Fig. 5 illustrates diagrammatically a simple apparatus by which the Schoop process may be carried out. In the diagram *A* designates the electrolytic vessel; *B B*, two lead electrodes suspended in the vessel and in course of formation; *C*, the dynamo from which the plates are to be formed, and *D* the connecting wires.

In carrying out the process the plates *BB* are suspended in a solution of mercury salt, preferably mercurous sulphate, containing about five per cent. of this salt within the vessel *A*, which is filled with this solution, slightly acidulated by sulphuric acid. One of these plates is then connected with the negative pole of the dynamo and the other with the positive pole. It will now be found that the first plate, the cathode, becomes covered with a film of metallic mercury, while the other plate, the anode, apparently remains unaltered. The mercury deposited upon the cathode quickly forms an amalgam with the lead, penetrating its surface to a certain depth. It may be mentioned, however, that in order to insure a satisfactory result in this respect the strength of current must be kept within a certain limit, depending upon the exposed surface or area of the electrode, in order to avoid too great an accumulation of metallic mercury on the plate, which might cause it to drop off before the amalgam is formed. After this treatment the direction of the current is reversed, and it now enters at the plate which was formerly the cathode, passing from it to the other plate, former anode, which now becomes cathode, and then back to the generator *C*. In other words, the electric quality of the two electrodes *BB* is reversed, the cathode becoming the anode by this reversal of current, and vice versa, which is accomplished without disturbing the plates. The result of this is that the mercury deposited upon one of the lead plates becomes dissolved and transferred from this plate to the other one, formerly the anode, but now the cathode. As soon as all the mercury has been removed in

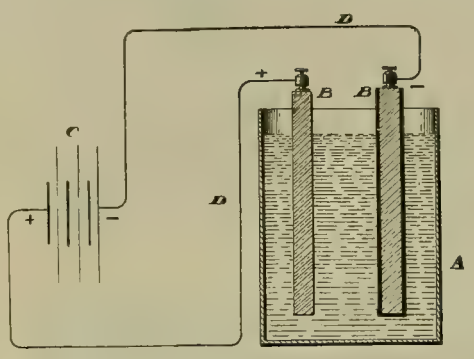


FIG. 5. THE IMPROVED SCHOOP ACCUMULATOR.

this manner by electric chemical action this plate is taken out of the bath, washed and rinsed with water, and is now ready for the ordinary charging. In its place a fresh plate is suspended in the solution opposite to the remaining plate, and now the current is again reversed. This results in the mercury which has been deposited upon the old remaining plate being again dissolved and deposited upon the fresh plate, resulting in the old plate getting in the same condition as the first one by the amalgamation of the lead surface with the mercury deposited thereon; that is to say, the lead surface has become spongy so as to make it fit, after washing, for the ordinary charging. This charging process is the same as that usually followed in forming electrodes for secondary batteries. By this method it is claimed plates of high capacity are obtained in a short time and without waste of energy or material. It is also claimed that these plates are not subject to deterioration, as plates composed in part of the oxides or salts of lead in a plastic state are of less weight for a corresponding area of active surface, and can be produced in less time and at considerably less expense.

Chicago's Electrical Service.

The New York papers have been discussing the electrical service of the police departments of the leading cities of the country. It has long been conceded that Chicago's fire alarm service was superior to that of any other city, and it is gratifying to learn that the New Yorkers have found something else in the Western metropolis to commend. Here is what the *World* says of the police telegraph service: "Chicago is probably better equipped in this respect than any other city in the Union, and millions of dollars have been expended in the various appliances necessary to a perfect department. When Chief Inspector Byrnes made an unofficial visit to the Lake City he was driven by the local officials to one of their signal boxes, where this alarm was sounded: 'Send reserves here at once.' In a few moments a pair of powerful horses came dashing to the spot, drawing a squad of policemen, fully equipped for a battle with a Haymarket mob, or any other serious work demanding their presence. While the inspector returned home fully convinced that in point of personal appearance and discipline the New York force has no equal in the civilized world, he was forced to admit that Chicago was ahead in the matter of an electric signal system and patrol wagons."

Adjustable Stand for Dynanos.

Those accustomed to handling heavy dynamos or large stationary electric motors will need but a glance at the accompanying cuts to enable them to understand the features of this device. This stand was designed for the purpose of

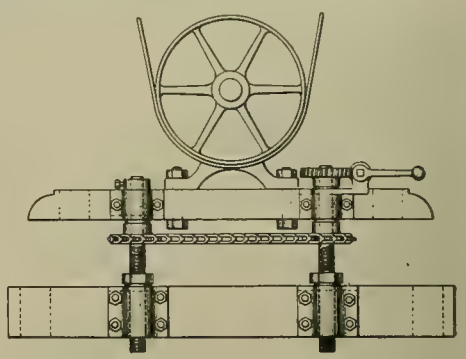


FIG. 1. ADJUSTABLE STAND FOR DYNAMOS.

enabling dynamo tenders quickly and nicely to adjust the tension of a vertical, or nearly vertical, driving belt.

Referring to the illustrations, Fig. 1 is an end view of the stand on the pulley side of the dynamo, and Fig. 2 is a plan.

The device consists essentially of two heavy rectangular wooden frames placed beneath the dynamo and connected by jack screws working in boxes as shown. The boxes on the lower frame are in reality nuts for the screws, and are, therefore, threaded internally. The upper boxes, however, are not threaded. Upon the upper ends of three of the jack screws are placed collars held by set-screws and the fourth

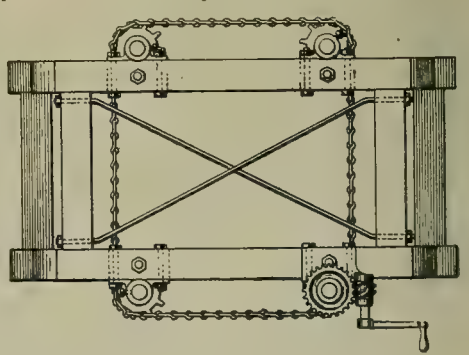


FIG. 2. ADJUSTABLE STAND FOR DYNAMOS.

jack screw is fitted with a worm wheel, Fig. 2. Each screw also carries a sprocket wheel, as shown. All four screws may be revolved by the movement of the one link belt. Further explanation is hardly necessary. To tighten or slacken the dynamo belt, the handle shown in the lower right hand corner of Fig. 2 is revolved in the proper direction. Four lock-nuts, Fig. 1, keep the jack screws tightly in place.

This invention is owned jointly by the inventor, Thomas Wrigley, Oak Park, Ill., and F. B. Badt, Chicago.

An exchange says: There has been a long and bitter warfare between the two rival telegraph lines in Oakland, the Western Union and the Pacific Postal. At the Golden Gate Fair races last year the rival managers, J. E. Morris of the Western Union, and A. J. Hatch of the Postal Telegraph, spent all their time trying to gain exclusive control of the grounds. Mr Hatch succeeded in obtaining from the Fair managers the exclusive privilege of the grounds for his wires, but Mr. Morris quietly erected a telegraph office on the edge of the grounds, and did considerable business. The old feud was revived this year, but Mr. Hatch stole a march on Mr. Morris and leased all the ground surrounding the race track for some distance, and the Western Union has been frozen out completely.

THE CONVENTION

Of the National Telephone Exchange Association at Detroit.

The National Telephone Exchange Association held its annual convention in the Russell House at Detroit, Mich., September 9th and 10th. The delegates upon reaching headquarters were warmly welcomed by W. A. Jackson and F. A. Forbes of the local telephone company, who were indefatigable in their efforts in behalf of the visitors. The first session was held Tuesday morning. President W. D. Sargent of Brooklyn, N. Y., occupied the chair. Following is a list of the delegates:

MEMBERS AND VISITORS.

Albree, George.....Chicago, Ill.
Anderson, Warren.....Xenia, O.
Beck, L D.....New York, N. Y.
Bailey, R. M.....Williamsport, Pa.
Barton, Enos M.....Chicago, Ill.
Barney, C. H.....New York, N. Y.
Baker, C. O. Jr.....Newark, N. J.
Beach, F. G.....Chicago, Ill.
Brown, J. M.....Washington, D. C.
Carney, M. J.....Toledo, O.
Cole, W. J.....Atlanta, Ga.
Clark James, Jr.....Louisville, Ky.
Child, W. A.....New York, N. Y.
Clark, James.....Louisville, Ky.
Carroll G. J.....Detroit, Mich.
Lewis, Alex. H.....Chicago, Ill.
Lockwood, Thos. D.....Boston, Mass
Lockwood, Joseph W.....Detroit, Mich.
McFarlane, L. B.....Montreal
Marshall, Howard P.....New York, N. Y.
McQuaide, James P.....New York, N. Y.
McLeod, John D.....Milwaukee, Wis.
Manson, George T.....New York, N.Y.
McKinstry, E. C.....Zanesville, O
McDaniel, Charles W.....Kansas City, Mo.
Morrison, C. A.....New York N. Y.
Magee, F. A.....New York, N. Y.
Mosley, C. E.....Chicago, Ill.
McKinlock, W. H.....Chicago, Ill.
McKinstry, J. P.....Cleveland, O.
Meaney, E. P.....Chicago, Ill.
Murray, D. S.....Salt Lake City, Utah
Morgan, A. O.....Boston, Mass.
Patterson, W. R.....Chicago, Ill.
Pickernell, F. A.....New York, N. Y
Price, C. W.....New York, N. Y.
Powers, E. L.....Chicago, Ill.
Palmer, Harlan C.....Buffalo, N. Y.
Smith, G. M.....Chicago, Ill.
Stanley, H D.....New York, N. Y.
Sargent, W. D.....Brooklyn, N. Y.
Scribner, C. E.....Chicago, Ill.
Storke, H. L.....New York, N. Y.
Stockwell, H. G.....Portland, Me.
Smith, D. A.....Auburn, N. Y.

and the Callender Insulating & Water-proofing company was dropped from the roll of honorary members, as it had gone out of business. At the same meeting the Cumberland Telephone & Telegraph company was re-elected to active membership, and Messrs. Felton and Gilleaume of Cologne, Germany, were elected as associate members. A. G. Day, an honorary member, has died during the year. These changes leave us with a membership at the close of the association year, as follows: Active, thirty-four; associate, six; honorary, twenty-five.

There is now in my hands, to be presented to the association, the resignation of the City & Suburban Telegraph association of Cincinnati, as an active member, and of J. A. Roebling's Sons' company, of New York city, as an associate member.

The office of the secretary has remained at 510 West Twenty-third street, New York city, during the entire year. The usual number of inquiries for information have been received and replied to, and the "NEWS LETTER" has been regularly issued semi-monthly, until January 1st, 1890, and monthly since that date. The treasurer's report will show that the income of the association has, during the past year, considerably exceeded its expenses, by reason of a reduction in the latter. There is now in the treasury a balance of $320.99 as against $66.41 at the beginning of the year. All accounts due the association have been collected, and all debts of the association have been paid to the end of the fiscal year.

The income of the year was derived as follows:

From annual dues	$1,950.00
From initiation fees	10.05
From sales of extra copies of proceedings	49.10
Total	$2,009.15

The expenses have been distributed as follows:

For salary of secretary	$1,000.00
For printing proceedings, Minneapolis meeting	245.25
For other printing, "NEWS LETTER," circulars and blanks	129.40
For office expenses, stationery, postage, telegrams, express and newspaper clippings	98.06
For stenographer at Minneapolis meeting	136.50
For other expenses at Minneapolis meeting	145.36
Total	$1,754.57

The report was accepted and placed on file.

NATIONAL TELEPHONE EXCHANGE ASSOCIATION—GROUP OF ATTENDANTS AT THE DETROIT CONVENTION.

Carty, J. J.....New York, N. Y.
Crandall, A. W.....New Orleans, La.
Cherry, E. V.....Cincinnati, O.
Crandall, C. D.....Chicago, Ill.
Collins, W. F.....Chicago, Ill.
Carson, D. I.....New York, N. Y.
Culbertson, John N.....Buffalo, N. Y.
De Land, Fred.....Chicago, Ill.
Dickerson, J. W.....Chicago, Ill.
Durborow, A. C., Jr.....Chicago, Ill.
Drake, Flemon.....Omaha, Neb.
Dee, James R.....Houghton, Mich
Degenhardt, F. E.....Chicago, Ill,
Doolittle, Thomas B.....Bridgeport, Conn.
Davis Josiah R.....Harrisburg, Pa.
Doolittle, C.....Bridgeport, Conn.
Estabrook, W. H.....Elmira, N. Y.
Forbes, F. A.....Detroit, Mich.
Farnham, I. N.....Boston, Mass.
Fuller, Arthur G.....St. Louis, Mo.
Gifford, H. N.....Louisville, Ky.
Ghegan, J. J.....New York, N. Y.
Greene, W. D.....Detroit, Mich.
Hall, Edward J.....Buffalo, N. Y.
Hall, Edward J. Jr.....New York, N.Y.
Hibbard, A. S.....New York, N. Y.
Huidekoper, H. S.....Philadelphia, Pa
Hovey, W. K.....New York, N. Y.
Hamilton, George A.....New York, N. Y.
Harvey, Francis J.....New York, N. Y.
Hall, George G.....Cincinnati, O
Ivers, Samuel.....New Bedford, Mass.
Jackson, W. A.....Detroit, Mich,
Kelly, James F.....New York, N. Y.
Knight, F. B.....Austin, Tex.
Keller, J. N.....Boston, Mass.
Land, James F.....Detroit, Mich.
Stump, C. E.....New York, N. Y.
Thayer, W. B.....New York, N. Y.
Taltavall, Thos. R.....New York, N. Y.
Tyler, Morris F.....New Haven, Conn.
Uline, A. B.....Albany, N. Y.
Watson, S. E.....Detroit, Mich.
Wallace, George Y.....Salt Lake City, Utah
Wilson, C. H.....Chicago, Ill.
Wetmore, J. A.....New York, N. Y.
Westbrook, W. T.....Philadelphia, Pa.
White, A. C.....Providence, R. I.
Yensen, P.....Cleveland, O.
Yost, C. E.....Omaha, Neb.
Zeublin, J. E.....Columbus, O.

Tuesday Morning's Proceedings.

After calling the convention to order, President Sargent stated that it had been expected the Mayor of Detroit would deliver an address of welcome, but unfortunately he had been called away from the city. He could assure the delegates, however, he added, that the hospitalities of the city would be extended to the visitors.

The roll call showed that twenty-six telephone companies which are active members, were represented; in addition three associate and six honorary members were present.

Gen. C. H. Barney, secretary, read his annual report as follows:

SECRETARY'S REPORT.

At the beginning of the association year the roll contained the names of thirty-four active, six associate, twenty-seven honorary members. The changes during the year have been as follows: At the Minneapolis meeting the resignation of the Sunset Telephone-Telegraph company of San Francisco, as an active member, and of Clark B. Hotchkiss as an associate member, were both accepted,

TREASURER'S REPORT.

THE PRESIDENT: The next business in order will be the reading of the treasurer's report.

H. L. STORKE: I have a report here of the details of the association's business, and the vouchers, which has been examined and approved by the executive committee. The balance brought forward from last year was $66.41; cash on hand, $320.99. This is an improvement of about 500 per cent. over the report made a year ago.

The report was accepted without reading the items.

W. A. JACKSON: I would announce that there will be a carriage drive tendered to the members of the association and those attending this convention to-morrow at 2 o'clock. We will drive around the city and to Island Park, with a lunch to be served at the Casino. This invitation is general to both gentlemen and ladies accompanying them, and to all others who are here at the convention.

The invitation extended by Mr. Jackson on behalf of the Detroit Telephone company was accepted with thanks.

President's Address.

President Sargent made the following address:

On the 7th of September, just ten years ago, the first convention of telephone men assembled at Niagara Falls. The meeting was the result of a circular sent out some time beforehand, signed by representatives of the leading telephone companies in the United States. The object of the convention, as stated in the circular, was "formation of a general telephone association to consider the various questions affecting the telephone business and its development."

This meeting was organized by the election of George F. Durant as chairman, and E. J. Hall, Jr., as secretary. The roll of representatives showed 86 individuals, representing various companies, six representatives of the American Bell Telephone company, and 21 representatives of manufacturing interests; making a total of 113 individuals. A constitution and by-laws were offered, and various reports and papers were listened to and discussed, after which the convention, on the morning of September 9th, adjourned sine die.

Immediately following this adjournment, and on the same day of which this is the anniversary, the first meeting of the National Telephone Exchange association of the United States assembled. The present constitution and by laws were adopted, and the following officers elected: President, George L. Phillips; vice-president, H. H. Eldred; secretary, M. F. Tyler; treasurer, D. I. Carson. The association then adjourned to meet in Chicago on the first Tuesday in April. The subsequent meetings in Saratoga, Boston, Cincinnati, Philadelphia, and so forth, are a part of the history of our business.

Of the original members many have left the business, and a few—but all too many—have been taken away by death, notably our universally-esteemed first president, George L. Phillips, and others, of whom the association has expressed its appreciation in just and loving tributes to their memories.

Ten years ago, how crude the business was. The multiple switch-board was a mere idea. Tables were only hinted at The use of iron or steel wires was almost universal. Insulation was considered of little account by many, and some declared insulators superfluous; the value of the service was underrated by the public, and our own standards were far below those of to-day. The highest efficiency and reliability is what the public demands of us, and business and prosperity will follow us just as fast as we are able to meet that demand. The standard of to-day requires the use of copper for conductors, overhead as well as underground, and the substitution of metallic circuits for single-grounded wires. The underground wires and cables of five years ago do not answer the requirements of to-day, and the same may be said of central office and subscribers' equipments. With improved service comes increased use by the public, and the ability and energies of the best minds in the business may well be taxed to the utmost to keep up with the demand.

This association has in the past been active in the development and extension of new ideas and improved methods, and it is, therefore, with regret that I call your attention to the lack of interest and the falling off in membership during the past three or four years. The City & Suburban Telephone & Telegraph company of Cincinnati has resigned, and the active membership is now only 33. The secretary's request for papers to be read at this meeting met with no response. The papers which we have were procured by personal solicitation on the part of the officers. It may be said, indeed, that outside of the secretary's statistical report, the furnishing of papers to serve as topics for discussion during the last few years has been done by a very few individuals. If the association is to be of service in the future its members generally must take a more active part in the preparation of the papers and reports which form the basis for our discussions.

In conclusion, I desire to thank the association for the kindly manner in which it has treated an inexperienced presiding officer.

Election of Officers.

Mr. Crandall: I desire to place in nomination a gentleman who, a few years ago, was one of the vanguard that was leading the way and teaching many of the members of the association what telephoning should be; I desire to place in nomination a gentleman who has filled many important positions in telephone service, and has never been found wanting in any; I desire to place in nomination a gentleman who is now filling a position in the telephone service, and who has filled it, I believe, to the satisfaction of every member of this association; I have the honor to nominate for president of this association for another year our worthy president, Mr. Sargent of New York.

The secretary was instructed to cast the ballot for Mr. Sargent. On the announcement of his re-election the president made a brief speech in acknowledgment of the honor.

F. G. Beach, vice-president, and H. L. Storke, treasurer, were re elected, the secretary casting the ballot.

W. A. Jackson and A. W. Crandall were elected to fill vacancies on the advisory committee.

The following executive committee was elected: E. J. Hall of Buffalo, Charles F. Cutler of New York, Charles H. Wilson of Chicago, and H. N. Gifford of Louisville.

The following paper by Mr. Davison was read:

The Operation of the Double Cord Key-Board at Brooklyn, N. Y.

BY GEORGE J. DAVISON.

A year ago, I addressed a somewhat extended report regarding the workings of the new multiple switch at Brooklyn, as then operated with the single cord key-board. On account of the troubles therein shown, and because it was essential that we should be able to operate mixed circuits in the multiple board, it was decided to change the key-board from the single cord, grounded system to the double cord metallic. This change was completed early in March, 1890, and the new key-board therefore, has now been in use for about six months.

The equipment is full metallic, with tubular clearing out drops, retardation coils, condensers, split telephones, etc., etc.

The change required the connection of answering spring jacks which were placed horizontally in the lower part of the switch, necessitating the moving upward of all the spring jacks originally connected. This movement disarranged the switch cable wiring to some extent, and increased the liability to troubles in that particular, but very little has developed.

The wiring of the line drops had to be entirely renewed, they having been wired originally for grounded circuits only.

The number of troubles as shown by the table herewith is very low, and those occurring were almost entirely of a trivial nature, readily located, and easily removed.

In the parts of the apparatus not referred to in the tabulated form, there has been scarcely any trouble. After the change of key-boards had been completed, new transmitter cords were put in, none of which have failed; triple receiver cords were necessarily substituted for the double cords; only one of these have failed.

One of the condensers became short circuited, the result of which was to cause all grounded circuit lines to test "busy" whether in use or not.

The split telephones have been very satisfactory, no trouble whatever having been experienced in their use.

Spring Jacks: We have added 1,720 spring jacks to the 15,660 in use last year, making 17,380 now in use. For the first thirteen months' use there were ten cases of dirty contact; for the past six months, there have been twenty-two cases of this trouble. I think this increased percentage of trouble is due to a considerable extent to the disturbance of the switch cables at the time of changing the system, which set free whatever slight accumulations of dust there was in the cables, no small portion of which found lodgement in and about the spring jacks. None of the spring jacks have platinum contacts, the use of which would, I think, lessen this difficulty.

Drops: One thousand seven hundred and seventy in use, an increase of 110 over last year's report.

The troubles with these have been much fewer than was previously shown, comparing as follows:

	13 months. 1889.	6 months. 1890.
Catch	26	3
Shutter	36	8
Armature Trunnion	203	none
Crossed with Core	6	1
Open in Coil	2	1
Burned out	1	5
Broken Wires	20	8
Total	294	26

None of these troubles require any special comment, the cause and remedy of each being apparent.

Ringing Keys: The ringing keys are of the pattern known as Long Distance Metallic, and there are 273 pairs, or 546 individual keys in use. Only five cases of trouble have developed, four of these being a failure to ring, caused by the generator springs not being properly adjusted, being so far away that the depression of the button did not close the contact between the line and generator springs. The remedy was easy and is obvious.

The other case of trouble was where the button, being depressed, would not return to its normal position. This was due to a slight roughening of the sides of the wedge-shaped rubber plunger where the springs rest against it. A little oil applied at the point of trouble was all that was necessary.

Listening Keys: There are 273 listening keys in use with which there have been forty-one cases of trouble; no one of which, however, was in the main line circuit, or interfered with the subscribers after a correction had been made.

These forty-one troubles may be divided into four classes, as follows:

Failing to cut in operator	9
Failing to cut out operator	1
Rubber plunger sticking	27
Rubber pin broken	4
Total	41

Failing to Cut in Operator: The nine cases of this trouble occurred in the first two months and on account of the springs not having been properly adjusted when they were connected. The springs rested against the rubber plunger and did not close the contacts on the operator's circuit. No recurrence of the trouble after properly adjusting the springs by bending them

Failing to Cut Out Operator: Only one case of this trouble caused by the rubber pin of the plunger being so short that the "throw" was not great enough to break the contacts.

Rubber Plunger Sticking: This trouble occurred twenty-seven times, and, as in the case of the ringing key, was where the plunger remained down, when cam was thrown forward. It was due to some extent, to a lack of proper smoothness of finish on the wedge-shaped sides. The plunger is pressed upon by two springs on one side and one on the other, the unequal strain having a slight tendency to make it bind. The difficulty was readily overcome by rubbing a little oil on the sides of the 'wedge."

Broken Rubber Pins: Four of the little rubber pins, which are acted upon directly by the cam, became broken from some unknown cause.

The cams of the listening key make considerable noise when they are thrown forward, but I do not know how this can be avoided.

Tubular Clearing Out Drops: Two hundred and seventy-three in use, which have required attention twenty-three times. All of the troubles, except two, were with the catch. The drops are located directly in the rear of and on a level with the cords, the plugs of which in being returned to their normal position occasionally strike against and bend to some extent; the rather slender catch of the drops, which in consequence fails to release the shutter. The remedy for these troubles, after their occurrence, is obvious. To guard against them, the drops should be located elsewhere, which, however, is not practicable in this switch.

The "adjustments" referred to were where the armatures were too loose, requiring the changing of the position of the trunnion binding screws.

Cords: It appears from the record that only about 35 per cent. of the cords in use had failed during the six months. As a matter of fact, a percentage of failures of the cords *actually used* is much greater. Each of the subscriber operators has eighteen pairs of cords available, but habitually used a much smaller number. A half dozen or so pairs of cords being used for the greater portion of the connections, the other pairs in a lesser and lesser degree according to the volume of business.

There were a few failures of the cords at the point of soldering into the shoe, inside of the plug, but the percentage of troubles from this cause is very low.

Almost all of the failures were at the base of the plug, due to the strain upon the cord in withdrawing the plugs from the spring jacks. The breaking of the tinsels increased considerably by the perspiration from the operator's hands penetrating the covering of the cords. It is the rule that operators shall withdraw the plugs by taking hold of the same, and not by the cord, but it is almost impossible to enforce the rule on long reaches.

The percentage of cord troubles in the double metallic is very much greater than in the single cord, grounded system. In the thirteen months' use of 1,200 single cords there were only eight failures as against 209 failures in six months out of 576 in use in the double metallic. There are two prominent reasons for this increased percentage; first, because as there are two conductors in the metallic circuit cords the liability to trouble is doubled in the same number of cords, and second, because in the double cord system, the use of the cords is so much greater. In the single cord system, a cord is not used except to complete the connections for which the subscriber, of whose line it forms a part, may call, while in the double cord system a pair of cords may be used any number of times, in fact, may be used almost continually.

The one case of trouble, "conductors crossed in cord," was caused by abrasion of the insulating material. The effect of such a crossing of the line or test is that any grounded circuit subscriber's line tested with that pair of plugs would show "busy" whether in use or not.

Plugs: The troubles with the plugs have not been many, amounting to thirteen in all out of 576 in use.

Four tips of plugs were broken off in the spring jacks due, however, more to accident and a lack of care than to faulty construction of the plugs.

The removal of one of these tips from a spring jack is a somewhat difficult matter when it happens to be broken off when the plug is wholly within the jack, and the tip held fast by the line spring. It is then necessary to relieve the tension of the spring by partially or wholly withdrawing the screw holding it in place and pushing the tip forward until it is within the sleeve of the 'test." From this point I find the most convenient plan of removal to be the use of a short piece of flexible rubber tubing; placing one end of the tubing firmly over the opening of the spring a quick inhalation of breath rarely fails to bring it out.

Tips Unscrewed: The little rivet used to prevent such troubles has come out of nine plug tips, rendering it unsafe to use the plug until repaired.

Referring to last year's report it will be seen that in the thirteen months' record, there were 459 cases of trouble with the combination key and seventy-six with the grounding jacks, a total of 535 in the single cord key-board, or an average of a little over forty-one per month. The report herewith for six months, shows troubles in the double cord key-board as follows: Ringing buttons, 5; listening keys, 41; clearing out drops, 23; a total of sixty-nine or an average of eleven and one-half per month. When it is further considered that about 40 per cent. of the troubles in the single cord key-board interfered with the subscriber's conversation after the connection had been made, and that not one of the double cord troubles interfered in this way at all, the contrast is very great.

Add to this, too, the great difference in the ease with which repairs may be made to the double cord system and that the making of such repairs need not interfere with the operator's efficiency nor with any subscriber's line, it seems to me that there can be but one conclusion arrived at.

The Discussion.

Mr. Lockwood: When we consider the calls to be received from the subscribers, and consider also that the operator must ascertain whether any of the line is already in use, and when we consider that the second subscriber must be called and that the two lines are then to be united for conversation, and that the conversation must be largely guided and supervised, and that finally the disconnecting appliances are to be supplied, it is not surprising that this organism frequently gets out of order. It requires the most constant supervision of any electrical instrument that I know of, for many reasons. Each line has to pass through a great number of contacts, and necessarily so. The instruments for receiving calls have to deal with currents which are not strong, and sometimes they have to pass over unavoidably leaky lines which cannot at all times be kept in the best of repair. The current by which the talking is performed is not strong at the very best. Frequently it is very weak—the weakest, as we are in the habit of hearing, which is capable of accomplishing any useful result. Therefore I say that the troubles which have appeared are neither in number nor in variety greater than might have been expected, if we had stopped to consider the current and the very uncertain nature of all machinery, especially when it is worked to such a large extent as is a central office switch-board.

There was one other thing which has also impressed me,

and that is the very great improvement which has taken place this year in comparison with 1889. The paper corroborates my view that there must have been constant supervision in order that faults should be detected; that ways of finding faults could be ascertained.

PRESIDENT SARGENT: I would like to say that while it may seem that the paper ended a little abruptly, the facts presented were so obvious to the writer that in making the concluding remarks he assumed everybody would see that the double cord switch-board which he had just described was so far superior to the single cord switch-board that he did not need to make the statement. There is far less trouble in using the double cord than the single cord board. With the single cord switch-board the removal of faults usually involves other troubles and prevents the operators from doing their work properly. With the double cord board all these troubles may be located, and removed without interference in the slightest degree with the efficiency of the operator. I think in fact the record shows conclusively that the use of the double cord board, indeed, the use of a key-board that is entirely separate from the wires, is the best.

MR. CARTY: I might say a good deal about the relative merits of the double and single cord switch-boards, but as far as the work is concerned there are no single cord switch-boards which are adapted for mixed circuits. Until we have one that is, any discussion of the relative merits of the two boards will not be very profitable. When a company comes to consider the question of a new office the first question is whether a board is adapted to a metallic circuit and if it is not so adapted it is usually thrown out.

MR. KELLER: I would like to ask if there is a single cord switch-board in use in the United States to-day?

MR. WILSON: In answer to the gentleman's question, I will say that we have a single cord board in operation in Chicago in the main office, arranged for single wires and grounded circuits. We have also a single cord metallic circuit switch-board in operation in the Stock Yards office in Chicago. It fills all the requirements for metallic circuits, but, as compared with the double cord metallic circuit switch-board, it has not been considered so good on account of mechanical details. I would say also for the information of the gentlemen present, that in Chicago, we had the metallic circuit problem to contend with, and we were not anxious to introduce any more experimental apparatus in our general system than we could help. So we took one of our branch offices to experiment with. We have in operation in that office now five different metallic circuit key-board systems. The spring jack part of the swtch-board is the same in all of them, and, as the different systems dove-tail together, we are able to operate the five different schemes in the same office. We have been doing that for six months or more, and from those five different schemes we have adopted one for use in our main office, and the apparatus is now being constructed for that office. But the single cord plan has had to give way for one of the double cord systems on account of its advantages.

Now, I want to say that the part of the paper which has been read which interested me the most is the reference to troubles in the spring-jack. We found in Chicago, where we have long underground circuits, that the introduction of a small amount of resistance in the circuit makes a very great difference in the talk. It is especially apparent in systems where the incoming trunk line business from the branch offices does not pass through the spring-jacks. The trunk lines end in cords and plugs. The out-going trunk lines necessarily duplicate through the switch-boards, passing through 19 sections of the switch-board and 20 spring-jack contacts.

If the contacts in the switch-board become dirty—not necessarily open so as to interrupt the circuit entirely—we notice a difference between the incoming and outgoing talk. We have found that a resistance of 200 or 300 ohms in a contact makes a very appreciable difference in the conversation.

Some six months ago we organized a force to work every night on our switch-board. The series of contacts through the switch-board have been measured with a galvanometer. If the resistance exceeds 150 ohms—that includes the drop which is 100 to 130 ohms—the spring jacks are cleaned. In that way we keep our service reasonably uniform. Our experience is that after six months' hard work in cleaning up the contacts we still have an average from five to ten cases of trouble a day. This does not mean open contacts. And I would like to ask if the statistics given in the report refer to open contacts only, or to dirty contacts. If reference is only made to open contacts the figures might be consistent with our experience. If the allusion is to dirty contacts, where resistance of 200 or 300 ohms would not be called a cause of trouble, then I cannot understand the difference between our experience and that of the East. In order to ascertain what the experience of other companies was, I arranged to get reports from New York and Boston, through the Western Electric company by the kindness of Mr. Barton. I was very much relieved to find that our troubles were less than existed in the two cities which I named. I attributed the fact to the pains we took every night to clean contacts. But the report that we have before us now is so much superior to anything that I have heard, that I would like to have it explained. I think that dirty contacts in the spring jack in every large office constitute a very important and serious trouble. We have now 65,000 spring-jacks in our main office switch-board and we are about to triple the number. Unless we can eliminate the cause of this trouble we shall naturally expect just about three times as much of it.

MR. GIFFORD: I think the Brooklyn people ought to be congratulated on the small amount of trouble they have. Our trouble in Louisville results from the fact that we have a considerable number of dirty spring jacks. We have a detached building that we occupy in a middle of a square. My wire room and shop are underneath, but I have a thick floor and very little dust can get through. In spite of all our precautions we have very dirty spring jacks. A subscriber will say that he cannot hear anything, and we first examine the battery. If we don't find anything wrong there then there is a suspicion of a loose joint or an old iron wire. We go over those things carefully, and if we find any trouble it is removed, but then after that is done sometimes the thing still wont work. Then we look at the spring jacks; we find that a large percentage of our trouble with inside service arises from those dirty spring jacks We had to go to work and clean them. A short time ago I detailed three or four employes to clean out the whole switch-board. You should clean out your whole switch-board every month.

Then, too, we have had a great deal of trouble with broken cords. We have an exchange of not quite 2,400 subscribers. I find we have from 25 to 40 broken cords every day, and of course they are a serious cause of difficulty. A man calls up a connection, the operator connects him, and then we cannot hear anything. We have tried the ordinary tinsel furnished by the Western Electric company, and then we tried a combination of tinsel and spiral wire. At last we concluded to have a cord made to suit ourselves, composed of about three times as much tinsel as is ordinarily put in; that gives us a great deal of satisfaction. I have told my electrician to be just as extravagant as he likes in the use of cords, and to put in new cords of this kind whenever any cords are out of order.

In regard to the listening key we have a great deal of trouble with those little hard rubber plungers. They got worn, they got dirty, and they were very hard to get at, and we have a great deal of trouble. They are causing so much that I was about deciding that I should have to go home by way of Chicago, and see whether they couldn't devise some remedy for it. The Warner lever gives a great deal better satisfaction. I think we should call the attention of the manufacturers to these difficulties, and see whether they cannot do something to remedy them.

MR. HIBBARD: I wish to mention it as a matter of observation in exchanges pretty much all over the country that the dirty jack trouble is more noticed in places west where they do not burn hard coal and where the whole atmosphere is permeated with dirt and dust; also, in places where no exchange is located near a railroad yard, where smoke and soot from the engines float in through the windows. I think it may be possible that that is a reason why we do not have so much trouble with dirty jacks in Brooklyn as they have out in Chicago and Louisville. Why, in the Chicago office if you enter it you are at once impressed with the fact that it is a dirty office. In Brooklyn if a trouble occurred I should say it was pretty likely to be an open contact, because there is not enough dirt floating in. The Brooklyn office is a neat, clean office—as clean as a parlor. It is a great deal cleaner than this room is. The Buffalo exchange has linoleum on the floor, and when they want to clean it they simply wipe it off. I think that is a feature that we should all pay attention to—that is, having clean floors.

MR. FARHHAM: Something was said in the paper about the noise of the listening lever. In our new Boston exchange we have provided against that by having the lever strike upon a flexible contact instead of on a solid metal base.

In regard to dirty jacks, I suppose we need to know whether that trouble is due to corrosion or to dust that gets in between the springs. My opinion is that it is due to both. The question has occurred to me recently whether the lower contact of the spring might not well be trimmed with German silver as well as the spring itself. We have adopted the German silver spring. Would it not be a sufficient improvement and guard against corrosion if we used German silver there? Brass, we know, corrodes more than German silver.

There was a suggestion made two or three years ago in regard to freeing the switch-boards from dust which I think has not yet been adopted. That is to case up the switch-board on the back and supply a gentle current of air so that it would always flow outward through all the crevices of the board, and keep the dust out in that way. Then any little dust circulating in the room would never be thrown into the board, but would be kept out.

MR. WILSON: I will forgive Mr. Hibbard for his remark about Chicago and pass over that very lightly. It is a fact, however, that the main office in Chicago is very near the river. The steamers going up and down the river emit a good deal of soot and smoke, which come into our offices. We find a great deal of difficulty with the small spring jacks that have been reduced in size during the last few years for large switch-boards. We don't have any trouble with any of the old jacks. All the new jacks have German silver springs. The difficulty seems to arise entirely from the dust and dirt. The moisture in the atmosphere clings to the spring jacks and the dust more readily adheres. The only relief I have ever been able to discover is to have an inverted contact point. The difficulty is very pronounced If the difficulty we have in Chicago is generally experienced I think it would be worth the while of the convention to ask the manufacturers to do something to relieve us from the trouble.

DR. CULBERTSON: We have 12,352 jacks in use in Buffalo. During the months from January to July we had twenty-seven cases of dirty contacts. We are using the double cord, and we had more trouble with them in proportion. We had forty-three to ninety-four cases per month—making a total of 387 cord troubles. We had a total of 636 troubles during the seven months from jacks, cords, transmitter and telephone and connecting cords and keys. Our key troubles aggregated 202. They were mostly from dirty points of contact. We have the Warner key on our board. Now, while this trouble doesn't affect the Brooklyn board, our board has been in use two years. During the most of this time we have been putting in a new section and making changes in our key-board, and that probably has been quite a source of this trouble, because the general care of the board has been to some extent neglected. The Brooklyn board is entirely new, having been finished in March. I think, besides, Brooklyn is a much cleaner city. When that board gets older, it is a question whether they wont have some of the trouble that now afflicts others.

MR. BARTON: I desire to call the attention of the association for a moment to a general question of one cord or two cords. The question of spring-jack contacts is an important one, and it will require attention from members of the association in the future, as well as from those who have to do with the manufacturers of the boards. I don't wish to say anything to decrease the satisfaction of our Brooklyn friends with their switch-board. There is nothing that I could say that would avail to lessen their satisfaction with it. I wish to draw attention, however, to the fact that it does not follow because they had a certain number of troubles with their single-cord board and a certain less number with their two-cord, that the troubles or absence of troubles are due to the single cord or the double cord. The fact is, in the single-cord board which was put in in Brooklyn the apparatus was considerably crude in detail. The difficulties, of which I have read in the report presented at Minneapolis last year, were very largely due to the crudeness in the detail. Now, if Mr. McKinstry in his Cleveland single-cord board has as many troubles with the subscriber as they had in Brooklyn, why then there would be a chance to make a comparison of the systems, because between the time when the Brooklyn exchange was organized and that at Cleveland was equipped there was a good deal of advancement made in the details of construction. The way to reach proper statistics of trouble would be to compare the present Cleveland board with the present Milwaukee board, or the Thirty-eighth street, New York, board, or the board that has just been put in Denver. The Cleveland board embodies a pretty good degree of excellence in details of construction. The same degree of excellence has been applied in the single-cord boards in use by the German government in Berlin, and those boards, I think, are fairly satisfactory.

I do not propose to enter into a general discussion of the advantages of single or double cord, as it is a very large question, and there are a great many things to be said on both sides. The present tendency of the judgment of the experts in this country is in favor of the two-cord key table, but I do not think that should be entirely on account of the trouble to be found with the single cord system. The troubles depend largely on the perfection which has been achieved in planning and in manufacturing of the apparatus. The real question as between single and double cords depends upon other considerations.

In answer to the question of a gentleman here awhile ago as to whether there are any single cord boards in use in the United States, I would say that there are a considerable number of such boards Among others, at the principal exchanges in Cleveland, there is one in Cincinnati, one in Providence, one in Columbus, one in Portland, Ore., one in St. Joseph, Mo., one in Topeka, one in Los Angeles, and perhaps others which do not occur to me at this moment. Those boards are tolerably well liked, I think, by those who have them. So far as I know, however, with the exception of the one which has been mentioned as in use in a certain office experimentally in Chicago, there is no switch-board on the single cord system, containing the best equipment for metallic circuits.

MR. IVERS: I think it would appear from what has gone before, that Mr. Barton's very last remark covered the whole question. As I remember it, the prime reason for changing the Brooklyn board was that it might be enlarged and that metallic circuits could be used. So far as I have heard, the only reason that Chicago takes the double cord system is the fact that the detail of handling metallic lines has not been worked out in its application to the other systems. I think Mr. Wilson was as firmly wedded to the other board then as anybody is. I don't think his record of troubles in his main office shows that there is any inherent difficulty in operating his office on that plan. Moreover, in order to change his system and to put his wires into cables, and operate metallic instead of grounded lines, it is my opinion that they have been obliged to take these other systems. Therefore, a comparison of the system which is applicable only to the old method of operation is a question which is not in the discussion.

MR. WILSON: I should say that we have in Chicago nine offices, all of good size. Our largest office accommodates 3,000 subscribers. The switch-board is filled up and we have started an annex office that has now 250 subscribers, and we are waiting for additional equipment for the main office. Of course, in putting in additional equipment, we are providing for metallic circuits. At the time the switch-board was constructed in the main office there was no metallic switch-board which we were willing to accept. We have been experimenting with a view of altering over the switch-board for metallic circuits. It is not a very considerable job to do it. In deciding upon a new system, the points of excellence between the different systems to be considered were principally those of contacts. The system which had the lesser number of contacts in the circuit and had the most workmanlike apparatus, for which we depend on the manufacturer, was the one adopted. In regard to the comparison of our one cord switch board with the Brooklyn board, I will say that the principal objection which I understand was made to the Brooklyn board, was this: That if a cord became out of order the subscriber's line was temporarily interrupted. In the Chicago board that was not the case, and in that sense the Chicago one cord board is not strictly speaking a one cord board. It has the one cord feature, which is the primary feature of the board, but we also have enough double cords overhead to relieve that one cord when it becomes out of order, and we have never had any difficulty. It is a very simple thing for the operator to discover when the cord is broken; if so the cord can be tied in a knot and the operator use the overhead cord. We never considered that the one cord board without a few overhead cords was a good thing. Answering is done by the insertion of a plug in the spring jack. We considered the spring jack the best thing that we had at that time. When we could substitute a spring

(*Continued on page 157*)

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

John I. Beggs, President of the Association of Edison Illuminating Companies, with Portrait 149
Chicago Edison Company 149, 150
Plant of the Minneapolis Light & Power Company. Illustrated 150
Edison Plant on the Baltimore. Illustrated 151, 152
Convention of Edison Companies at Minneapolis 151
Electric Tower at the Minneapolis Exposition. Illustrated 151
The Improved Schoop Accumulator. Illustrated 151, 152
The Convention of the National Telephone Exchange Association.
- Members and Visitors 153
- Secretary's Report 154
- Treasurer's Report 154
- President's Address 155
- Election of Officers 155
- Operation of the Double Key Board at Brooklyn, N. Y. By George J. Davison, and Discussion 154, 155, 157
- Editorial 156
- Corporate Organization. By Edward J. Hall, Jr. Illustrated, and Discussion 157, 158, 159
- Place of Meeting 159
- The Housing and Care of Central Office Apparatus By W. R. Patterson, and Discussion 159, 160, 161
- Some General Remarks on Telephone Exchange Construction and Equipment. By F. A. Pickernell, and Discussion 160, 161
- Bridging Bells. By J. J. Carty, and Discussion. Illustrated 161, 162, 163
- Operating Transmitters by Edison Current 163

Electrical Patents 164

THE present number of the WESTERN ELECTRICIAN is published earlier than the date which it bears in order that copies of the issue may be in the hands of the attendants at the annual convention of the Association of Edison Illuminating companies of Minneapolis, September 16. Considerable matter of special interest, we think, to those who will be present at that convention, will be found in this number. The programme of the meeting as far as arranged is presented elsewhere. There is every reason to believe that the convention will be highly interesting to those who will be fortunate enough to be present.

COL. R. C. CLOWRY, Chicago, has been chosen chairman of the committee of directors of the World's Fair having charge of the electrical department. The selection will be approved by the electrical fraternity at large.

A STENOGRAPHIC report of the Detroit convention of the National Telephone Exchange Association appears in this issue.

THE next convention of the National Telephone Exchange Association will be held at New Orleans, probably in December, 1891.

THE National Telephone Exchange association held its annual convention at Detroit last week and a full report of the meeting is presented in this issue. The meeting was one of great interest to the delegates and as will be noticed, the discussions were more general than usual. The Detroit company, the host of the occasion, entertained the visitors with lavish hospitality and made their stay in Detroit thoroughly enjoyable.

THE London *Electrical Review* in a recent issue gravely informs us that "during the recent hot weather in America motors have been largely used for propelling fans." As the item quoted was run under a special head it is to be presumed that our English contemporary labored under the impression that it was giving to the world an item of news. It might also have been stated as an item of equal novelty that a great deal of sewing at the present time is done on machines in America.

IF the matter of the World's Fair comes before the convention of Edison Illuminating companies at Minneapolis we trust the organization will give its unqualified indorsement to the project and take action with a view to co-operating with the authorities of the World's Columbian Exposition. That the Edison exhibit will be one of the chief features of interest at the great exposition, goes without saying; but it would be a thoroughly proper thing for the organization to express its sympathy with the World's Fair.

THERE were several interesting facts presented in the reports of officers of the Telephone association, and not the least important referred to was the question of membership, and the fact that many of the members did not appear to realize the importance of keeping up the interest in the association. The president, in his annual address, stated that papers to be read before the convention could only be secured upon personal solicitation by the officers. In some cases, at least, this may be explained by dissatisfaction on the part of the members with the action in regard to papers and discussion taken last year. This, however, should not be allowed to threaten the progress of the association. The necessity of a representative telephone body is apparent, and managers of exchanges throughout the country should realize the fact that in supporting the telephone association they are not only sustaining an educational body, but are providing themselves with an organization for the protection and defense of their own interests.

THE two papers at the Telephone convention which provoked perhaps the most extended discussion were those by W. R. Patterson and F. A. Pickernell. The former considered the subject of "The Housing and Care of Central Office Apparatus," and the latter presented "Some General Remarks on Telephone Exchange, Construction and Equipment." Both papers were thoroughly practical, as was to be expected. The one point which especially aroused the interest of the telephone men was the location of the operating room in an exchange. Mr. Patterson suggested that the second floor might perhaps be found well adapted to this purpose. The top floor was ordinarily used and this, he said, was the natural location when aerial lines prevailed. To-day, however, when cables are used to such an extent the decrease in their length was extremely desirable; therefore a plan by which they could be terminated at the second floor might under certain conditions be found advantageous. According to Mr. Pickernell the operating room should be located as it ordinarily is, upon the top floor. There are many points which enter into the determination of the question, in addition to the matter of cables, such as light, ventilation, freedom from dust and smoke, decreased liability to interruption of operators, etc. These topics were touched upon at considerable length, and those contemplating the construction of a new exchange or the reorganization of an old one will find many a practical point which will be of assistance to them in their plans.

THE operation of the double cord key-board at Brooklyn, N. Y., and a record of the troubles and complaints experienced were discussed in a paper by George J. Davison, read before the Telephone association. As compared with the record of the exchange operating under the single cord, the new system has many points to commend itself. Mr. Davison says: "When it is further considered that about 40 per cent. of the troubles in the single cord key-board interfered with the subscribers' conversation, and that not one of the double cord troubles interfered in this way, the contrast is great. Add to this, too, the great difference in the ease with which repairs may be made to the double cord system, and that the making of such repairs need not interfere with the operator's efficiency nor with any subscriber's line, it seems to me there can be but one conclusion arrived at." In the discussion the comparative merits of the single and double cord were considered at considerable length. It was stated by one of the gentlemen that Mr. Davison's unqualified indorsement of this double cord system was, as contrasted with the single cord method, scarcely fair, inasmuch as the switch-board built on the latter principle was crude in its construction; a fair comparison could be instituted only between switch-boards embodying the very latest ideas.

IT will be observed that much attention was devoted to the consideration of the organization and management of companies as well as the details of the construction and operation of exchanges at the Telephone convention. Mr. Hall's paper contained many suggestions that will commend themselves to the consideration of managers of exchanges. The plan favors maintaining discipline which should certainly be a feature in the management of every exchange.

One paragraph from Mr. Hall's paper will bear repetition here. Speaking of a general manager's work, he says: "It is often so much easier to do personally than it is to teach others, that we fall, often insensibly, into the error of doing routine work which others can do as well or better; and having filled our day with arduous labor, go home at night tired but satisfied that the day has been well spent, when, as a matter of fact, we have performed the work of a junior clerk, while the interests committed to our charge have suffered in all directions from neglect."

One might preach a sermon to the managers of electric companies with the above paragraph as a text. Who has not seen that executive officer who, after having engaged a staff of competent men, was continually shouldering their respective responsibilities and attempting personally to perform their duties, or at least a part of them? What can be more discouraging to an electrical engineer in charge, or what can have a greater tendency to lower his self-respect than the continual meddling of an electrically inexperienced manager? We once overheard a successful manager of men give his opinion on this subject. His words were to the effect that the one way to get the best work from men was to make them feel a personal and individual responsibility. Take this responsibility away from your lieutenant, and you not only destroy his ambition but increase your own labors. A general manager, as Mr. Hall says, should exercise a veto power, but it should not be forgotten that his under officers are appointed to share the general responsibility. It may be added that in our opinion more trouble arises in the management of a concern from a failure to carry out this principle laid out by Mr. Hall in his diagrammatic representation of an "artificial person," than from almost any other cause.

(*Continued from page* 155.)

jack for a cam lever key we did so. Aside from our dirty spring jacks we had less trouble in proportion to the size of that switch board than any board I have known anything about in the country, but when we undertook to change our system to metallic circuits we considered the same features that we did when we put in the one cord switch board We found that the one cord metallic circuit switch-board had more contacts in it than the two cord system which we adopted. From experience we have formed a prejudice against cam lever keys,and we don't propose to use any. We have a new key that goes into the board like a spring jack. It has all the features of a spring jack in it. We have had those keys in operation now for over six months, and never had a single case of trouble with them. We had the Thirty-eighth street system in operation alongside of the system which we have adopted, and we think that our experience is positive enough to warrant us in adopting what we call the Chicago system.

MR. LOCKWOOD: In addition to the present inapplicability of the single cord, it seems to me that there is one other consideration which Mr. Wilson hinted at when he said that if a cord gives out it could be tied in a knot and left out of use for the time, the operator using the overhead cord. It appears then that the most fragile part of their circuit with single cord board, is a portion of every line, while it is only a series of links in the double cord switch board. That fact of itself seems to me to be a consideration which should weigh very heavily with all in regarding the matter. There is also a word about the location of exchanges on the Eastern seaboard that I could mention. One of the greatest troubles is the moist and saline condition of the atmosphere, which of course brings in quite a different class of trouble than the carbonaceous trouble in Western cities where they burn soft coal. That material what seems to interpose itself in the contact system in the Western cities is carbon that floats in the atmosphere. It was my fortune to be able to prove that in a remarkable way at one time. I had to stop over some hours at a little station on the Erie railway, and I went into the telephone office. In the course of some conversation with the operator he said there was one line that wouldn't work. I looked at it, and I loosened the spring jack down a little, and I found I could actually use it as a transmitter, there was so much carbon between the points.

Now, I have found another trouble with spring jacks. Some months ago I had occasion to spend a couple of days in Albany, and I found that one of the spring jack troubles there was not the result of dirt or carbon between the points. It has struck me that perhaps some of the troubles which have been ascribed to the dirt are really due to the trouble they had in that city. In that case the insulated contact screw in the lower part of the jack had been made with such a sharp point that it made a dent in the screw in the spring above. By and by that depression was made so deep that when the foot was taken out it was all that the spring could do to make contact with the screw point. The occurrence of this fault of course depends largely upon the material used, and in this case I may say that the material was not brass, but German silver. As there are different grades of German silver, of course we should be careful and get the proper grade.

THE PRESIDENT: Referring to Mr. Wilson's question, I would remark that I think the troubles referred to are those experienced in connecting the wires with the subscribers. There is a rigid system of inspection at regular intervals, with all parts of the apparatus in Brooklyn. In regard to the change from single to double cord switch-boards, the substitution was made not on account of the large amount of trouble, but because the single cord was not adapted to the mixed system of metallic and grounded wires. The present key-board was put in to accommodate that system. Our metallic system was increasing very largely. I will say that I introduced these papers for the very purpose of contrasting the two systems, and to bring out the faults that they may have. The key board is the most important part of the switch-board. It is a part that is in coastant use and wear. It needs constant watching, and requires renewal very frequently.

In regard to the dirt between the contacts I have no doubt that climatic conditions do affect the spring jacks to a very great degree, so that different cities will experience different results with the same apparatus. I think also that it is better in all large central offices to have a hard wood floor. It can be more easily kept clean. I think it is much better than a carpet or even linoleum, because there is less chance for dust to accumulate. We have never had a carpet or rug in our operating rooms.

The opinion we have formed by the trial of the two key-boards is, that taking into consideration all the conditions of the business, the double cord system is essentially the best. With single cord system, doing the best you can it is so crowded and troubles that occur in the midst of busy hours are very difficult to remedy. That fact alone is enough to condemn it. Mr. Wilson's recommendation of the single cord board reminds one of the cripple who had become very expert with his crutches, which in this case are the double cords used when the single cord failed; but no cripple would be willing to continue the use of his crutches if he could use his legs. I do not think anybody wants to use a single cord board if he must have a double auxiliary key-board to keep it on its legs.

MR. WILSON: I don't entirely agree with President Sargent that the single cord board is to be considered in the light of a cripple, although it may be so in the light of metallic circuits. The advantages we saw in favor of the single cord system are just as apparent to-day as they ever were. In the first place, you have half the number of cords in use. Instead of using two cords to make connections we use one. In a case of cord trouble, we know exactly where to find the cord, which you don't know in the case of a two cord board. If you have a defective cord, and it is not sufficiently defective so that the operator discovers it when she rings, that interruption will pass around over half a dozen or perhaps 20 subscribers before it is discovered. You get a complaint of cutting off and unsatisfactory service, and you know from the nature of the complaint that the trouble is in the cord. You get the number of subscribers that are connected in the particular complaint, and you know then which group of cords was used, and you examine them and see if you can find the trouble. But you may not be able to find it, especially if you use tinsel cord. Now, with the one cord system if you get a complaint of that kind we cut the cord off and repair it, whether we find the trouble or not, and in nine cases out of ten if an examination is made carefully, the trouble is found. But I do not want to be understood as advocating the one cord system for metallic circuits. If I were going to equip a new office, which I am doing all the time in our small exchanges, why, I would use the one cord system. We use the one cord system altogether for metallic circuits in small exchanges where we do not have multiple switch-boards. The advantages are that we equip those switch-boards just as we add subscribers. For instance, we have a small exchange with 10 to 15 subscribers. We add the complete equipment for each additional subscriber. If the cord becomes defective in those switch-boards we simply use the cord of the other subscriber—and we have the same advantage as we have in our main office with the two cord auxiliary used in emergencies. We are increasing the number of our private exchanges in Chicago rapidly—that is, a sort of combination of speaking tubes and exchange service—and we use what we call the single cord system. Every subscriber's line has a cord. It is double cord in the sense that it is arranged for metallic circuits but the two cords are under one cover and have only one plug; and we think we can see advantages in it. It is the cleanest and nicest equipment that we have and is without cam lever keys, or anything of that sort, and wherever we have those small switch-boards in operation they give complete satisfaction.

In case some gentleman here may not understand what I mean by private exchanges, I will say that we have quite a number of subscribers—like, for instance, the Illinois Steel company, which has its general office in Chicago with about twenty telephones in use. It has three rolling mills in and around the city and they have lines connecting them. We run all those lines into the private exchanges located in company's general office, and we give them three trunk lines from that switch board into our office. We call that a private exchange. We make them a special rate of course for service, and then the telephones in their general office are connected up in such a way that they have what we call speaking tube service. That is, they don't have to call their operator to get that service. We are putting in quite a good many of such outfits. Armour & Co,. have one like that. The Milwaukee & St. Paul Railroad company has one, and we are now connecting the Wisconsin Central Railroad main office with all the branch offices in the city. The subscriber in such cases becomes the company's agent in the transaction of that business, and the deduction they get in rates is the compensation we pay them for handling the work. They pay regular rates for everything, and we pay them so much for operating the private exchanges. In all those places we use the one cord system, and prefer it to the two cord system. If I were going to equip a large exchange with metallic circuits I would use the two cord system.

The convention adjourned to 2 P. M.

AFTERNOON SESSION.

At the afternoon session the following paper was read by E. J. Hall, Jr.

CORPORATE ORGANIZATION.

BY EDWARD J. HALL, JR.

Corporations have been called "artificial persons," owing their existence to the creative power of the state, and designed by process of law with more or less skill to approximate natural persons in their powers and duties.

When the legislative powers are exercised wisely and skilfully and these artificial persons have been properly constructed, they take their place in society as most useful members, serving the needs of the public in many ways with far greater efficiency and reliability than any natural persons possibly could; for while it may be true that corporations have no souls, it is equally true that they are not subject to paralysis or indigestion.

On the other hand, their design being subject to the fancy of legislative bodies, these artificial persons are sometimes over-developed in some directions and lacking in others. The builder who follows the legal specifications often finds that parts essential to some material function are wholly omitted while others are so dwarfed or magnified as to be out of proportion to the symmetry of the intended design.

In the early days of these new members of society the natural persons then composing it had a feeling of, perhaps, not unnatural alarm that if these artificial persons became too big or too numerous they might be troublesome neighbors. What, for instance, if the power which gave them legs and arms should take a notion to add cloven feet, horns and tail.

This has, from time to time, occasioned the introduction of various restrictions into the specifications, some of them doubtless wise, others unquestionably unwise; but with a realization of the fact that society had not lost, and could not lose, the power to protect itself, has come to it a better understanding of the benefits to be derived from properly constructed corporations and a disposition to formulate the specifications so that their construction shall be encouraged and their capacity for work utilized to the fullest extent by society.

The tone of the press during the recent labor troubles on the New York Central Railroad reflects a marked change in public sentiment from that existing even a few years ago, and, to some extent, this change is due to a better understanding on the part of corporation managers of the obligations which rest on them to so organize their forces that the public shall be efficiently served, stockholders receive proper returns, and last, but by no means least, that employes shall be justly compensated and fairly treated.

To organize and conduct a corporation so as to fully meet all these obligations, is no easy task. In my own work I have been greatly helped by making diagrams of any proposed arrangement of forces, for the purpose of studying from that the exact relations which would exist between various departments and employes if the plan were carried into effect.

Almost invariably the study of a diagram brings out unexpected defects of arrangement or suggests changes which would improve the efficiency of the force. President Sargent has asked me to explain this diagram system, and I am glad to comply with his request, because I believe there is for us no more vital problem than the best method of constructing the "artificial persons" who are furnishing the public with its telephone service but for whose actions we are all largely responsible.

I do not see why we should not go at this just as we would at the construction of any piece of mechanism. Surely it is more complicated and more delicate than any of our electrical apparatus, and, at the same time, its motions are attended with such consequences that we can not afford to make any mistake.

When we undertake to prepare plans and specifications for the construction of an "artificial person" to conduct the business of a telephone exchange we must look, first, to the statutes of the state, in which we will find the legal specifications. From them are prepared the charter, articles of incorporation, which, in a general way, define the nature of the proposed corporation and the position which it desires to occupy in relation to the state, while the by-laws, which are to some extent controlled by statute, provide, generally, for the relations of the corporation with its stockholders.

By the articles of incorporation and the by-laws provision is made for the control of the corporation by trustees or directors elected by the stockholders, and by certain officers, usually a president, secretary and treasurer, elected either by the stockholders or by the directors These officers are common to all corporations, and are charged with certain duties by the state and the by-laws.

It would be interesting to go more fully into the relations thus established between the new corporation, the state which gives it being and the stockholders who risk their fortunes on its success. We will not, however, stop to do so now, because we are considering to-day only the executive forces, the physical structure of our "artificial persons." The functions of the officers named will be considered only as they relate to the performance of the work for which the forces are to be organized.

The unit of work, that is, the amount which can be performed by one person, is very small, so we must subdivide until each part of our work receives its proper share of attention. but, as all of the parts are inter-related, it is evident that there must be somewhere a single central authority, or the division means chaos. From this central authority there must be a direct line of communication to every department and every employe; no matter how many departments or employes there may be, this line must be kept in good working order, free at all times from breaks and crosses.

To carry our simile of the artificial person a little further: When in a natural person the stomach wires the brain for supplies, the feet must receive orders to move toward them, first one, then the other; they cannot be left to argue between themselves as to which shall move first; then the hands must do their work and, at the right moment, the mouth must be ready to do its part, and so each member performs its office as the orders are sent over the connecting lines, and reports from each keep the brain constantly advised of the manner in which its instructions are being carried out.

To construct a diagram of these lines of communication will help us to see how best to arrange the various parts of our artificial person to secure exact results.

For convenience we will call this main line the "Line of Authority," and extend it unbroken from the management to each employe. Other lines there may be and must be to unite all the parts of our mechanism into a complete working body, but they must never be mistaken for or tangled with the line of authority, or confusion will follow.

On the diagram which I have made, we can trace now the line of authority originating with the stockholders, extending to the board of directors, then to the president, then to the general manager, and dividing at that point, branches ex end to each department chief and through him to his subordinate officers, superintendents, managers, foremen and so on until it reaches the last messenger boy.

The general office is particularly the department of the general manager. Its work consists, first, in receiving and recording the orders of the president and directors and transmitting them to the proper persons for execution. With the orders must go the funds and materials for carrying them into effect and the details of the methods to be followed; second, to the general office must come back the reports and results of all work, which must be recorded and transmitted in proper shape to the directors; third, through the general office all arrangements must be made for transfers from one department to another.

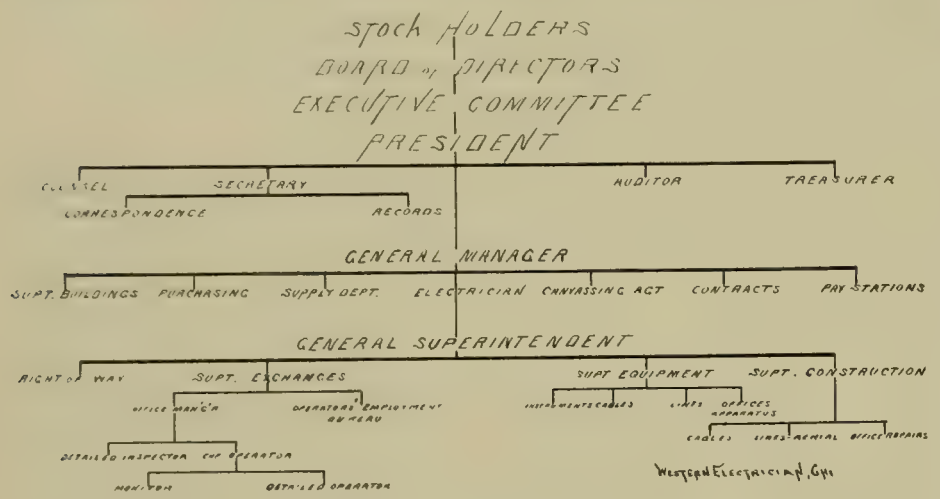
The general manager acts as the connecting link between the authority which shapes the plans and controls the policy of the company and forces which carries those plans into effect. He should be identified as closely as possible with both, and this is often accomplished by making him a member of the board of directors, thus enabling him to fully understand the nature of the results to be accomplished, while, at the same time, his close relations with the working forces enable him to keep the directors fully informed as to the condition of the company's plant and forces, their possibilities and needs for accomplishment of any desired result.

The general manager, as the diagram shows, has no authority over the secretary, treasurer, auditor, or any em-

ployе on the president's line, but such relations as are necessary must be established by order of the directors or the president, unless, as is often the case, the general manager is also vice-president, in which case his relations are established by the latter position.

This distinction is important, and it applies equally in the case of all relations between officers and employes of different grades when one person fills two offices not on the same "line of authority."

The general manager should be responsible for the appointment of all employes on his staff or below it, but it does not by any means follow that he should in person select all individuals for appointment; on the contrary, holding a veto power over all, he should select none but his personal assistants and the heads of the departments. For the same reason which makes it necessary for him to control all appointments, makes it necessary that, following the lines of authority and conversely of responsibility, each



CORPORATE ORGANIZATION.

other officer should, so far as possible, hire and discharge all for whose efficiency he is immediately responsible.

Just here I want to point out the error which all of us who have charge of a number of men are apt to make—that is, of doing too much detail work, too much work, I was about to say; but it is the quality not the quantity generally at fault. It is often so much easier to do personally than it is to teach others that we fall often insensibly into the error of doing routine work which others can do as well or better; and having filled our day with arduous labor, go home at night tired but satisfied that the day has been well spent, when, as a matter of fact, we have perhaps lost sight of our duty to keep track of and direct the work of others, and have performed the work of a junior clerk while the interests committed to our charge have suffered in all directions from neglect.

The functions of the construction and operating departments with their various subdivisions are so well understood by all that it is unnecessary to go into details, and we will follow quickly along the line of authority through the office of the general superintendent to the linemen on one side and on the other to the operator and messengers.

Now to pass on one point of the diagram to another we must follow back and around on the established lines. There must be no cross lines of authority established, or immediately there is a division of responsibility. This does not mean that there are to be no direct relations between officers and departments except over the route of lines of authority. On the contrary, as I have already said, there must be almost innumerable "lines of relation." These lines may be established in two ways: First, by order of some common superior authority, and second, by an understanding between the employes concerned.

For instance, by order of the president, the treasurer might be authorized to use office managers to collect certain accounts or pay certain bills. The treasurer would then have a line of direct relation established with each office manager, but the authority would originate with the president, and his order would pass through the hands of the general manager, general superintendent and superintendent of exchanges to the office managers. Authority given to the treasurer to employ the managers would always be given with the tacit or expressed understanding that the regular duties of the employe called on should not be interfered with, and that the employe's first duty was in every case to his immediate superior.

As an instance of the second sort, it might be arranged between the construction department and the equipment department that one would do certain things in connection with the other's work; for example, that the equipment department would hang a cable which the construction department was responsible for hanging. The test of this transaction would come in case of failure to carry out this understanding. Would it be any excuse for the superintendent of construction to say that the superintendent of equipment had promised to hang the cable, and had failed to do it? Clearly not. The diagram shows how such an arrangement could have been made by authority He took the chances of an arrangement under which he had no control over the other party, and he accepted all the responsibility.

In a bad organization this constant shifting of responsibility is always found, and the blame should be with the organizers rather than with the employes, who are probably doing the best they can with the faulty system.

Another fault always found in a bad organization is a defective method of giving orders. Sometimes an organization that otherwise would be good is demoralized in its work by a careless habit of giving vague verbal orders, a practice sure to result in confusion.

Whenever practicable, orders should be given in writing. They should be brief and clear, and whatever is to be left to the discretion of a person carrying out an order should, if possible, be so stated. Advice and suggestions may be verbal, and often are better so. When an order is accompanied by advice or suggestions as to methods, care should be taken to so separate the order and the suggestions that there may be no misunderstanding.

When verbal orders of any importance are received by any employe, he should take the earliest opportunity to reduce them to writing and send an acknowledgment of them, explaining his understanding of their nature to the officer from whom they were received.

The chart which I have made shows substantially the general organization of a large company, but one which operates a comparatively small territory. Of course chart prepared for one telephone company or exchange would not be suitable for all others, or perhaps for any other; but there are certain functions which are common to all, and modifications can easily be made to fit all conditions.

The key note of all successful organizations is sounded in the Bible words—"No man can serve two masters." In the abstract we doubtless all agree with this, but in practice we often make discord instead of harmony among the delicate strings which bind our forces together. It is easy to say that we all arrange our forces so that no man shall serve two masters, but it is far from easy to do it. Especially is it difficult in a small company where the number of men must necessarily be limited, but where the manifold duties of the service must still all be performed. Even in the larger organizations it is far easier to cross and tangle the lines than it is to keep them straight. The diagram system will aid the manager of a small company to arrange his men to advantage, while to the manager of a large company it will act like the "deadly parallel column" in the newspaper, pointing out all inconsistencies between theory and practice.

Our work of organization and administration is, under the most favorable conditions, perplexing and difficult. Lines must be built, offices equipped, apparatus designed and constructed, records kept, rights of way obtained, reports made, supplies purchased and taken care of, problems, legal, financial, scientific and practical, solved, and withal we must reckon with human nature in all its varied forms. Each unit of the vast aggregation must be placed where it will be most beneficial to the whole, and yet each be so dealt with that personal pride and self-interest shall be considered, faithful service and capacity duly rewarded, the ignorant educated, the idle punished, the vicious and incapable eliminated, and over all strict discipline, tempered with sympathy and kindness, maintained. Only a thorough organization, wisely administered, can accomplish all this. Without organization the ablest will fail, and with it the best will often fall far short of their ideal.

When we have constructed our "artificial person" from drawings which clearly show the location and relations of all the parts, and from specifications which define in exact language the function of each, it may still lack much of the perfection of the natural person, but I am sure it will do its work far more efficiently and with vastly less disturbance than if it be simply an aggregation of unrelated parts tangled together by the old-fashioned "rule-of thumb" method.

The Discussion.

MR. HALL: While this diagram is applicable to the general organization of a company, I will ask Mr. Carty, who is interested in this plan, to explain a diagram showing how he, in following out this line of thought, has organized the department for which he is responsible in his own company. Starting in, as you see, at the "Superintendent of Equipment," in the general scheme, he has arranged a diagram of the force which he has under his control.

MR. CARTY: This diagram on the wall represents one of the departments of the Metropolitan Telephone company. The superintendent of equipment is responsible for the condition of the plant. Any trouble with the wires, cables or apparatus in a subscriber's office, or in a central office, comes here. This is the chief indicator here (indicating) and he has under him first, a foreman inspector who gives out the daily work to the inspectors who visit the subscribers' stations. The duty of an inspector is to go to a station and see that it is in order, make a note of what condition he finds it in, and of what he has done, and hand to the subscriber a printed slip, which has on it a request for the latter to inscribe on the back any fault he may have to find.

This foreman inspector has a large detail of men under him, and he is responsible for seeing that his men do their work properly.

For taking care of the trouble there is located at each of the various offices what is called a "wire chief." For instance, at Cortland street, we have a man who sits at a desk called the "trouble desk," and who has all the necessary apparatus for locating the trouble. If the trouble at any one of the several stations becomes greater than the ordinary staff can properly take care of, the wire chief at that station communicates with the chief inspector, and the detail is increased, or, on the contrary, if the work is well up at that point, the fact is reported and the men are transferred elsewhere. The chief wireman, who receives from the general superintendent the order to put in an instrument for a new subscriber, gives it to his foreman, and the job is assigned to a particular workman. The chief wireman also sees that the line is cut in at the cable terminal and at the subscriber's station. The task of getting the line working is, therefore, in the hands of one man. When the line is connected up in working order, the chief lineman sends the order back through the superintendent of equipment to the general superintendent, and a record of it is made on the books. When a new subscriber is put in at Thirty-eighth street, the representative of the equipment department there has the receipt for everything furnished that subscriber. At Thirty-eighth street, therefore, there is a complete record of all the terminals ending there and all the subscribers, and no change can take place without the supervision of the Thirty-eighth street wire chief. A similar record is kept at each of the branch offices, and a record of the entire city is kept by the superintendent of equipment.

This scheme is not thoroughly completed in New York, but as far as we have gone it has been of the very greatest assistance. It completely divorces from the operating department all responsibility for the plant. If trouble should occur in a subscriber's office in the Thirty-eighth street station, a notice of the fact would find its way to the office of the general manager, who would forward it to the representative of the equipment department located at that office, and called the wire chief. Any ordinary trouble would be first known by the superintendent of equipment by a notice that it had been attended to. An arrangement of this kind enables you to keep records of trouble and compare one office with another, and make important savings in the number of men at each office.

MR. BARTON: I should understand from this diagram and from what Mr. Carty says, that the chief operator, we will say, of the Spring street exchange, would have charge of the operating force—that is, of the operators who answer the subscribers' calls for connections—but that the chief operator and the operators themselves are not in this organization at all.

MR. CARTY: They are quite separate.

MR. BARTON: They are in another department?

MR. CARTY: Yes, sir.

MR. BARTON: Then at the Spring street exchange there is a chief operator and a wire chief; one has authority over the operators, and the other has authority and control over the apparatus, and they give information from

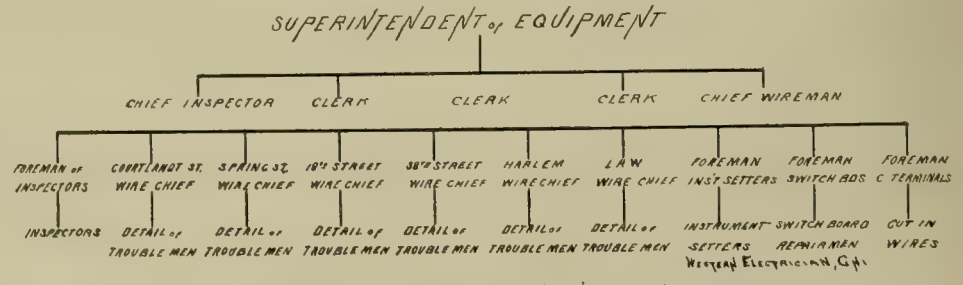


DIAGRAM ACCOMPANYING MR. CARTY'S REMARKS.

one to the other, but there is no authority passing from one to the other.

MR. CARTY: There is simply a line of communication between the two. The manager of the office or the chief operator is responsible for the service of that office, and if there is any fault with the equipment department, it is his duty to get it on record; but the responsibility of the plant rests with the superintendent of equipment, and is accordingly a separate matter from that of operating the switchboard.

MR. HALL: I think perhaps I could go a little further by reference to the original diagram. Mr. Carty has taken the diagram at this point [Superintendent of Equipment] and has shown what is done by the special division of force under his charge. Now, the central thought of all that is this: That in that company one man is responsible for the condition of the line and switch-board in the company;

there is one man responsible for the physical condition of the property, who has no relation with the operators or with the operating device. He is, however, responsible for seeing that the operators and the subscribers are furnished suitable apparatus, and apparatus properly taken care of. That division simplifies the problem as to who is responsible for any fault in the service. If the fault is one of apparatus or maintenance then the superintendent of equipment is to blame. He has nothing to do with the construction of that plant, and he has nothing to do with the operation of it. The question might then be raised that if he has nothing to do with the construction, it might not be properly built. That is possible, but his skirts are entirely clear, because all he has to do is to report to the general superintendent that, owing to a certain construction, it is not possible for him to keep the system in proper order. Then he is relieved from blame. The general superintendent may refer the matter to the general manager. It may or may not be possible to correct it. If it cannot be corrected then the superintendent of equipment simply does the best he can with what is furnished him. If it can be relieved, then it becomes a question for superior authority to give proper instruction over here (indicating.) In each of these offices are "detailed operators," and under the office manager's are "detailed inspectors." That means that while these men are under the office manager, he does not employ them. They are simply placed there for the purpose of receiving information as to what is to be done in their work. To illustrate: If a subscriber in the Harlem office is in trouble, the proper place for that information to go is to the superintendent of equipment, because he is responsible for it. His office is at Cortland street. Now, it would not be reasonable for him to send a man away up to Harlem to remedy the fault. So, as a matter of convenience, this superintendent details a certain number of men to receive their instructions from the office of the manager at Harlem. The manager of the office at Harlem simply informs those men that line so and so is in trouble, and his duties are ended when he has given them that information. The men go out, and if the man who is sent to fix it cannot do so he reports back, not to the office manager, but to his superior, the superintendent of equipment, as to what is to be done. The latter gets information how it is to be fixed. Thus in the office of the superintendent of equipment there is a complete record kept, and it comes down to this, that I should expect Mr. Carty to be able to say at a moment's notice exactly what the history had been of any instrument in his company for any period of time under which he had had the system in operation; his records would show precisely all that had been done by every man in every department under his charge. If he has 10,000 or 15,000 stations to look after, he must have a complete system of doing it, because he cannot have personal knowledge; he must depend upon his records, and the only way is for the reports to come right back to him.

MR. GIFFORD: Your superintendent of equipment does not undertake to build anything. He simply undertakes to take care of it.

MR. HALL: Yes, sir; and that brings up another thing. Written specifications should be made out defining precisely what the superintendent of equipment is to do.

Then there is another point about this. The forms and blanks in use are sometim s defective. Now, we had in one company an expert go through the whole organization from the subscriber's order up to the rendering of the treasurer's bill. He determined first whether the books of the company were in such shape as should be required; whether each man knew exactly what he had to do and whether he was supplied with records to keep account of things. And I think we can say that a proper organization does not mean red tape and complications, but it means simplification. I have found that in most companies there is a vast amount of duplication and unnecessary routine. The fault does not lie in having too little, but in having too much. Now, our expert was an accountant and familiar with the general system of laying out a company. Instead of undertaking to take the blanks and forms of the company and determine which should be dropped and which continued, we simply closed the book and started out with what we thought ought to exist; we cut off here and added there until what had existed was brought into line, and we made the books fit the business. If you undertake to straighten out a company by fitting out what they have got you will never succeed. The only way to do is to start and organize as if you were beginning a new concern, and then if what you have already corresponds to that, why all right; if something is unnecessary, omit it The expert started first at the "contract department," and a form of contract was prepared. Then the question of the kind of books the contract man should keep was taken up and settled. Then it was determined that the proper place where the contract should go would be to the general manager, and he accepts it on behalf of the company by placing his signature upon it. Then there is the line to build, the telephone to put in, and so forth. The general manager sends the order to the general superintendent to build the line—and that is a matter, as to how he shall build it, of internal arrangement. The superintendent of equipment has charge of the building of the line, and finally the subscriber gets his telephone service. Then all that detail is reported to the proper officers back to the general superintendent and to the general manager.

MR. EASTABROOK: As the long distance company is beginning to touch the different companies, and the further they go the more the complication increases, the matter of tolls, rates and the prorating of toll rates is becoming a very important subject. Where would you locate that, on what level and how would you reach it—under the general manager's department, or through the auditor?

MR. HALL: My idea would be that it should go to the general manager.

MR. LOCKWOOD: This matter of proper authority and the proper delegation of authority is one of great consequence. Prior to my present employment I was for six or seven years with different electrical companies, and I think I may say that there was but one of them which was properly organized. Where there is defective organization there will always be conflict of authority. The company I refer to was the American District Telegraph company of New York. It started out under the superintendence of Mr. Shawness, and then William H. Sawyer was the second general superintendent and he was followed by Mr. Durant, now of St. Louis, and H. W. Pope; but it was under Mr. Pope that the organization was perfected. The conflict of authority was fatal to good work. Where every man's position is strictly defined he knows he cannot tread upon anybody's toes. Following out the line that Mr. Hall referred to last, it has often come to my knowledge that a president or general manager, ignoring all intermediate channels, will meet some office manager or some lineman, perhaps, and will say, "Such a line is out of order, why don't you fix it?" or will give absolute orders, and the office manager or the lineman is bound of course to carry out those instructions; but frequently if he does so, and if he doesn't carry the information on the back track to his intermediate superior, there will be at once hard feelings generated on the part of those men, who, quite unwarrantably, will assume that this man had no business to carry out orders unless they were given through the proper channels. It would also be a pleasant thing for this subordinate to say to the president, "I will do so and so, and I shall also speak to my general superintendent about it." By so doing he will convey a delicate lesson, and not cause any hard feeling, and ten to one the president who gives him the order will say, "Certainly, I wish you to do it, but I wish you to do it in the right way."

On motion the convention adjourned until Wednesday at 10 A. M.

Wednesday's Proceedings.

After the convention had been called to order Wednesday morning the question of selecting a city as the next place of meeting was taken up.

PLACE OF MEETING.

MR. CRANDALL: I believe it was generally understood at our last meeting in Minneapolis that New Orleans would be selected at this meeting for 1891. I hope there has been no change in the opinion of the members since then, as I can assure you that we all heartily desire to have this association meet there next year

E. J. HALL: You will recollect that last year Buffalo put in a bid for this convention which was afterward withdrawn in favor of Detroit. I rise to state that that invitation is still open.

It was voted that the invitation from New Orleans be accepted, and that the time for the meeting be fixed by the executive committee.

W. R. Patterson of Chicago, read the following paper:

THE HOUSING AND CARE OF CENTRAL OFFICE APPARATUS.

BY W. R. PATTERSON.

The cost of the apparatus in a large central office is often greater than the cost of the building which contains it; at the least it is equal to a very considerable fraction of the cost of the building.

In renting an operating room for a short term there may be some excuse for taking things as they are found and working the exchange at a disadvantage in some particulars; but when a special building is to be erected, nominally as a telephone exchange building, it must be something more than an office building with the most undesirable part grudgingly spared for an operating room. An outside income from rental of offices and stores is a good thing, unless it is secured at the expense of the legitimate business of the company. The switching apparatus of an exchange system is not a lot of separate instruments, like the outfit of a telegraph office, but it is a complex entity which requires weeks or months to put in position, and the parts of which are not easily renewable or accessible. Therefore, in planning the construction of a building the fact must not be lost sight of that it is a telephone building, and that its purpose is to protect the central office apparatus and facilitate economical and satisfactory service.

In planning a new building the company's electrician is to be consulted before the architect. The electrician's duty is to plan a switch-board room with reference to the best possible arrangement of the board and all the apparatus connected therewith, having as the only limitation the size and shape of the building lot. The process of evolution of the building must be: First, switch-board with its accessories; second, the finished rooms to contain them; third, the building of which these rooms form a part. At the third stage, and not till then, except as a consulting engineer, should the architect be called in. Give him the building lot and the finished operating room and its complete equipment as his limitations, and then let him do the best he can with the building.

As to the location of the operating room in the building, precedent is for the top floor. When all the wires were on poles and housetops, the most convenient place for the switch-board was at the top of the building. The use of underground wires is almost universal, at least for leading in from neighboring poles, and this would suggest that a more advantageous place might be found in the lower part of the building. It is impracticable to lay down any hard and fast law, but it would seem that the use of the first or second floor for an operating room was worth considering. Financially, the problem is whether the rental value of the top story, plus the rental value of the space occupied in each story by the cables leading in, plus the interest and depreciation on such cables, is greater or less than the rental value of the first or second floor. In case of a building covering an entire lot the advantages of an operating room on a lower floor are not so obvious, but in a large building where an interior or rear court is left for light, the operating room may economically be placed on the second floor; building up the court two stories instead of one and using the rear of the basement and first floors for storage, so that, for example, the room taken for the exchange room would be in the rear of the second story as against the whole of the top story. Of course, this is only an illustration of what might be done in one case.

Electrically, everything is in favor of an operating room near the ground when, as is the general practice, underground cables are used. One or two hundred feet of cable made a permanent part of every circuit is in itself of no importance; but in large cities the amount of cable absolutely required elsewhere, and the possibilities of long distance work with connections into and through other cities, make it important to cut the amount of cable down to what must be used

All these things, and many others which local conditions impose, being considered and the operating room planned and the position in the building determined, the next points for consideration are: Getting the switch-board and other apparatus into the room; connecting the switch-board with the underground conduits; heating, lighting and ventilating the operating room, and protecting it and its contents from fire.

Providing means for getting in and out with apparatus must be considered. In making plans the best way is to project into space the switch-board, then project around it an operating room, and then fill in the rest with the best arrangement of rooms and offices. But in building, the process must be reversed, first, the building, then finish the operating room, and last of all put in the furniture.

Dragging switch-board sections into an unfinished building through a window or a hole left in the wall is poor policy. While the ultimate end of any machine is the junk shop, a piece of work like a switch-board makes more progress toward that end in a few weeks in an unfinished building than in years of service.

Provisions must be made for getting cables from the street conduit to the switch-board. The position of the building relative to the conduit, and the number of cables to be accommodated, will determine the best way of getting from the conduit into the building. In general, a tunnel accessible throughout its whole length is best. If the cables are to be taken up through the building to an operating room on the top floor, there are several ways of getting them there. One is through ducts built in the wall; another through pipes fastened to the walls, either inside or outside; another is through a shaft or well-hole in which the cables are accessible. Whichever plan is adopted it should be carried out in such a way that cables of as good specifications as the regular underground cables can be used. In general, the shaft is the best plan, then the pipes on the walls, and least satisfactory the system of small flues in the walls. The shaft is of advantage not only in handling cables but also as a ventilator for the conduit. A good plan for a large exchange to require a hundred or more cables, is a straight tunnel or passage-way through the building from the conduit in the street to a point under the cable terminal room. From the inner end of this tunnel a straight shaft to be carried through the roof with provisions made for clamping the cables upon the sides at short distances, and with a stairway or an elevator in the center; the cables to run continuously from the street to a terminal room adjacent to and practically a part of the switch-board room. If the operating room is on the lower floor the large shaft through the roof will be unnecessary, provision being made for a shaft or flue large enough to ventilate the conduit, either by natural draft or by a fan.

Now as to the construction of the operating room itself with reference to lighting, heating, ventilating and fire proofing: First, let us consider the contents of the room. The apparatus therein forms a part of every circuit and every conversation passes through it. The time is rapidly approaching when all the circuits will be metallic—that is, a circuit will be no longer a single wire, but two sides which must be balanced within a very small limit—balanced not only in resistance but in capacity and insulation. Then, there are, in spring-jacks and keys, contact points numbering in the aggregate into the hundreds of thousands, poor contact in any one of which will cause poor service on some line. The surfaces on which the springs and contacts are mounted, and to a greater or less extent the insulating material of the thousands of miles of wire used in connections, are hygroscopic, and the insulation of this part of the circuit rapidly falls with the increase of moisture in suspension in the air. A particle of dust under a contact spring either opens the line entirely or throws in more resistance than the whole circuit should have. The extension of underground telephone circuits, the increase of electric light and motor lines, and the continued demand for better service all require that better work shall be done in the switch-board room than was even suggested a few years ago. This being the case, more thought must be given in the future to the heating, ventilating and care of such a room than they have received in the past. Instead of letting this matter rest and provision be made for heating as a sort of after thought after the building is planned, and no provision made for ventilating except by open windows and doors, it must be one of the first to receive attention. The heating and ventilating of the operating room must be planned together. Windows and doors as a means of ventilation must be ignored and windows only used for light. Heating should be by a system of indirect radiation, and the air must be at all seasons of the year of uniform dryness, and free from dust. The coils for heating the air in the winter may be used for cooling it in the summer, circulating cold water or a freezing mixture through them instead of steam. The electrical and mechanical engineer must furnish the detailed plans and specifications for this work, and the architect must accept them, together with the switch-board room and cable conduit, as the things around which the building is to be erected.

When windows are used for ventilation good service cannot be expected. In a city where soft coal is burned the

soot is a source of high resistance if deposited on the contacts and passing contacts of platinum will not remove it, because the separation of the surfaces is a mechanical one and is not due to surface corrosion. This soot is much worse than street dust since it is adhesive, and the continued closing of contact springs tamps it down on the surface so that only a file or scraper will remove it, on account of its adhesiveness putting contacts vertically will not cure all the trouble, for the reason that the particles of soot will not fall off. Smoke from hard coal is less objectionable, but even this causes corrosion of contact surfaces and renders the use of platinum necessary. Apart from these electrical difficulties caused by dust, its presence, more especially gritty street dust, in the room, causes the rapid wear of cams, plungers, and other parts of the apparatus which require to have a motion which can be affected by friction. A switch-board set so that a draft of smoky or dusty air passes through will arrest a great part of the ponderable particles. The principle of dust arresters used in pipes from sawmills, grinding rooms, and the like, is that the current of dust-laden air has its direction suddenly changed. The inertia of the particles preventing them from changing their direction promptly, they are left, while the air pursues a tortuous course and escapes. The springs and wires act in just this way on a current of air driven through the board. Inclosing the back of the board is good as far as it goes, but it is not enough. It is much easier to keep dirt out of the room than to keep it out of the board when freely admitted into the room.

In cities exposed to frequent fogs, especially along the coast, the insulation of the apparatus will run very low at times, and the deposition of salt on the surfaces makes them more hygroscopic and tends to increase the escape. The only insulating material suitable for most of the switch-board work is vulcanite or hard rubber. This is a vulcanized compound and a continual moistening and drying of the surface results in the oxidation of sulphur to form sulphuric acid. Both these causes result in a permanent lowering of the insulation.

The regulation of the amount of moisture in the air, and its removal above a hurtful limit, has also a direct bearing on the fire-proofing of the board. Of necessity, a great mass of insulated wire must be used to connect key tables and jacks. The spring-jack connections can to a great extent be cabled, and by this means made less inflammable, but the key-board must be wired with loose wires. There is no insulating material available so far that it is both moisture proof and fireproof. Fireproof qualities are generally made secondary to waterproof qualities, and so the under and back sides of the boards are covered with an inflammable mass of paraffine, beeswax or rubber covered wire. If hurtful amounts of moisture can be kept out of the room the problem of fireproofing is solved, because dry cotton or silk can be used for the insulation of the wires. A wire closely covered with dry cotton is as near fireproof as it can be made, and the only objection to be brought against its use is its hygroscopic nature and the consequent low insulation resulting from moisture absorbed from the air.

Precautions having thus been taken to prevent the ingress of dust and moisture with the air, the room should also be constructed with reference to its care and with a view to reducing to a minimum the production of dust and dirt within the room. A tile floor, or, at least, one of well finished hard wood will assist in this, and the janitor must have learned his trade in a picture gallery rather than on a canal boat. Battery and repair rooms must be entirely disconnected from the switch-board and cable rooms and the operators coming in from muddy streets should not go into the switch-board room to reach their dressing room. Dust collecting and producing carpets, rugs and hangings must be omitted from the furniture, and it may be that sometimes the operators will be required to dress in the least dust and lint producing fabrics. Before that time, however, the manufacturers will be expected to produce a cord that will not fray out and add its contribution to the dust.

It may seem that too much importance has been attached to such little things as a regulation of moisture to within a small percentage, and removing dust. But all the precautions advised are no more insignificant than have to be observed in some branches of manufacture, notably the spinning of fine cotton. The telephone itself is made up of little things. The little things in connection with circuit construction, cable work, strong current protectors and line tests, have been worked out to a greater or less extent, and no step has been so small as not to show an improvement in the result. The next advance is to be in the proper care of the switching apparatus, and in the construction of exchange buildings mainly with a view to the protection of the apparatus.

Now, having decided upon the position of the room in the building, your electrical engineer having laid out the best plan of board and cable room, your heating engineer having provided ducts and rooms for admitting and treating the air, you are ready for the architect. You will have projected into space the rooms devoted to exchange work, and the connection of these rooms with the street conduits, and the complete heating and ventilating plant attached. This is turned over to the architect. He may not be able with these limitations to introduce all the artistic features he would desire in the front; he may not be able to plan such desirable suites of offices as he would if left to his own devices; he may not be able to plan stores more desirable to tenants than anything else in the neighborhood; but you will have an exchange room which is not an after-thought, and which is not the leavings of everything else. In such a room the life of the apparatus will be prolonged, and if originally well constructed it can be depended upon to give an unusually good service.

There may be exchanges working under exceptionally favorable conditions of climate and surroundings where all these precautions would seem unnecessary, but none of them are very expensive and none of them could do any harm.

In existing buildings, where the record of troubles shows a preponderance of open contacts and where frequent cleaning of contact points is found necessary, it would undoubtedly pay to introduce the heating and ventilating plan above recommended. An indirect radiation system of heating is fully as cheap as any other, the only additional expense being the running of the apparatus for ventilation when artificial heat is not required. This expense would not be worth considering if all trouble from open and high resistance contacts could be avoided. That it can be there is no reason to doubt. If the dirt is kept out of the room it cannot get into the board, if moisture is kept out of the room it cannot get into the insulation of the wires. Dirt can be kept out of the room and the degree of moisture regulated just as well in a switch-board room as in a theater, library, or spinning room.

F. A Pickernell read the following paper:

Some General Remarks on Telephone Exchange Construction and Equipment.

BY F. A. PICKERNELL.

The modern telephone exchange building should be thoroughly fireproof. False floors and concealed masses of wires should be avoided, for a fire once started in such places is extinguished with great difficulty. In its erection everything should be sacrificed that in any way interferes with the particular object for which it is built.

In the basement racks are to be provided for underground cables. Between the basement and terminal room a cable shaft or system of ducts is to be constructed. On the top floor are to be located the operating, terminal battery and power, cloak and lunch rooms. These rooms should be provided with chemical fire extinguishers and the manager, fire chief and assistants thoroughly instructed in their use.

In case of fire every effort should be made to suppress it without calling on the fire department. If the fire should attain considerable proportions, it could at its worst only consume all the combustible matter in the room, for inasmuch as the operating room is on the top floor, the fire could not cripple any of the supporting columns or beams of the building and cause it to fall. If a small fire was started and the average fireman admitted, he would do more damage with his ax and hose than the fire would in entirely consuming the apparatus.

Before a telephone company is in a position to erect a suitable building it is necessary to make definite estimates of the probable extent of the underground work, the ultimate number of subscribers it will be desired to handle at the proposed exchange, the probable number of trunks to other exchanges, the probable number of extra territorial lines, the amount of private wire business, the probable average number of calls per subscriber per day, when the switch-board attains its ultimate capacity.

A careful estimate of this kind determines the ultimate capacity of the switch boards, underground cables, runs, etc., and consequently fixes the minimum size of the building.

In order that the building may fulfill the requirements of a modern telephone exchange, a technical expert should be provided with these estimates and his opinion taken before any land is purchased or building erected. He should co laborate with the architect in making the building plans. Mistakes have already been made by telephone companies in adopting plans of good office buildings and afterward placing the switch-board wherever room could be found. Such buildings have been found unsuitable for modern telephone exchanges. It does not follow from this that the requirements of a good telephone building are necessarily incompatible with the demands of an office building.

One of the first matters to be considered in planning the building is the handling of the underground cables. The system for bringing in the cables should be thoroughly flexible and permit of the drawing in and out of any particular cable when the point of ultimate equipment is reached. The cables are to be extended through the basement to vertical rows of ducts or to a suitable cable shaft, extending to the cable terminal room. The massing of the cables in rows of ducts extending two in number should be avoided. Wherever it is necessary to pass from one system of ducts to another system, the cable should be brought into a vertical row, thus rendering each cable accessible.

Before any building plan is adopted a complete working plan for the handling of the underground cable should be made. This working plan should show the exact location of every cable in the sub-way, at each turn and the location of its inside terminal.

It is preferable to head up cables in a terminal containing a sneak current and lightning arrester. The sneak current arrester should operate with the current of .3 of an ampere in forty seconds, and the lightning arrester should operate when the potential of the wires rises to 300 volts. By using a combined cable head and strong current arrester, economy and space are insured. The strong current arrester should be so designed that the lines can be tested at this point, by using suitable plugs.

The terminal room should also contain a distributing board and chief inspector's desk. The most economical, compact and flexible distributing board that has yet been devised, is that known as the "Hibbard Iron Distributing Board." The cable terminals should be connected with the line side of the distributing board by flexible cable, all connections being solid. The switch-board cables terminate on its other side.

For cross-connecting wires, okonite wire No. 20 B. & S. gauge, insulated to $\frac{3}{32}$ of an inch twisted in pairs, should be used, all connections being solid.

The chief inspector's desk should be located immediately in front of the distributing board and should be provided with a telephone outfit, Morse key and relay, Wheatstone bridge and galvanometer and loops extending to the tower and battery room, local switch board and chief operator's desk. It should be provided with testing plugs for use at the strong current arrester.

Near the terminal room should be located a power and battery room and in this room battery racks should be provided upon which the operator's transmitter batteries and chief inspector's testing batteries can be located. The battery rack should be wired with waterproof wire in a permanent manner.

In this room a generator switch-board should be provided, and have terminating upon it loops to the various portions of the multiple board and also the terminals of all generators. Electric motors, water motors, or other suitable power supply, should be located here. Both the terminal room and battery and power room should be so located that it will be possible to enter them without passing through the operating room.

On the same floor and adjacent to the terminal room should be located the operating room. This room should be large and well ventilated, free from elevator shafts, columns or other obstructions. The switch-board should commence at the end of the operating room nearest the terminal room and extend from it in a straight line.

If it becomes necessary to deflect the switch board from a straight line, it should be arranged so that the operators sit on the inside of the curve. This enables the chief operator's desk to be so located that all parts of the switch-board are visible from this point. The size of the room necessary will depend upon the ultimate capacity of the switch-board.

If the switch-board is to have an ultimate capacity of 4,000 lines or over, the extra territorial trunk section should be the first in the system. It should be equipped with five point spring jacks and three point plugs, so that when the line is in use at the trunk section, it tests busy at the other boards.

If a switch-board is to have a capacity of less than 4,000 lines the trunk board should be made the last section in the system and the regular Chicago spring jack used. The reason for locating it last in the system is as follows: Whenever a metallic circuit connection is made at any section, an open leg is attached, which extends throughout the rest of the board to the answering jack, the open leg being shortest on connections made at the last section. In large boards this introduces an appreciable amount of cross-talk. By making the trunk line section, the last section in the board, all connections made at this board have a minimum length of open leg and consequently the switch-board cross-talk is reduced to a minimum.

The answering jack should be the last spring jack in the system, thus insuring in every connection, at least, one of the parties connected having no open leg attached to his circuit. If the answering jack were the first spring jack in the section every connection would have at least one open leg attached to it extending throughout the whole system.

Next to the trunk section comes the regular multiple board, the number of sections depending upon its present equipment. It has been found that sections of multiple board six panels wide, of the hog-trough type and having an ultimate capacity for 300 subscribers' drops, is the most desirable form of multiple switch-board. On the back of the hog trough is to be located tubular clearing-out drops and tubular subscribers' drops.

Immediately back of the hog-trough is to be located a cord shelf upon which both cords are to be placed.

In the face of the board, immediately above the cord shelf, is to be placed the answering jacks; above the answering jacks, the subscribers' jacks.

The standard condenser listening and long distance ringing keys with talking contacts of platinum have been found to give most excellent service. On the framework immediately under and back of the cord-shelf is to be located an intermediate distributing board. It has been found that it is possible to so distribute the busy subscribers with those that are not so busy, as to make approximately equal the work for all the operators. In order to do this, without changing the number of the subscriber, the intermediate distributing board has been designed. One side of this board is connected to the answering jack and subscribers' drop, and the other side to the cables coming from the multiple board.

By placing two numbers on the subscribers' drop, one on the shutter corresponding with the answering jack and one on the face plate corresponding with the spring jack number in the multiple board, it is possible to make cross connections at the intermediate distributing board and not change the drop number of the subscriber.

A change of this kind will be effected as follows: Suppose that the operator upon which subscriber No. 654 terminates, was very busy, and that the operator upon which subscriber No. 235 terminates, was not so busy; and also that the subscriber No. 654 was a very busy wire, and subscriber No. 235 was not a busy wire, it would be desirable to interchange the answering jacks of these two subscribers, for, by so doing, the work of the operators would be more equally divided. This would be done at the intermediate distributing board by cross-connecting the two answering jacks and by changing the face plates on these two subscribers' drops. The office record of circuits should be so constituted as to admit of this dual numbering of drops.

The double track system for inter-communication between offices is recommended.

Push buttons connecting local operators with the talking circuits are to be placed within easy reach in front of each operator.

All incoming trunks should terminate on single cords and be operated by call wire system. For this purpose the incoming trunk line operator has his head telephone included in the talking circuit from the other exchanges. The trunk circuits should be arranged so that if the calling wire breaks down any other trunk line may be quickly substituted and pending the change, the trunk lines operated by drops.

It is also desirable to have the circuits so constructed that when the operator at the originating office disconnects a trunk line, the operator at the receiving office is notified automatically by special signal. This reduces the number of calls on the talking circuit one-half.

In front of the switch-board, in such a position that all sections may be easily seen, a monitor desk should be

placed. This desk should have terminating on spring jacks, loops extending to each operator, to the chief inspector's desk, and to circuits in the multiple board.

All operating rooms should be carpeted with linoleum to prevent noise by people walking about

On the same floor as the operating room a cloak room and lunch room should be provided. The lunch room should be equipped with tea and coffee urns, lunch table, etc.

By providing such conveniences for the operators, a better class of women become available, and exchange service correspondingly improved.

In closing these remarks I would call attention to the necessity of providing complete working plans and specifications of the proposed equipment including the cable run before the construction of the building is commenced. Extensive alterations in buildings and apparatus already made in several of our central offices, would not have been necessary had this been done. Such plans are necessary to the successful and economical erection of a modern telephone exchange, as are the plans for the erection of a suspension bridge, or other engineering work.

The Discussion.

Mr. Wilson: We have had read now two papers, one of which advocates an operating room on the top floor, and the other an operating room on the second floor. I hope that matter will be freely discussed, because I happen to be in a position where we are about to erect several new buildings and I would like to have the relative advantages of these locations fully brought out. It seems to me that the only advantage in having an operating room on the second floor would be in the decreased length of cables, and, as Mr. Patterson has expressed it, the expense of the cables as compared with the value of the second floor, would be the only consideration. But I think that as far as ventilation, light and the possibility of making the operating room more exclusive from outsiders are concerned the advantage is in favor of the top floor.

Mr. Hibbard: I think that question is one of the primary points and just as important in its relation to a telephone exchange as the question of the value of the building. If the operating room is on the top floor you will more than make up for the increased length of cable by having your operating room in a much better place. I think the advantages of having the operating room in the top of a building are very great. It has been the practice generally followed. The ventilation and the light obtained are strong points in favor of the selection of the highest floor. It is better to have the operators where they are out of the way and more free from interruption. We have exchanges in New York where the operating room has been given a black eye by running an elevator into it. Now, the operating room is designed for the operators, and in a large exchange, where you employ from 50 to 100 young women, I think it is a good plan to have them up in the top of the building, out of the thoroughfare. Besides, the operating room should be convenient to the point where the cable is hung up, and where the distributing board is. That is quite a point to be desired in a big local exchange. There are three links in the successful working of an exchange: The head of a cable is one, the distributing board is another, and its entrance to the multiple board is the third. Now, if it is possible to have those three points within the reach of the man who has this work in charge, he has a good grasp on the business. If, however, you put in a terminal point in the basement, and a distributing board away up in a tower, perhaps, and an exchange board in a third place, these links become disjointed, and the result is apt to be bad.

Mr Pickernell: Another objection to an operating room located on the second floor is the close proximity to the street. In Cortland street if the operating room was on the second floor it would be almost impossible to operate it on account of the noise. We are obliged to have three sound-proof booths in the front offices in order to be able to use the telephone at all

Mr. Crandall: Is not the dust arising from the street another objection to placing the operating room on the second floor?

Mr. Pickernell: I think so.

Mr. Patterson: I did not intend to advocate the first or second floor locations as against the top floor in all cases. So far as dust and noise are concerned, the lower floors would not be so objectionable if the operating room were placed in the rear, facing on a court, for instance, lighted by a skylight from above, and the heating and ventilation taken care of by artificial means.

Mr. Hibbard: I think that the introduction of dry air into your operating room is of essential importance. We should put in nothing wet, and should keep out all dirt and dust. Now, I have noticed in offices located on top floors where it is possible to keep the windows open, that the operators not only have a much pleasanter office to work in but that the operating service is superior. The operators like the fresh air, and the better you treat them in their surroundings the better the service. I recollect an exchange in which a few years ago there were flowers in one end of the room. If you went in there on a hot day you would notice that the work went on without any appreciable difficulty, and the operators seemed to be a contented company. I think since that time the flowers have ceased to bloom, and more switch-boards have been put in; it is not the same office either in appearance or in efficiency.

Mr. Gifford: I think the locality has something to do with the building of an exchange. In Louisville our operating room is on the second floor, but we are situated in the middle of a square, and in a comparatively clean, pleasant, location We have a big skylight in the top of our operating room, and then we have windows besides. We have a hard floor and we get very little dust, our switch-boards are all cased in. We don't succeed in keeping all the dust out, however, because we use soft coal there. Now, about bringing in the cables—I formerly had our shifting room in a little tower on the third floor, but in the last few months I have taken a room on the first floor. There we have our underground system coming down on one side with branches to the east and west. On the north side the arrangement is the same. We do not lose 25 feet from the point where our cable terminals come in to the switch-board, and we do away with a great deal of interference and resistance. That room is just like a hall, the windows are bricked up I have electric light in there, and nobody gets into the place except one man and my electrician. I hold them responsible for everything in there.

Mr Carty: I think Mr. Pickernell's idea was based upon the assumption that more than one employe could be trusted to go into that room and to do the work there. I think we should so organize our staff that any member of it could be so trusted. I think it would be a good thing to have the chief inspector located in that room because then he is near the point where he could do his testing.

Mr. Hibbard: I should hardly favor the idea of having a room locked up in which you have your protectors. In a plan of having a testing room it is a feature that the terminal and distributing room should also be at a point where you head up your heavy lines of underground cables. As a matter of fact all the testing of wires is done at the head of the cable. It is a point, therefore, of frequent access. That is, you test out all the apparatus, and you test in through the switch-board all the underground cables. One of the points of having the room easily accessible and next to the operating room, is this: The most frequent troubles with the electric light wire are to be expected at night. There has been no arrester put in any exchange which will head off all of this kind of trouble. Each arrester probably does its work as it has been designed in a particular line, but I do not think we have found any that are good all around. I have had perhaps the misfortune to have my name attached to an arrester of which a great many are in use. I regret perhaps, to be obliged to acknowledge that I know of ten or twelve experts who would burn up a telephone with an arrester. So that I hardly think were in a condition yet to wrestle with the question of arresters, because even if it is in a place that no living man would attempt to get into, yet these electric light fellows will creep in over our wires which are apt to burn sometime. If our protection is available to a telephone exchange, we should have at all hours the means of opening the wires and saving our apparatus. If a current comes in any chief operator who is posted is able at once to go to the seat of the trouble and remedy it.

Mr. Gifford: While I said I was going to put in one man and hold him responsible, I meant to say that I have several very good men working in there to-day, but when I get the thing perfected and finished I shall keep it under the care of just one man and shall make him responsible for the care of that room.

Mr. Patterson: I understood Mr. Hibbard to say that the operating room was not so pleasant if the windows were kept closed. Now, take this room, where we are assembled, with four windows on one side and two doors on the other. If the windows are kept open, as those sitting in the rear would no doubt desire, the noise from the street should prevent those in front from hearing what took place in the room. I think it would be a great deal more pleasant, if instead of those windows there were a dozen inlets for fresh air all around the room with the temperature graduated to suit the seasons of the year.

Mr. Carty: There might perhaps arise a condition where we would be helped out in lighting a room by locating the operating room on the top floor and availing ourselves of skylights If the operating room was on the second floor you might meet with conditions that would interfere with the light from the windows, and you could not avail yourself of that expedient.

Bridging Bells.

The President: If there are no further remarks upon these papers we will next hear from Mr. Carty on the subject of "Bridging Bells."

Mr. Carty: I was asked by the president to prepare a paper to be read before the association, but owing to the pressure of many matters of business I was unable to do so. I will, however, give you my views briefly on the subject of "Bridging Bells."

After describing the poor working of the looping-in system, which is the one in general use, Mr Carty showed a number of plans by means of charcoal sketches, two of which are reproduced in Figs. 1 and 2. Mr. Carty continued:

It was found that a magnet in a line had something in it besides the mere resistance of the copper. The fact that the wire is coiled on a core offers a resistance to a telephone current a great deal more than that represented by the number of ohms of wire. In nearly all of the lines that are constructed with more than one, stations all looped in, the talking is very poor. A line was built in New York containing eight miles of underground cable and four miles of overhead wire and ten stations looped in "solid," and it was impossible to talk over it. The bridging bells were put on that line and the talking over it is now as nearly perfect as it could be. It is impossible to tell the difference between a line having ten stations on it, and a line with only two stations. Mr. Sabin of San Francisco, procured eight of the bells and put them on an iron wire fifty miles long, running from San Jose to San Francisco. The line has eight stations looped in, and it has been impossible to use it for through business at all, and talking to the way stations was very poor. But having equipped the line with these bells he reports that it is impossible to tell the difference between talking on the way line and talking on the through line which runs on the same poles. He says the induction on the way line bridged in this way is less than it is on the through line. Thus it has actually turned out that the way line with eight stations on it, works better than the through line with only the usual stations These wires are of iron and are grounded circuits, and the bells are simply bridged in or "legged" on.

Now if they will give such good results on that line, I don't see why they wont fit on all of the lines of an ordinary exchange if proper care is taken to look after the resistance of the drops of the central office.

When lines are constructed on the bridge or multiple arc system, the construction of the wire is made much simpler.

You simply tap on a branch and run off from it like than (indicating). There you see you make an important saving in wire. With the loop plan you would have a station it here (indicating) and use twice as much wire as you would in the bridging plan. A metallic circuit constructed in that way would look something like this (illustrating). You tap off from each side of the circuit this way. Now, supposing you had another station over here (indicating) We tap off from this other branch in that manner (illustrating), and you could carry that still further and go off here (indicating).

To those that have to build lines, that simplifies matters very much. To loop that into a way station on the old plan it would require twice as much wire

Now, supposing you have a line connecting the central office with three stations on it. Those stations are selected

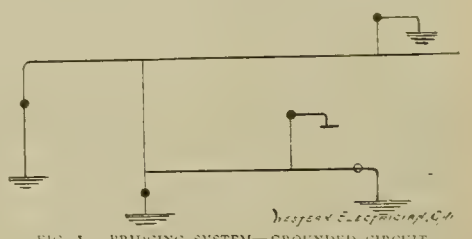


FIG. 1. BRIDGING SYSTEM—GROUNDED CIRCUIT.

very often with regard to their location, but on the bridging plan you could have a terminal of a cable and run a leg off to a subscriber, and run another one right from that same conductor, and another subscriber could be taken off in that way.

The bell is on exhibition in the rear of this hall. It is a magnetic bell that is much simpler than any yet designed. There is no bottom contact on it, and the bell rings equally well whether the telephone is on the hook or off.

In looking at some railroad troubles in Albany, I found that the drops were down and business was paralyzed. Mr. Pickernell made a suggestion that I take up some double wound resistance coils and put them in between the drop and the ground. I did so, and found it a perfect remedy. We ordered fifty of them and fixed it. While there it occurred to me that a bridging bell would act even better. I sent one up, and it freed that line from the drop trouble. The particular bell that has been designed for this work has had introduced into it some mechanical improvements that are also applicable to the series bell. We have nut-lock binding posts, and wherever a wire was fastened by a screw, a tip was put in and the wire was soldered. The lightning arrester was also taken off, because you might as well paint one on there as to use the present one. The lightning arrester forms a point generally where a fire starts This bell was prepared with that in view, and if lightning protection is wanted it should be provided by the most approved plan and should form a part of the general scheme of protection against any currents.

I think that is briefly all there is to it. In substance, it is that if anybody here has a line with a lot of stations on it, that is not working well, if he orders some of those bells they will make it work well. The Boston people have used some of the bells and have constructed a fifteen-station line for the Armstrong Transfer company, and they

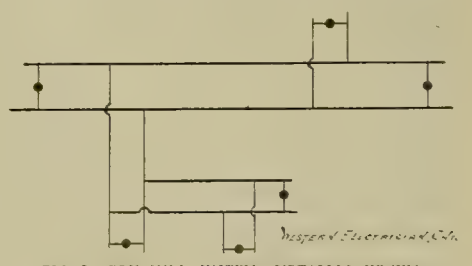


FIG. 2. BRIDGING SYSTEM—METALLIC CIRCUIT.

reported to me that, taking the old line at one the working of the new line might be placed at 300. The working of this system in New York has been very gratifying. We started with the New York Central Railroad, and reconstructed their ticket line and equipped it with bridging bells. Then the freight people heard about it, and now the result is that we have forty stations on three lines for that company.

A Member: Are those metallic or grounded circuits?

Mr. Carty: Those are metallic. This practice is quite different from the ordinary looping practice. For instance, in the American Express company—who made a big contract with us to equip them in the same way—they moved one of their stations, and we sent one of our men up. He took out the telephone, and, as had been his custom following the old idea, he twisted the two ends of the wires together when he disconnected the telephone. That was a correct thing for him to do, as far as he knew. But it had the result, as you see here, of just throwing the whole line out by short-circuiting it. Another man, in putting in a bridging station, drove a tack which crossed two wires together, and that prevented his bell from ringing. He started around looking for an opening, whereas he should have looked for a short circuit. So that this

practice is diametrically opposed to what we have been used to.

The question of an individual bell should not be considered with this. The first thing is to get a line over which he can talk. After that is done, then that old saw, the individual bell might come up again. You arrange signals, and all of the stations are signaled when anybody rings.

The construction of that bell is very little different from some other bells that are made to do the work, but when you come to use ten or fifteen stations on a line you have got to have exactly that construction, and it is such an important matter to the licensees that we are making great efforts to get a patent on it. In designing that we not only have an idea of our immediate wants, but we aimed to get a bell that we could say would work on any line up to twenty stations. They are building a line now on Long Island forty miles long, of copper wire, and to be equipped with twenty stations.

MR. LOCKWOOD: Is that a metallic circuit?

MR. CARTY: That is a metallic circuit. But that does not make any difference, although, of course, if you have a grounded circuit you will have most of the troubles that are incident to grounded circuits, yet Mr. Sabin reports in his case that the disturbance is a little less. That brings up the induction question, which I think would be best not to go into at this time.

MR. CRANDALL: Was there any noise which created that disturbance?

MR. CARTY: What Mr. Sabin had reference to was cross-talk from adjoining wires. The magnets in this bell are simply the ordinary ones lengthened out, and 500 ohms wound on each spool; while the resistance of that measured by the Wheatstone bridge is a 1,000, Mr. Hamilton makes the measurement of one of those magnets about 10,000 ohms to an ordinary generator current. Now then, with a higher rate of alternation, the resistance might run away out of sight, and it is safe to say that those bells are practically without any bad effect on transmission.

An experiment which is very interesting in that connection was made by connecting a Boston trunk wire to this New York Central Railroad ticket line. That made a line extending from the Grand Central depot down town, and then crossing the bridge and going over to Brooklyn The observer at Boston could hear the ordering of tickets at the ticket office in New York just as well, he said, as though they were in Boston. Of course when we put that line on we added six or eight miles of cable to the Boston line, and that of itself is sufficient to account for a slight diminution of the transmission. But while we had that circuit arranged with ten stations on in New York and one station in Boston, we cut in and out sixteen of these bells which we had in the office, and nobody could tell the difference.

Now, the point at which this breaks down first is the ringing. If you get more than twenty stations the ringing of the bell would be gradually weakened. If it is desirable to put on more than twenty, it is merely a question of design of the generator. In some places we have obviated that trouble by putting in a larger wire. That meant less turns and consequently a lower electromotive force. So we had to put in stronger field magnets to bring up the e. m. f. It is possible to make a generator that will ring any number of bells. The only limit will be the power of the subscriber to turn the crank. [Replying to Dr. Culbertson.] In the New York Central line we put in a push button. I rather favored that. I thought that complicated signals could be sent over a line better by a push button. Our bells are now being made with an automatic cut-in for the generator. With the other bell it is a cut-out.

A MEMBER: Do you make eighteen or twenty different signals rather than one?

MR. CARTY: That is a business arrangement rather than an electrical one.

A MEMBER: Has there been any system worked out on that?

MR. CARTY: I think so. I haven't it in mind now, but it is not very difficult. You could have a system of short rings and long rings.

MR. GIFFORD: It would be very easy to arrange that, just as the district messenger people do as their calls come in.

MR. BAILEY: I want to say with reference to that system that, while the idea of telephone service is supposed to be the supplying of subscribers with an individual or single circuit—that is, a circuit on which but one telephone is placed—yet the conditions are such in a great many parts of the country, and particularly with corporations, that you cannot persuade them that that is the kind of service they want. These corporations are those that have been accustomed to telegraph systems, and they imagine when they have a system which they can reach individually without the intervention of a central office, that they are getting very much better service. It doesn't matter what our opinion is about that, when you try to bring those people to your way of thinking you will find it very much of an uphill job. The next thing to do is to accept the conditions and comply with them. That can be done by a system of that kind.

There is another advantage in that system which I think will be available in the future, and that is in the way of giving cheaper telephone service on metallic circuit lines to residences. The chief difficulty that I see about that system is on long extended lines on which there is a liability of damage to the apparatus by lightning. Our company has had for a number of years a system similar to that in operation on quite a number of lines. We have arrived at it by running a shunt wire out from the exchange, commencing at the first station. This shunt wire is passed in through the station, and the calling wire is looped through. The operation of that is so arranged that when a call has been made the removal of the telephone opens the caller's circuit, and the talking circuit through the shunt wire is a free and independent wire for conversation. The talking over those lines has been magnificent. We get rid of the resistance of the coil through the circuit.

I wanted to ask Mr. Carty if he found any of the effects of those coils reached the earth as acted against the talking circuits. In the operation of those lines of ours we have found that in thunderstorms the usual accidents we had were lifting the switch and burning out the induction coils or the transmitters That trouble we obviated by putting in a bridge, which shoves the switch to earth. The current more readily passes through this direct wire rather than through the induction coil. I do not know whether in this system the ringer coils would be subject to destruction. I think possibly considerable trouble in that respect would be met with. However, it may be met by introducing some device. I should say high resistance coils were more susceptible to damage by lightning. When you take a line of that kind working in the country it means stations far away and hard to reach, and therefore expensive, with long interruptions to service.

MR. GIFFORD: That is a kind of business that isn't desirable to take.

MR. BAILEY: But it is a kind of business you are obliged to take.

MR. GIFFORD: I try to dodge all of that I can.

MR. BAILEY: But I should say in Mr. Wilson's case at Chicago he will find service of that kind that he cannot ignore. You must accept the situation and devise something that will meet the demand.

MR. GIFFORD: I do not wish to be considered as throwing any cold water on this system. I hope the bridge bell will be perfected, but I do not see how it will work in all localities. Perhaps in some localities it will do. I would not know what to do with it—for instance, if I tried to use it for residence service. We make a cheaper rate in order to get residences. In Louisville the residences are on one side of the town; the business portion of the city is on the other, and we debated whether we should cultivate that trade or not At last we made a cheap residence rate with two and three subscribers on a line. Now the Louisville woman don't want any other woman listening on her line, and they raised so much of a row that we had to do away with it.

MR. BAILEY: Then you have had the advantage of educating those people to something better.

MR. WILSON: Reference has been made to this question in Chicago. At one time we had quite a number of very long private lines, and the stations having been added one at a time that condition of things was permitted to go on until we found that we had considerable very unsatisfactory private line service. About a year ago we established a rule that we would not take any more private lines with more than five stations upon them. We have succeeded in getting our private line business on that basis, and where a larger number of stations was required we have put in what we call our branch exchange service. For instance, the West Side Street Railroad company had a private line of that description. They have their own exchange, and their own operator. It costs them more money than it would to have a line run into our exchange at $125 a year each, although we give them a reduction in the rate. The expense of operators to them makes it a little more than they would have to pay us. In that way we have entirely eliminated the long line private wire difficulty.

Now, the only objection that I see to the bridging arrangement on grounded circuits is the difficulty in locating troubles on the lines. We have been bridging our clearing-out drops in Chicago for about two years, and find a great improvement. We have some very long underground lines, through cables, which were laid in the early history of the underground business, and the margin for conversation is small. When we came to inserting the clearing-out drop in the old way it made conversation in some cases entirely impossible. After we rewound our clearing-out drops to 300 to 500 ohms it brought the talk right up. So that I am well satisfied that the bridging scheme is the proper thing. But if you can avoid the bridging scheme and have independent lines, it is still better.

DR. CULBERTSON: This bridging-in question is a very important one. In Buffalo we have been doing a good deal of metallic circuit work for the last two years, and we had a good many combination lines, or party lines, which, after the electric lights were in operation, gave very poor service. We commenced this system of bridging-in with one or two or more subscribers on a line, using first the ordinary bell, which gave us, of course, very poor service. Then we put in 500 ohm ringing coils. With that system and with 500 ohms in the central office, we are getting first class service with five and six on the line. We have also quite a number of private lines used by railway companies, where they have as many as 8 and 9 stations on the lines, bridged in with 500 ohm bells. Those stations are giving splendid service.

MR. BAILEY: Are they all metallic lines?

DR. CULBERTSON: Yes sir. There is a great saving in wire in doing that work also We have a wire running from Buffalo to Rochester, nearly 70 miles, using a 500 ohm bell, about 35 miles east of Buffalo, and it has given satisfaction. With 1,000 ohm bells of the kind Mr. Carty has reference to, I think we will get for that kind of work much better service. Of course, the question of testing comes in, which I think will be a serious one.

MR. CARTY: Everything has its advantages and its disadvantages, and because one disadvantage is pointed out, it does not by any means settle the whole thing. Take the case of Mr. Sabin of San Francisco. He had a line 50 miles long which he could not use. I told him the trouble was in the way he had it connected up. He had the advantage, then, of knowing where the trouble was, and the disadvantage of not being able to use the line. Now he can use the line, and there is no doubt but he can find out where the trouble is when it occurs.

In New York we do not recognize the long private line difficulty. Where a long private line is not desirable, we do not advocate the use of that bell. The line that caused the development of this particular bell, is that connecting the New York Central ticket agents scattered all over the city, who, when a traveler comes in to buy a ticket for Omaha, and the condition is that he must get a berth, or a seat on the river side of the car, the ticket agent telephones up to the Wagner office, and says: "Can I have a lower so and so?" and the answer comes back immediately, "Car 5, lower 6." The rapidity with which they transact business over that line is startling, and I can imagine what a time they must have had selling tickets over that line of railroad when it was looped in. Now they have increased the number of their lines, and the American Express company has come in, and the Adams Express company has been converted to that system The Adams company has one of these private switch-boards and also a number of stations on each of the lines. The lighterage line of the New York Central has a switch-board, but there is a certain amount of its business which it wants to do by ringing up direct and not being obliged to go through a switch-board.

We do not want to make any contention for a patent on bridging. Bridging apparatus is not new. It was advocated in a paper read at Minneapolis last year, and one of the first things that Mr. Hibbard did in the long-distance company was to throw out the looping arrangement and bridge the operators in. Down in Cape Cod they had these three-legged lines as long ago as I can remember, and we used to laugh at them, but it turns out that they are the right idea after all. It is a question of the design of the apparatus. We have succeeded in making this a practical thing. You can take any of these wires and quadruplex it, and you would never know who was talking.

In regard to lightning, I appreciate Mr. Bailey's position out in the country in having the bells burned out, but I would hate to complicate that bell which has been rendered so simple by putting in any of those devices to get a ground in a circuit point. If there was no other way out of it there might be a bridging bell designed for that particular use. I think if he tried the most approved arrester he would not have any trouble from burning out. In fact, the trouble he speaks of is not necessarily connected with the bell at all. It is the old question of the transmitter being legged on, and the fact that it is 1,000 ohms does not make it any more delicate than these 500 ohms bells used for bridging. I think lightning jumping across is largely affected by the thickness of the insulation.

MR. WILSON: Don't you think it is true that the retardation of the coils increases the tendency to jump?

MR CARTY: I don't think so

MR. HIBBARD: While we are speaking about the lightning's effect, I should think that Mr. Bailey's legging on of the talking wire was a lightning trap in itself. You get a good deal of chance for the lightning to escape to the ground. When bells burn out by lightning, it is due a great deal to the mechanical way in which they have been wound. The winding of a magnet has much to do with it. On a long-distance line, using 500 ohm drops, as they were first turned out, we had a good deal of trouble. We found that the wire burned in the outer wrapper generally. That was changed so that the winding was kept away from the iron No other change was made, and our drops are not burning out, as they did before.

MR. BAILEY: I referred more particularly to the trouble we have experienced with the burning out of the induction coils rather than transmitters. We have not suffered from the destruction of the ringer coils of the metallic plates; but in our case the ordinary arrangement is to leg the talking apparatus to the iron wire, or to the earth, so that in the operation of the switch there is but one connection made. As compared with that plan of coupling a telephone with one side in contact with the earth, would it not be better to devise switches that will cut loose on both sides of the telephone?

MR. WILSON: I would dislike to see another contact point put in a switch. The burning out happens once in a while, but so rarely in my experience that I prefer to have the coils burn rather than the additional contact. I think in curing one evil you would introduce another that would be still worse.

MR. HIBBARD: I think it is found pretty generally that where you give a high tension current any path at all it will stick to it until it entirely uses it up before it jumps any way Mr. Bailey has been taking lightning into his loop line and then offering it a chance to get to the ground through the induction coil, and I think it safe to say it has taken the jump on that account.

MR. CARTY: In some experiments which we made in the development of strong current protectors, it was found that we could make an air cut out—which is another name for a lightning arrester and that it would go out at any number of volts which you wanted to fix it at. It was at one time made so that the actual telephone current could jump to ground. Now it seems to me that if Mr. Bailey used a lightning arrester of that kind it would remedy the difficulty. At least, we should give that a fair trial before we undertake to complicate a bell.

E. J. HALL: We have had considerable experience with both those methods, and the 500 ohm bells have been found very satisfactory. I am speaking now from a business point. I do not see how it would be possible for us to do away with these combination lines in Buffalo. Some of our underground cables run out two miles, and if we were obliged to make single lines to parties beyond we never could do it at a price which they would be willing to pay. But by attaching to a pair of wires at the end of this cable and putting five or six people on bridged in on that system, we find that we are able to furnish a subscriber a telephone at a reasonable price.

MR. FARNHAM: We have found the bell arrangement works admirably. We have not tried putting bells on grounded lines. My objection has been mainly to the fear of lightning burning the bell coil. Now that we have a lightning arrester I think we can safely do it, and we have already taken steps to put these bells on some of the lines to see how they will work. I think, as Mr. Wilson suggested, that one of the difficulties in handling them, is the trouble of locating a fault or disturbance, and I think that is where one of the advantages of electrical measurements would come in. If we have a line with four instruments on it, the resistance of the line will be 250 ohms plus that of the line, which might perhaps be 50 ohms. If the line

is open beyond the second station, of course that resistance can be measured and doubled. We have got then 500 ohms, and we know by these measurements where the trouble is.

MR. CARTY: If the line was open beyond the first station your own bell would ring just the same.

MR. FARNHAM: I am speaking of testing such a line from the main office. In ordinary practice when a line is open the bell does not ring, and if the line is grounded it rings better; but here, grounding the line does not ring the bell at all. I am speaking of exchange lines.

MR. WILSON: We have a metallic circuit from Chicago to Michigan City, about 56 miles. In addition to the two end stations we have three stations bridged across the circuit. When we first put in that equipment we had great difficulty in locating trouble. We overcame these difficulties by simply inserting a three point switch in the bridge wire. That enabled us to call up the stations and ask them to turn the switch for five or ten minutes, and after they do that we have the old conditions of wires without any complication. That arrangement enables us to locate the trouble, whether it is an open line or a grounded line.

MR. CARTY: I might say a word in regard to the arrangement we have for locating trouble in New York. Everything is getting more and more underground there, and the branches or spurs are necessarily made at the central office. We have arranged for a test board on the plan of the long distance board with spring jacks in the board. There will be one of these located in each of our central offices, and the wire chief in charge of the private lines will be located at Cortland street. If he finds it is a short circuit he will take off all branches leading from his room, and he will then throw them onto a drop and dispatch a trouble man on to that branch. If he finds his own branches are all right he signals the next office up town, and they have a similar arrangement gone through with, until the trouble is located. That can be done in twenty minutes on those complicated lines. We can not only locate the trouble, but get the fault cut off and leave the other part of the circuit working.

MR. FARNHAM: What I said about measuring lines has reference to exchange lines. The private lines in Boston will be arranged just as Mr. Carty described.

MR HIBBARD: I would ask Mr. Wilson to tell us about the ringing in his exchange, using the Edison current.

OPERATING TRANSMITTERS BY EDISON CURRENT.

MR. WILSON: I will say that we are operating all the transmitters in the main office of the Chicago exchange with Edison current, and we are accomplishing good results. We use storage batteries. We are employing at present five cells of storage battery, which has an electromotive force of a little over two volts per cell and gives out about five amperes of current. The five cells are connected directly in the Edison cirquit which supplies the office with light, and the storage takes place when we burn the light, and we do not observe any diminution in the lighting throughout the building. There is, therefore, no expense for current. The internal resistance of each cell of the storage battery is about 1-200 of an ohm. Consequently, as you add transmitters, they simply absorb more current from the storage battery. The object of having five cells is that it enables us to maintain the storage battery throughout the 24 hours without becoming exhausted. If we connected all the transmitters to one cell we would necessarily have to turn on light during the day to recharge it. Our experience has shown that in five cells the charging is entirely automatic. We supply between 60 and 70 transmitters.

MR. GIFFORD: How many transmitters will one cell energize during 24 hours?

MR. WILSON: The arrangement we have contemplates 100 transmitters. We are only operating 60 to 70.

MR. BAILEY: How many transmitters do you couple on to one cell?

MR. WILSON: At the present time about 12 and we adjust the resistance until the current in each transmitter is all that the transmitter will stand.

MR. GIFFORD: What is the size of the battery which you use?

MR. WILSON: I cannot answer that. I simply authorized the purchase of a storage battery. We use the Edison current for ringing instead of small generators.

MR. BAILEY: Do you have any difficulty with the variation of current which the Edison company furnish?

MR. WILSON: No. sir. On one occasion the current was cut off for about twenty minutes.

MR. BAILEY: I have found that the current from all these incandescent plants differs frequently. Where they are supposed to carry 50 volts to 110 they will vary from 90 to 130.

MR. WILSON: The Edison company has a very large plant, in Chicago and it supplies motors. The Western Union company uses the Edison current for operating its dynamos, and I think the service gives satisfaction.

MR. GIFFORD: Mr. Forbes uses the same method in the exchanges here.

MR. HIBBARD: In watching the generators in the Detroit exchanges this morning I saw that they had three lamps in the open circuit, and you could tell the number of operators ringing at a time by the way the lamps went down and then became bright again. He had an electro-motor turning the commutator. He had his old equipment for running the ordinary power generator.

MR. WILSON: I could say also that 12 transmitters constitute the maximum, because the more transmitters you connect on a single cell the more current is absorbed from that cell, and you want to adjust the number of transmitters so that the cell will last 24 hours, or until the lights are turned on again to recharge them. If you are burning lights during the day, with that arrangement it would not be necessary to use so many cells. We found that when we added any more transmitters it would be necessary during the day to turn on lights to restore the charge drawn from them.

MR. FARNHAM: Don't you have a battery in reserve in case of accident?

MR. WILSON: Yes, sir. We propose to have a reserve series of storage cells, and in keeping them charged all the time we will be entirely independent of the source of supply. They will retain the charge indefinitely.

MR. BAILEY: Why wouldn't it be practicable to apply transmitters directly from incandescent mains without the intervention of storage batteries?

MR. WILSON: The Edison current itself is not smooth enough, but by storing it in the storage battery little or no Edison current goes around through your transmitters, and then you get out of the storage battery a perfectly smooth current. I will also add that we are now arranging to take out of the American District plant, which is owned by the Telephone company, the battery which is there. We now have from 10 to 100 cells of gravity battery located in the offices throughout the city. We are preparing to substitute a similar arrangement in all those offices.

MR. BAILEY: The Pennsylvania Railroad company takes battery direct from the main at Pittsburg and Harrisburg, and uses the storage batteries at Altoona. It gets very satisfactory currents for telegraphic purposes without the intervention of batteries.

THE SECRETARY: I wish to say that in accordance with the duty of the secretary he has prepared the usual statistical report compiled from reports furnished by different companies from the membership of the association. Of course, it is too long to read, and, as it consists largely of figures, it would not be allowed. If there is no objection I will simply report that I have prepared it, and will print it in the proceedings as has been customary.

MR. CRANDALL: As a motion to adjourn is now in order I desire to offer a vote of thanks to our hospitable hosts, both for what we have received and for what we are going to receive.

The motion was carried unanimously.

The convention adjourned sine die.

Convention Notes.

The amusement provided for the first night was a visit to the Lyceum Theater. A party of almost 100 occupied seats in the theater.

Thomas D. Lockwood is authority for the statement that the Detroit convention was one of the most interesting and instructive in the history of the organization

A large number of ladies was present at the convention. As a consequence the toast to "The Ladies" at the banquet had more significance than ordinarily. The attendance of ladies next year will be even greater, as a number of telephone men made a compact, by the terms of which their wives will accompany them to New Orleans.

No more hospitable hosts ever welcomed visitors than W. A. Jackson and F. A. Forbes of the local telephone company. They were untiring in their efforts to see that the delegates thoroughly enjoyed their stay in Detroit.

Detroit has two standards of time, local and railroad. No little confusion resulted from this miserable system. President Sargent stated that it was absolutely impossible to tell when to call the convention to order as there were two standards in Detroit and his watch denoted the proper hour in New York.

A large number of guests visited the exchange of the local telephone company. It is an interesting plant and several new wrinkles in telephony were examined by the visitors with considerable care.

The usual number of supply men was on hand. Their operations were not confined to work among telephone men. One electric light superintendent, whose passage from the hotel was blocked at 1 o'clock one morning by four zealous wire men, will testify that supply men are indefatigable and unconquerable.

The weather in Detroit was decidedly chilly, but no one had any ground for complaint. Rain threatened to mar the pleasure of the steamer ride, but fortunately it continued for a short time only,

THE DRIVE ABOUT DETROIT.

After dinner on Wednesday the visitors enjoyed a drive about the city of Detroit. Carriages were provided by the local telephone company. The route was through many of the beautiful residence streets. The terminus was Belle Island Park, Detroit's beautiful resort Lunch was served at the Casino, at the park.

THE BANQUET.

The banquet given by the Telephone and Telegraph Construction company of Detroit in honor of the National Telephone Exchange association and the attendants at the convention, took place at the Russell House, Wednesday evening. Over 100 persons were in attendance. The tables in the dining room were elaborately trimmed with flowers. After the dinner the delegates were called to order by W. A. Jackson of the local telephone company who proposed the toast, "The Guests of the Evening." President Sargent made the response. He said it was a great pleasure to him to express his great appreciation of the royal hospitality of their entertainers and to voice the appreciation of the delegates generally of the cordial welcome they had received in Detroit.

Morris F. Tyler was called upon to make a speech. The hosts he said had a peculiarly hard task before them for the delegates had come to Detroit with memories of New York, Providence, St. Louis, Boston and Minneapolis and St. Paul. It was evidence that their task had been wonderfully well performed for the attendants now only had memories of Detroit. Mr. Tyler then lapsed into a reminiscent vein. He went back to the first convention at Niagara Falls ten years ago, saying that those who were not present at that meeting did not know what "a telephone convention can be." He contrasted in a humorous way the conflicts which characterized the first convention with the harmony which to-day marked the sessions when the secretary is instructed to cast the ballot. Mr. Tyler referred to the absence of representatives of manufacturing concerns at the sessions at the present time. "The persistence and ingenuity" he said, "of the manufacturers of that day in attending the convention and showing their goods are only equaled by their persistence and ingenuity in keeping out of our way to-day." Since the first meeting of the association there had been a marked change in the persons who talked in the convention. At first it was those interested in small exchanges who engaged most prominently in the discussions. To-day the officers of large exchanges take the most prominent part in the deliberations. There had been a decided change in the organization of the business. At Niagara Falls they had scarcely a telephone man who could tell whether he was making money or not or how much the service cost per subscriber or who would state accurately how many subscribers he had. To-day all this information is known and in addition the manager knows how many times his subscribers talk and how many times they try and fail to talk. To-day, Mr. Tyler said, the business was as well settled as any. In 1880 the telephone men thought the telephone was a wonderful instrument. To-day they knew they were furnishing what the public could not do without. To-day it was a great art with manifold ramifications touching every industry and making the life of the community easier, happier and better.

A. W. Crandall of New Orleans responded to the toast "The Ladies." He referred to the beauty of the ladies of his city which he represented, and felicitated the association that so many ladies had attended the convention.

Thomas D. Lockwood was called upon for a speech but no topic was assigned him—an omission which led him to remark that the subject was a favorite one with him. Speaking of the convention he said the meeting had been one of the most thoroughly practical and useful in the history of the organization. He referred to the discussions which had proved he said exceedingly valuable. He followed with a humorous speech in which he touched lightly upon the litigation with electric railways, the duties of an expert and upon some of the peculiarities of several of the gentlemen present.

E J. Hall, Jr., responded for the American Telegraph and Telephone company and A. S Hibbard sang a solo which was greeted with such applause that the singer was obliged to respond to an encore.

Informal speeches were made by J. E. Zeublin, F. A. Forbes, H. N. Gifford, F. G. Beach, C H. Barney and Joseph Lockwood.

The banquet which broke up at a late hour was in every respect a most enjoyable affair.

THE STEAMER RIDE.

Thursday, the last day of the meeting was devoted wholly to pleasure. In the afternoon the telephone party boarded the 'City of Detroit" which had been chartered by the local telephone company. The boat started at 2:30 and carried visitors up the Detroit River to the St. Clair Flats.

The weather was decidedly chilly but as all the members of the party had prepared for the ride no discomfort was experienced. The trip was a delightful one and thoroughly impressed the visitors with the beauty of the environs of Detroit. Lunch was served on the boat. The city was reached soon after 6 o'clock. The Telephone convention was now at an end. The stay of the party in Detroit had been profitable and enjoyable and the visitors will long remember the generous hospitality of their hosts and the untiring zeal of W. A. Jackson.

The Chubbuck Brake Arm.

In the electrical industries, as in other mechanical lines, the old and heavy cast iron appliances are being supplanted by lighter and neater designs of wrought or malleable iron. The Great Western Electric Supply company has just placed on the market the Chubbuck

THE CHUBBUCK BRAKE ARM.

brake arm of which the accompanying cut is an illustration. It is made of malleable iron, and is strong, light and tough. The device is neat and has the strengthening rib and taper screw of the Chubbuck Springfield bracket. The star-shaped section of the arm gives great strength it is claimed, while the hollow split screws have a slight spring and grip the insulator firmly. Another feature is the small barbed pin used. This requires only a 5-8 inch hole and weakens the cross arm less than a larger hole. Moreover, when once driven in, the barbs catch in the wood, holding the arm firmly in place.

THE ELECTRIC LIGHT.

The Edison General Electric company has applied for a franchise at Alameda, Cal.

The Edison company is installing a 1,600 light plant in the Barton opera house, Fresno, Cal.

The Hagerstown, Md., Land & Improvement company, when recently organized, has applied for a franchise.

The Commercial Light and Power company, Tacoma, Wash., has been incorporated; capital stock, $25,000.

Boston capitalists are preparing to construct an electric railroad between Knoxville, Tenn., and Fountain Head.

The city council of Texarkana, Ark., granted the street railway company last week the right to substitute electricity for animal power on its line.

An electric road between Americus Ga., and Andersonville, a distance of ten miles, is contemplated by capitalists interested in that section. There is also under consideration a project for connecting Porterdale and Covington, Ga., by an electric road.

The National Conduit company has been awarded the contract for supplying sixty miles of conduit for the new electric street railway at Buffalo. Much interest will be felt in this work, as it is the first of the kind in the country, and street car companies contemplating the introduction of the electric system will have reason to give it their attention.

The Municipal Electric Lighting company of St. Louis has been putting up new lighis and extending the service during the summer, but the company has been greatly delayed on account of its inability to procure the lighting apparatus as rapidly as it was needed. The service will be increased by 400 additional lights during the winter. Many of these are being placed along Manchester road, while the vicinity of the water tower is being supplied. The service is also being extended in the western sub urbs.

A new electric miners' lamp is reported from Paris, devised by M. Constant Rosseau. It contains a Plante accumulator and forms an upright square, divided into four cells diagonally, and is about the same size as an ordinary miner's lamp. It carries a very small incandescent lamp, protected by a second glass bulb. The weight is about 4½ lbs., and the duration of lighting is 11 hours. The charge required is 12 hours. A specimen lamp has been submitted to the Societe de l'Industrie Minerale, and has been favorably reported upon.

The Home Electric Light company, Seattle, Wash., has elected the following officers: Isaac Dobson, president: Dr. E. C. Kilborne, vice-president and general manager; A. C. Balch. secretary; D. T. Denny, treasurer. The capital stock is $500,000. This company is a consolidation of the Pacific Lighting and Commercial companies. The plant will be enlarged and improved and contracts have already been awarded for the necessary machinery, including two 250-horse-power engines, four 150-horse-power boilers, 2,600 incandescent lights, 100 arc lights, 2,600 lamps, and about 40 miles of wire.

Business Mention.

A. J. Shaw of Milwaukee, was in Chicago last week.

The National Conduit company was represented at the Detroit Telephohe convention by Messrs. McQuaid & Stockwell, who displayed samples of the conduit manufactured for telephone wires.

Mr. H. H. Pattee, of Monmouth, Ill., inventor of the amp hour recorder, which bears his name, was in Chicago last week. He reports that his invention is used in stations in all parts of the country.

Jean A. Wetmore of New York city, exhibited at the Detroit Telephone convention a number of specimens of the production of the Norwich Insulated Wire company, and lost no opportunity to inform the delegates of the advantages to be derived from using this wire.

F. E. Degenhardt, representing the Standard Underground Cable company of Pittsburg, had on exhibition at the Detroit Telephone convention samples of bunched telephone cables with the wires twisted in pairs. The features of these cables are very low static capacity and high insulation.

William Hood, the Western representative of the Accumulator company of New York and the Electro Dynamic company of Philadelphia, has removed his office from the Phœnix building, Chicago, to 269 LaSalle street, where he will carry a full line of storage batteries and the electrical devices which he is handling.

Webb Hayes, a son of the ex-president, purchased a controlling interest last week in the Fidelity Carbon company for $50,000. The works cover an entire block in St. Louis. The company manufactures all kinds of carbon specialties—carbon points, plate, batteries, etc., for telegraph and telephone purposes—and was incorporated nearly two years ago, with a capital stock of $100,000.

The Great Western Supply company has just received a shipment of nineteen deer heads from the Yellowstone National Park. They are for fine mounted specimens, and when fitted up with lamps will give a number of handsome elkhead electroliers similar to the one referred to a few weeks ago. Most of the present lot have been sold, and will be sent out as soon as they are wired up.

Queen & Co., of Philadelphia, have a fine display of their specialties at the St. Louis Exposition, including a collection of resistance boxes which is probably the finest assortment of American make ever exhibited. The Queen standard resistance box number one, standard megohm box, postoffice box number two and a full line of new portable testing sets. These testing sets possess valuable peculiarities. and there is a great demand for them. Ammeters and voltmeters for all classes of work are attractively shown. Well known types are to be seen, such as the Ayrton and Perry, Deprez-Carpentier, Cardew, Electro dynamometer, and also Queen's new magnetic vane meters, which, while but recently placed on the market, are finding many friends. They are adapted for central stations, electric railways, marine plants isolated plants, etc. Reading telescopes, galvanometers, speed indicators, testing batteries and other instruments together with those mentioned make an exhibit that reflects great credit upon Queen & Co.

A new primary battery is now being exhibited in Chicago by B. J. Wheelock, of New York city. Mr. Wheelock makes some strong claims for his cells. A representative of the WESTERN ELECTRICIAN was shown the battery in operation driving a sewing machine motor. A peculiarity of the cell is that it needs no dismounting in order to renew the electrolyte. The elements are zinc and carbon. The carbon is in the form of plates and is contained in a porous cup treated in a peculiar manner to prevent the mingling of the inner and outer liquids when the battery is at rest. The zinc is in the simple form of flat plates, one on each side of the porous cup. The carbons are sealed in the porous cup and the zincs hang close against it. The elements are kept continually in the liquid, whether the cell is in service or not. The cells exhibited have been working for two weeks, requiring of course, the addition from time to time of a small amount of liquid. The outer solution is simply acidulated water and the inner liquid is one of peculiar composition and is covered by patents. Mr. Wheelock considers his method of automatically discharging waste or exhausted fluid a most important feature of the battery. The size of the present type of cell is 4x10x10 inches. Two cells are required to operate a sewing machine motor. The e. m. f of a cell is 2 volts and on a short circuit the battery will deliver, it is claimed, 30 amperes. It may be mentioned that a couple of the Wheelock cells have been in operation on a phonograph in New York, and it is understood the most satisfactory results have been secured.

Frederick Sargent who until quite recently was identified with the Edison interests as assistant engineer-in-chief of the Edison General Electric company, has opened an office in Chicago as electrical and mechanical engineer. His quarters are in the Owings' building, 215 Dearborn street. In thus starting out as an independent engineer Mr. Sargent says that he has long recognized the fact that there exists in this territory a field for experienced engineers well posted in modern appliances and improved methods of construction, who are in a position to give unbiased advice to the investor. He does not intend, however, to go into construction work, but simply to furnish the necessary data and supervision for the complete installation of plants. Mr. Sargent has had quite a varied experience. At one time he was chief engineer of the Western Edison Light company, then he was appointed superintendent of the Chicago Edison company; next, chief engineer of the Edison United Manufacturing company; and at the time of his withdrawal to start in business for himself, assistant engineer-in-chief of the Edison General Electric company. It will be remembered that it was Mr. Sargent who superintended the construction of the steam plant of the Chicago Edison company's station. Previous to his connection with the Edison company Mr. Sargent was actively engaged in mechanical engineering. His experience dates from the year 1875, when he entered the service of John Elder & Co., the famous Clyde engineers, who by the way, first introduced the compound and triple expansion engines. Seven years were spent in their shops and drawing offices, and he took an active part in the constructing and designing of compound engines, ranging from 500 to 15,000 indicated horse power, and of heavy gearing and mill work. The next four years, up to the time of his first connection with the Edison company, he spent with prominent American firms designing steam, mill and mining machinery.

Electrical Patents.

Issued September 9, 1890.

435,937. Lamp Holder and Switch. Charles H. Herrick, Winchester, Mass.

435,958. Method of Regulating Electrically Operated Mechanism. Merle J. Wightman, Lynn, Mass.

The invention consists in providing for any machinery which it is desired to operate by electricity with varying speed and power, two electric motors which are connected to the machine so as to co-operate in driving it.

The method consists in reducing the counter electromotive force in the armature of the motor to be removed and then short circuiting the said motor.

435,964. Electrical Amusement-Reporting Apparatus. Melvin D Compton, Newark, N. J.

The invention relates to systems and apparatus for reporting ball games or similar sporting events, and its special object is to enable a full report of such games to be made in sight of a large number of spectators and at the same time to dispense with one or more of the assistants now required in reporting such games.

435,967. Electric Lamp. William D. Graves, Cleveland, Ohio.

The invention has for its object to provide a means in a duplex lamp for the successive burning of one set of carbons after the first set has been consumed for the prolongation of the lighting from such lamp, and it also provides that a continuous and unbroken light shall be maintained throughout the burning of both sets of carbons.

The first claim reads:

"In a duplex or multiplex arc lamp, the combination of double sets of solenoids, one solenoid in each set being of low resistance, carbon holders and carbons connected in series with said low resistance solenoids, a lever, a suitable feed mechanism and a switch arm attached to said lever arranged within said circuit, constructed to operate substantially as and for the purpose specified."

435,982. Regulator for Dynamo-Electric Machines. William Stanley, Jr., Great Barrington, Mass.

The method consists in first providing a path for a portion of the lines of force between the field magnets, and second, compelling these lines to enter the armature in such a direction as to establish a neutral region at points approximately as far behind the normal position of the diameter of commutation as the brushes ordinarily have to be advanced ahead of such position.

435,983. Electrical Traction Apparatus. William Stephens, Santa Rosa, Cal.

435,985. Rheostat. Frank Thone, Oskaloosa, Iowa.

436,001. Electrolyte for Galvanic Batteries. Frank K. Irving and Frederick M. Hill, Brooklyn, N. Y.

The claim is as follows:

"In an electrolyte or liquid for an excitant and depolarizer in a galvanic battery, a chemical combination, mixture and solution consisting of sulphuric acid, chromic acid, and nitrate of the protoxide or peroxide of iron, as and for the purpose specified."

436,023. Electric Detonator or Primer. Henry J. Smith, Compton, N. J.

436,025. Electric Signal for Railways. George A. Tower, Richmond, Va.

436,030. Electric Burglar or Automatic Fire Alarm. Edmund R. Wilder, Kansas City, Mo.

436,050. Secondary Battery Plate. Thomas P. Whittier, Saginaw, Mich.

The last claim reads:

"A secondary battery plate or element, the body or framework of which is composed of separately formed coils intermeshed or interwoven to form a series of connected tubes or boxes, substantially as and for the purposes hereinbefore set forth."

436,080. Reciprocating Snap Switch. Jacob S. Gibbs, Manchester, and Charles G. Perkins, Hartford, Conn.

436,087. Cut out for Electrical Translating Devices. Charles G. Perkins, Hartford, Conn.

436,107. Electric Switch. Charles G. Perkins, Hartford, Conn.

436,113. Magnetc-Electric Machine. LaMotte C. Atwood, St. Louis, Mo.

The object of the invention is to prevent the shifting of what is known as the "polar" line in magneto-electric machines, and to thus keep the brushes always at a non sparking point, whereby a maximum amount of work will at all times be gotten from the machine.

436,119. Electric Soldering Iron. Charles E. Carpenter, Minneapolis, Minn.

436,120. Insulator Bracket. H. Eugene Chubbuck, Springfield, Ohio.

436,122. Double Pole Snap Switch. Howard H. Crowell, Syracuse, N. Y,

436,125. Electric Lighting and Heating Apparatus for Electric Railways. Mark W. Dewey, Syracuse, N. Y.

436,127. Electric Motor. Thomas A. Edison, Llewellyn Park, N. J.

Claim four is as follows;

"The combination, with a driven shaft, of two electro-dynamic or dynamo-electric machines, a differential gearing connecting such machines with the shaft to be driven, and means for changing the dynamic relations of such machines, substantially as set forth."

436,148. Steam Dynamo-Electric Machine. Edward C. Newton, Little Rock, Ark.

436 154. Electric Signals for Railroads. Frank C. Schroen, Baltimore, Md.

436,168. Electric Danger and Safety Signals for Railroads. Edward M. Burt, Paris, Ill.

436,200. Electric Converter. George Westinghouse, Jr., Pittsburg, Pa.

The object of the invention is to provide an electric converter which may be conveniently employed in transforming the alternating currents of high potential conveyed along the streets of a city or town by primary conductors into secondary or induced currents at such points as may be found desirable.

436,205. Watch Demagnetizer. Charles F. Berlin, New York, N. Y.

436,219. Electric Valve Controller. Harry W. Deeds, Indianapolis, Ind.

436,225 Insulator. Josiah C. Firth, Auckland, New Zealand.

436,238. Lightning Arrester. George D. Hoop, Jackson, Ohio.

436,275. Pulsating Current Battery System. Charles J. Van Depoele, Lynn, Mass.

436,276. Adjustable Current Reciprocating Engine System. Charles J. Van Depoele, Lynn, Mass.

436,277. Electric Power Hammer. Charles J. Van Depoele, Lynn, Mass.

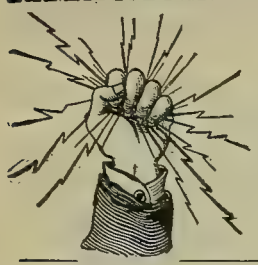
436,281. Portelectric. John T. Williams, Mount Vernon, N. Y.

436,316. Electric Incandescent Lamp. John S. Potter, Newton, David J. Cartwright, Boston, and Benjamin B. Keyes, Chelsea, Mass.

436,319. Type-writing Machine. Edward J. Silkman, Baltimore, Md.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

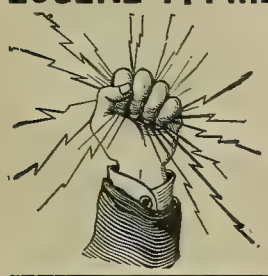
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union,** under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

---

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., { Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS

MAKE ANYTHING IN BRASS.

4 LASALLE AVE CHICAGO.

DO YOU USE

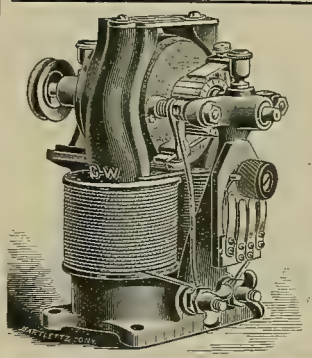
THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE

Crocker-Wheeler

PERFECTED MOTORS

Develop Full Power at Half the Speed of other Makes and are, Therefore, Noiseless.

WORKS:

14th, Washington and 13th Streets,

NEW YORK.

LONG LIFE, High Efficiency, **A CONSTANT** And Beautiful LIGHT.

The SUNBEAM is a SUCCESS.

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinde of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Belt Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

OKONITE

TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

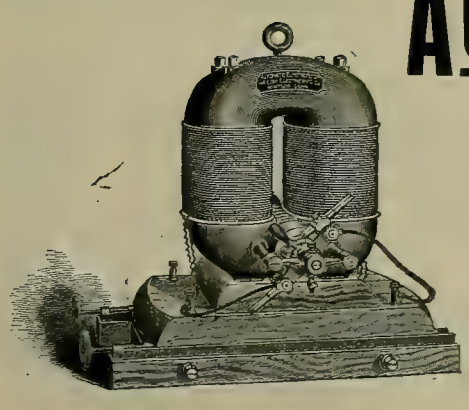
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: *NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 508 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 78 Customhouse St. CHICAGO, 329 Rookery Building.*

The EDDY ELECTRIC MFG. CO., - Windsor. Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 13, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 40c; 75c. bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 15-light	50	volt Dynamo
One 25-light	50	volt Dynamo
One 50-light	50	volt Dynamo
One 75-light	110	volt Dynamo
One 100-light	110	volt Dynamo
One 150-light	110	volt Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

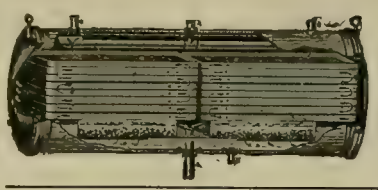
Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. Correspondence Solicited.

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents SCALE in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St., CHICAGO.

INCANDESCENT and ARC LIGHTING and MOTORS.

Isolated Lighting a Specialty.

H. H. HUMPHREY,

1034 New York Life Building.

Contracting and Consulting Electrical Engineer. OMAHA, NEB.

Cleverly, 1018 CHESTNUT ST. PHILA.

"Improved" Automatic Burner.

PATENT LIFT-OVER PENDANT BURNER.

AUTOMATIC BURNER KEYS.

SPARK COILS.

DESK PUSH BUTTONS

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE BARD PORCELAIN.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue 1--66 of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

BALL AUTOMATIC CUT OFF ENGINE MADE ONLY BY THE BALL ENGINE CO ERIE PA.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

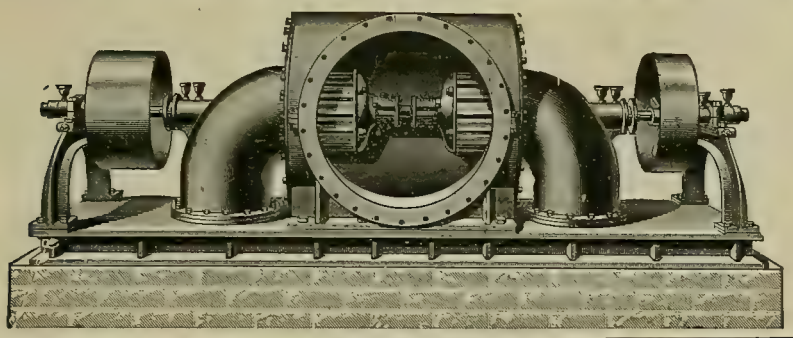
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its diameter, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

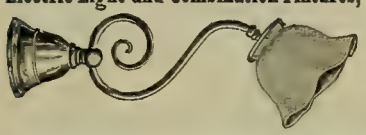
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

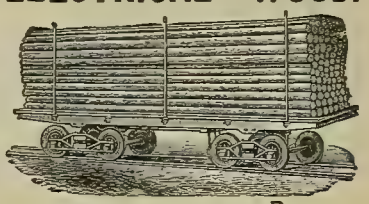
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.

Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

DOUBLE ARC LAMPS.

No finely geared clock work. No close fitting sliding solenoid cores.
No steel pinions or pivots to rust and stick. No gearing to clog with dust.

Practically and Theoretically the simplest and best constructed Double Arc Lamp.

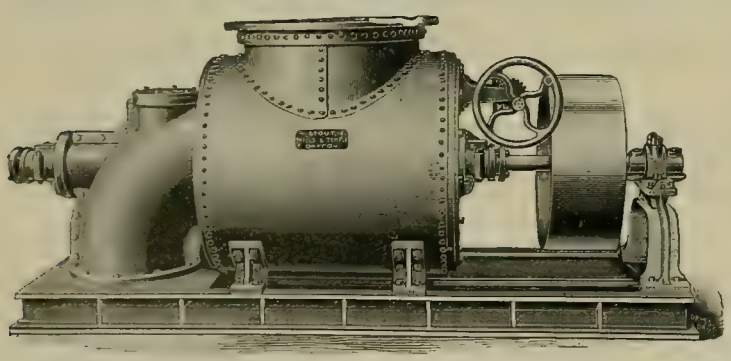
The ONLY DOUBLE ARC LAMP MANUFACTURED for both High and Low Tension Currents.

We offer to furnish Companies using high or low tension systems with new double arc lamps, guaranteed to work satisfactorily, and with guarantee against loss on account of suits for alleged infringement of patents.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

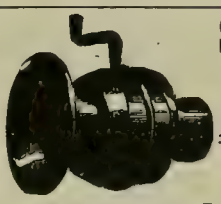
OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.



SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

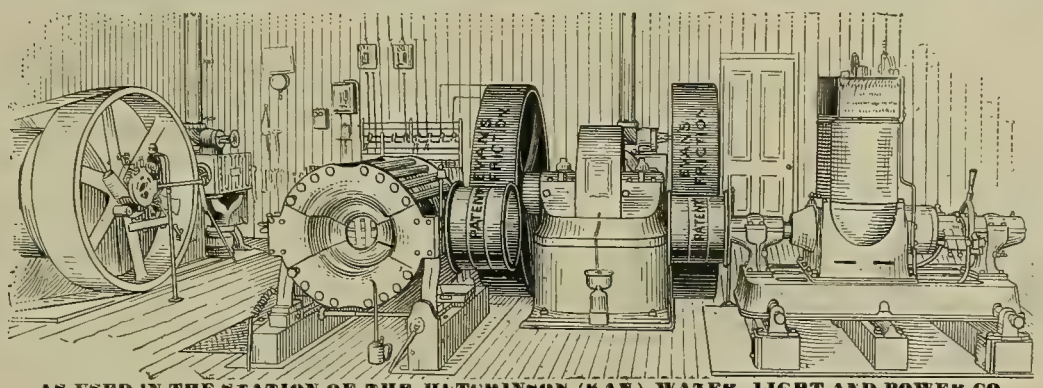
ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

The EVANS SYSTEM OF DRIVING DYNAMOS.

Has been in constant operation since January, 1890.



50 Full Arc Light T.-H. 720 Incandescent Edison Dynamos.

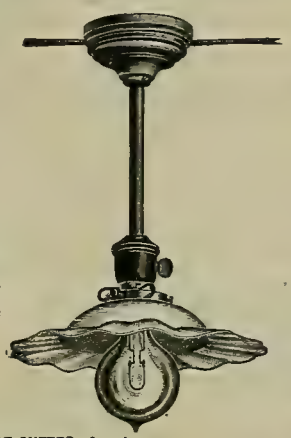
AS USED IN THE STATION OF THE HUTCHINSON (KAN.), WATER, LIGHT AND POWER CO.

Write for Catalogue "D" to **THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.**

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

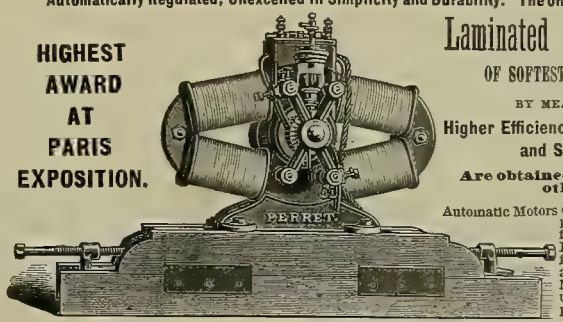
THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,
—MANUFACTURERS OF—
PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets
OF SOFTEST CHARCOAL IRON,
BY MEANS OF WHICH
Higher Efficiency, Closer Regulation, and Slower Speed
Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting, Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FRANKLIN S. CARTER. CHAS M. WILKINS. E. WARD W LKINS
— TRADING AS —

PARTRICK & CARTER,

Manufacturers of and Dealers in Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE
NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

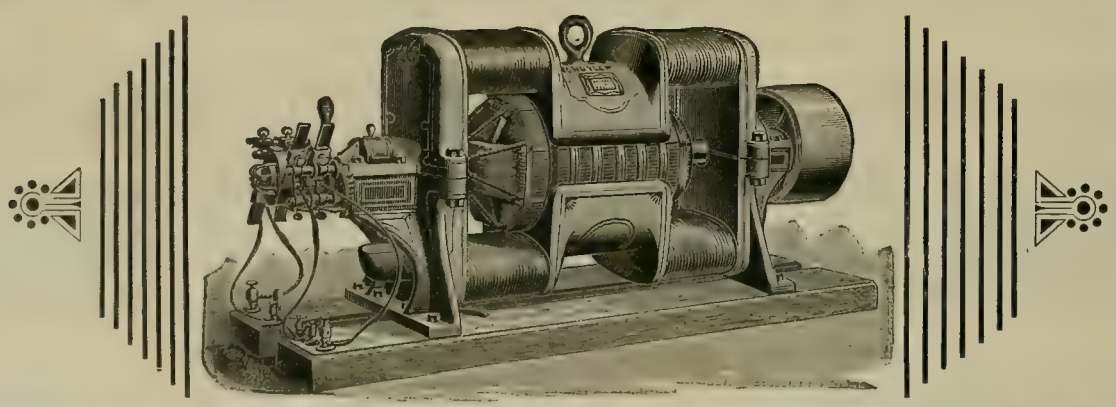
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY, CHICAGO.

OKONITE
TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

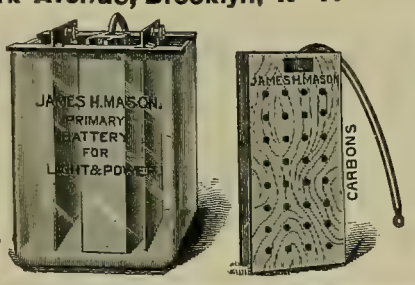
SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

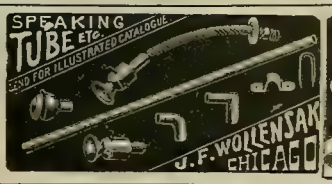
PRIMARY BATTERIES
—FOR—
Household Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.
These Batteries are in practical use, and giving perfect satisfaction.





BARNES' NEW SENSITIVE DRILL

Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

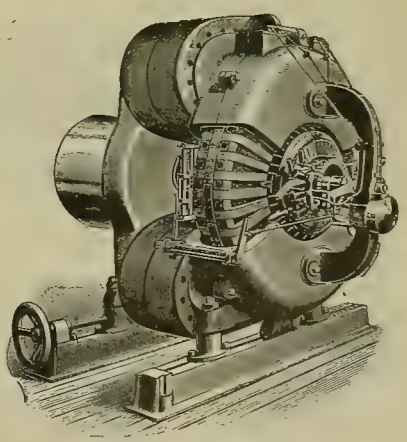
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

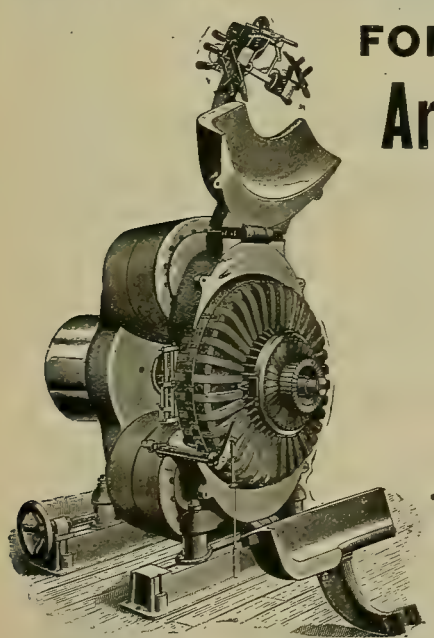
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

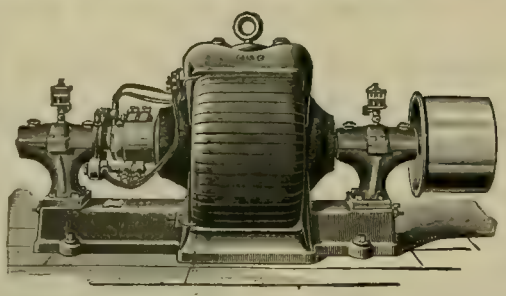
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

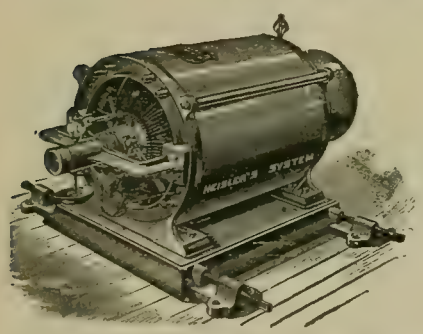
Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.



UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.

"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2 000	"
" " " "	3d " (Just ready.)	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition (Just ready.)	2,500	Copies
Bell Hangers' " "	1st "	2,500	"
" " " "	2d "	1,000	"
Total within Eighteen months		15,000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single S roke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

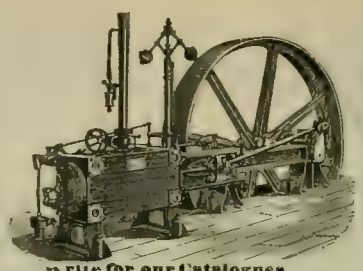
Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

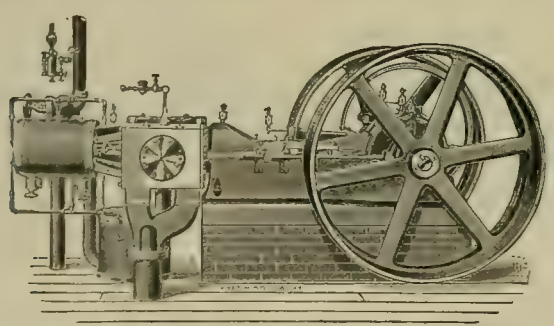
JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
—FOR—
ELECTRIC MOTORS

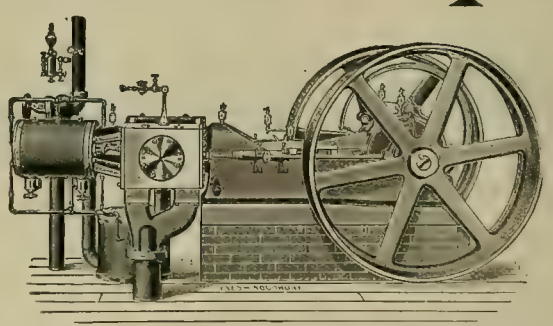
CARS ADAPTED TO ALL SYSTEMS.

WE ARE HEADQUARTERS IN THE WEST
FOR ELECTRICAL BOOKS.
SEND FOR OUR NEW AND COMPLETE CATALOGUE,
Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

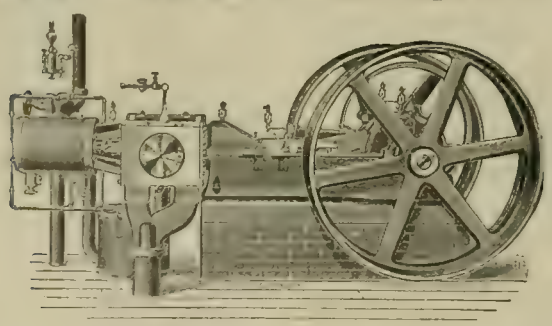
None so Good, None to Equal.



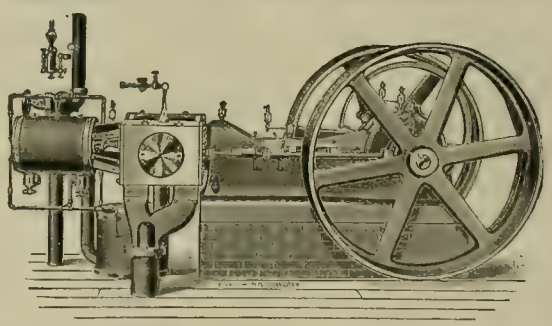
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

WHIPPLE'S

Electric, Gas & Street Railway

FINANCIAL REFERENCE DIRECTORY

FOR 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

THE MONON ROUTE

Affords choice of Four (4) Fast Trains each way, commencing June 1, 1890,

EVERY DAY AND SUNDAY, TOO

In Pullman's Patent Perfected Safety Vestibuled Buffet Sleepers and Chair Cars between

CHICAGO and the OHIO RIVER.

These are all solid Pullman trains of latest design and improvements, consisting of Elegant Day Coaches, Chair Cars, Composite Cars, Dining Cars and the very finest of Buffet Sleeping Cars, equipped with Pullman's Perfected Safety Vestibules.

Trains from Cincinnati and the Southeast, and from Louisville and the South, arrive at Chicago in ample time to connect with the morning and evening fast trains for Milwaukee, Minneapolis, St. Paul, Omaha and all points in the Northwest.

Morning and evening connections made both at Louisville and Cincinnati with the Fast Express Trains of connecting lines for Memphis, Knoxville, New Orleans, Jacksonville and all points South.

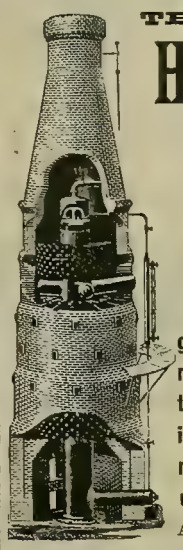
At Indianapolis connections are made with all diverging lines.

Special Features: Steam Heat, Electric Light, Perfected Safety Vestibules.

For rates, through and local schedules, address any Ticket Agent of the Monon Route.

Wm. F. Black, General Manager.
W. H. McDoel, Traffic Manager.
James Barker, General Passenger Agent.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.



THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

C., M. & ST. P. R. R.

The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. **Compound and Valveless.**

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

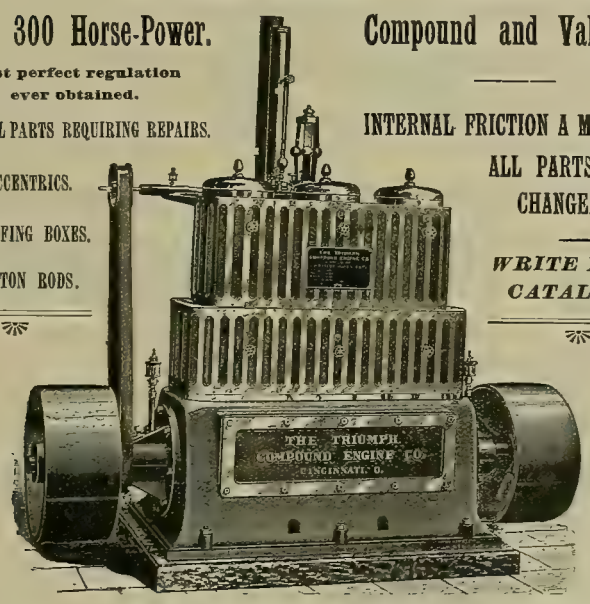
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

Over 105 Roads operated under Our System, and that Successfully, both Financially and Electrically.

EDISON GENERAL ELECTRIC COMPANY,

Edison Building, BROAD STREET, NEW YORK CITY.

ELECTRIC STREET RAILWAYS.

Our Electric system for Street Railways has been found to be the most durable, reliable, economical and convenient.

New roads in course of construction going on in all parts of the country.

Railroad Managers and Others interested in this business are earnestly requested to correspond with us, to *get facts* and *data* showing the advantages and possibilities to be obtained by Electric Traction over any other existing methods.

DISTRICT OFFICES:

NEW YORK, Edison Building.
SAN FRANCISCO, 112 Bush St.
PORTLAND, ORE., Fleischner Bldg.
TORONTO, CAN., Bank of Com. Bldg.
CHICAGO, Rialto Building.
NEW ORLEANS, Cotton Exchange.
DENVER, Masonic Building.
BOSTON, 38 Pearl St.

C. H. & D. R. R.

BEST ROUTE

From CINCINNATI to the North and North West.

C., B. & Q. R. R.

—IS THE—

Best Appointed Line

—FOR REACHING THE—

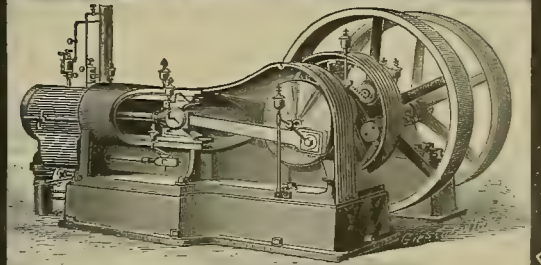
West, Northwest and Southwest.

MATERIAL AND WORKMANSHIP OF THE BEST.

ECONOMY UNEXCELLED

REGULATIONS PERFECT

BECK AUTOMATIC ENGINE.



HOT BEARINGS UNKNOWN

PRICES MODERATE

TAYLOR MFG CO. CHAMBERSBURG, PA.

COMPLETE STEAM PLANTS A SPECIALTY

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

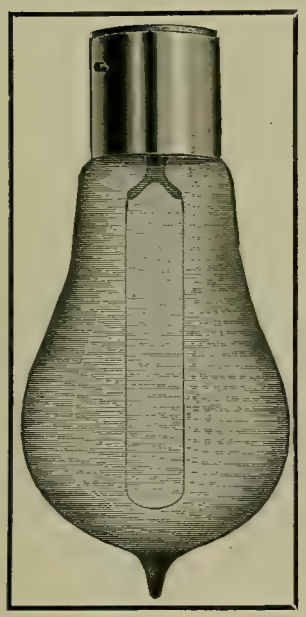
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

—THE—

Perkins Electric Lamp Co.

ALL CANDLE POWERS.

TO FIT ANY SOCKET. ANY VOLTAGE,

ANY EFFICIENCY.

GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

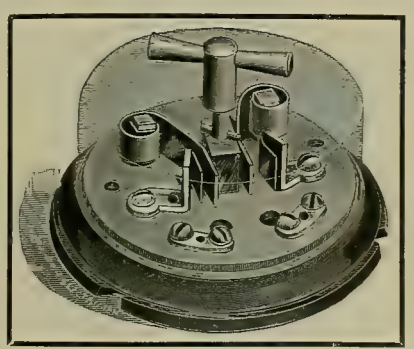
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

—WE CALL SPECIAL ATTENTION TO—

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

—FOR—

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

WESTERN AGENTS.

HABIRSHAW WIRES, CABLES AND CORES.

A HIGH GRADE OF RUBBER INSULATION.

[CONTINUED FROM LAST WEEK.]

In our advertisement of August 30th, we referred to the quality of Habirshaw Insulation, giving some letters from both experts and users. The week following we gave a list showing a few places where it had been used. Last week we illustrated some of the cores in the installations referred to.

Below are some facts and statements worthy of attention:

FROM OUR CHEMIST.

(LETTER JUST RECEIVED.)

"I have your letter in reference to the wires made by the —— Company. The goods which these people make, so far as I am able to judge from the samples which have come into my possession, are of the worst class of any so-called 'rubber insulations' that are made in the United States. I have analyzed several samples and find them as above stated. There is no doubt they can be sold a little cheaper, but not much. I will write more in the course of a week, as I have sent out to obtain more samples of the goods."

OUR OWN STATEMENT.

AUGUST 8, 1890.

The claim of superiority of insulated wires is based on purity of materials, and superior mechanical processes and workmanship.

It is pretty well acknowledged by intelligent practical men that to obtain both high insulation and long life, there are only two available insulating substances, Gutta-percha for under water, and India Rubber for under and over water. These are resins, but whenever mixed with oil, waxes, paraffine, ozokerite, and such like bodies, the life is impaired. It is also acknowledged that "recovered" rubber has lost its life, and is valueless for insulating purposes.

This is about the whole story, and is simple and plain. All plain statements and facts are more difficult to impress a hearer with their truth than lies and misrepresentations. The advance is very slow, but it is very certain. It is difficult to advance the causes of failure of low grade insulations, but we continually hear of the giving out of every variety of mixed goods. Many are too generous and ready to believe any plausible talker and most readily believe statements boldly made. The time will come when more knowledge will be brought to bear on this subject, and every little item helps to gain a better insight into the facts.

The Habirshaw insulation fulfills all requirements in places demanding the "BEST," and in that field finds no successful competitors.

THE BRUSH ELECTRIC COMPANY

STILL CLAIMS THE EXCLUSIVE RIGHT TO MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

AGAIN SUCCESSFUL

THE BRUSH ELECTRIC COMPANY
vs.
THE WESTERN ELECTRIC LIGHT & POWER COMPANY, et al.
(Western Electric System.)

Opinion by Judges Brown and Ricks in the United States Circuit Court for the Northern District of Ohio, filed August 15, 1890:

"Any dissimultaneous arc forming separation by mechanism resulting in the suc-"cessive burning of the carbons, is an infringement of the Brush patent."

So called double fixed carbon, three carbon or flat carbon lamps are crude and unsatisfactorv.

The Court says:

"Defendants experts are constrained to admit, not only that Brush was the first to "invent the principle of substitution in his double carbon lamp, but that the Western "Electric Company could not successfully compete with the companies using his patent, "in furnishing all night electric lighting plants unless it could provide double carbon "lamps to its customers."

"We should have felt fully justified in disposing of this case by a simple reference to "the opinion of Judge Gresham in the Brush Electric Company vs. The Ft. Wayne Electric "Light Company, in which the same construction was placed upon the Brush patent, but "in view of the importance of the questions involved, and of the elaborate preparation of "counsel, we have deemed it proper to give it an independent consideration."

"We are clearly of opinion that complainant is entitled to relief in this case, and a "decree will, therefore, be entered for an injunction, and the usual reference to a Master "to assess and report its damages."

BRUSH APPARATUS ALWAYS RELIABLE.

ARC AND INCANDESCENT LIGHTING SYSTEMS,

ELECTRIC MOTORS, GENERATORS, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

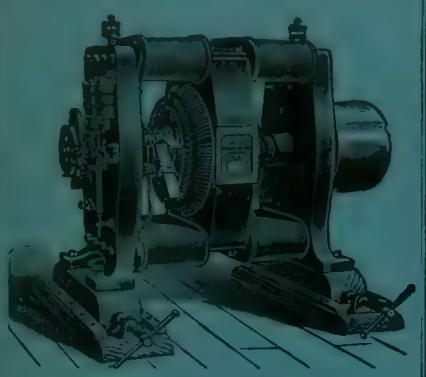
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



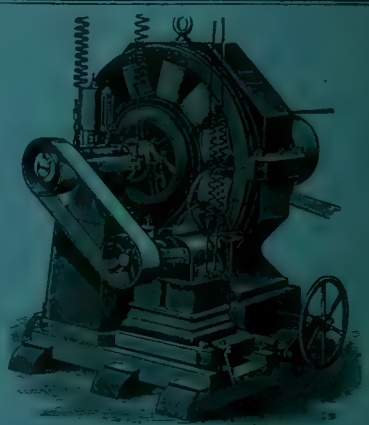
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 60 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

PHŒNIX GLASS CO

OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES SHADES

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

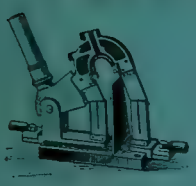
729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, SEPTEMBER 27, 1890. No. 13

"AJAX SWITCHES"

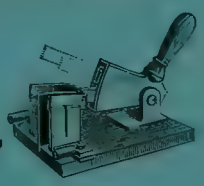


In all Sizes, for any Potential,
Single, Double and Treble Pole

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,
74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas.
{ PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

CABLES AND WIRES FOR Electric Railroads, Telephone and Telegraph, Electric Lights.

STANDARD UNDERGROUND CABLE CO.,
NEW YORK. PITTSBURGH. CHICAGO.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4½-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.
Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

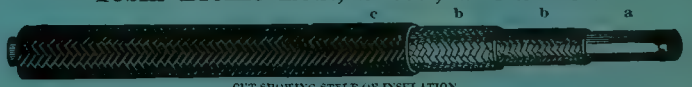
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof
ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.



CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York,
{ 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

INSULATING TAPE: "THE ACME."

CENTRAL DISTRICT OFFICE, RIALTO BUILDING, CHICAGO.

For Addresses of other District Offices, SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964		3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	[illegible]
Waterhouse	222	.....	222
Heisler	.....	500	500
Remington	159	300	459
Sperry	130	.....	130
[illegible]	90	.....	[illegible]
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc	Inc
Thomson-Houston	16,927	45,055
Brush	6,090	[illegible]
Westinghouse	321	[illegible]
Edison	.....	[illegible]
American	1,537	175
United States	632	6 141
Schuyler	1,166	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	[illegible]
Remington	129	.....
Sperry	160	.....
Excelsior	205	30
Hochhausen	[illegible]	.....
Weston	138	.....
Fuller	10	.....
Reliance	[illegible]	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for il umination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771
THOMSON-HOUSTON lights by Gas Companies	**11,084**	**16.927**	**8.826**	**45.055**
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716
Proportion of Thomson-Houston to whole number of lights	**52%**	**53 6-10%**	**15 7-10%**	**33 9-10%**

	Arc.		Incandescent.	
	T. H. System.	All other Systems	T. H. System.	All other Systems.
Lights in use as per clipping, June 14, 1890.	**16,927**	14,631	**45,055**	87,716
Lights in use as per clipping, March 20, 1889	**11,084**	10,229	**8,826**	47,064
Increase	**5,843**	4,402	**36,229**	40,652
Percentage of increase	**52 7-10%**	43%	**410%**	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.. ——
Alexander, Barney & Chapin.. xii
Allis, E. P. & Co..... xxiv
American Electrical Works.. xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co..... vii
Baggot, E..... xvi
Bain, Foree..... xvi
Ball Engine Co..... xxii
Barnes, W. F. & Jno..... xxi
Barton, Geo. P..... xxv
Baxter Electric Motor Co..... xxx
Bernstein Electric Co..... ——
Bleckert & Nelson..... xvii
Brown, Frank T..... xvi
Brooks Underground Tel. Co.. xiv
Brush Electric Co..... xxix
Bunnell & Co., J. H..... ——
Butler Hard Rubber Co..... xx
C. B. & Q. R. R..... xxv
C. & C. Electric Motor Co... xxii
Central Electric Co..... xi
Cleverly Electrical Works... xvi
Colburn & Co., I. W..... xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... ——
Consolidated Electric Storage Co..... ——
Continental Dynamo Co..... iv
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... ——
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xviii
Easton Electric Co..... iv
Eastern Electric Cable Co..... xv
Eddy Electric Mfg. Co..... xv
Eddy, Henry C..... xvi
Edison Mfg. Co..... xxii
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Railway Dept..... xxv
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co..... xix
Electric Construction & Sup. Co iv
Electric Merchandise Co..... xvi
Electrician Publishing Comp'y, xxiii, xxiv
Electrical Supply Co..... xxviii
Elektron Mfg. Co..... xix
Empire City Electric Co..... xviii
Empire China Works..... xvi
English, Morse & Co..... xvii
Eureka Tempered Copper Co.. xvii
Evans Friction Cone Co..... xix
Excelsior Electric Co..... xxi
Fibrone Mfg. Co..... xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works.... xxiii
Fort Wayne Electric Co..... xxx
Gibson Gas Fixture Co..... xviii
Giles Bros..... vii
Globe Carbon Co..... xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S..... xiv
Harmount, G. A..... xvi
Hawkeye Electric Mfg. Co..... ——
Hazazer & Stanley..... xiv
Hazelton Tripod Boiler Co.... xxv
Heisler Electric Light Co..... xxii
Hill Clutch Works..... xxiii
Holmes, Booth & Haydens..... xvii
Holmes & Co., C. H..... xvii
Holtzer-Cabot Electric Co..... i
Humphrey, H. H..... xvi
Ide & Son, A. L..... xiv
Illinois Electric Material Co.... xiv
India Rubber & Gutta Percha Co. i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L..... i
Jewell Belting Co..... xv
Jones Bros. Electric Co..... vii
Knapp Electrical Works..... xxvii
Laminar Fibre Goods Co..... xvii
Law Telephone Co..... xv
Leclanche Battery Co..... vii
Magnolia Anti-Friction Metal Co i
Mason, Jas. H..... xxi
Mitchell Vance Co..... xxx
Monitor Electric Co..... xvi
Munsell & Co., Eug..... xv
Munson Belting Co., Chas..... xiv
National Carbon Co..... iv
National Conduit Mfg. Co..... xii
National Electric Mfg. Co..... x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T..... xvi
N. Y. Belting & Packing Co... ——
Okonite Co..... xv
Ostrander & Co., W. R. xviii
Page Belting Co..... ——
Paiste, H. T..... xiv
Partrick & Carter..... xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co..... xxx
Pond Engineering Co..... xxiv
Powell Co., Wm..... xxv
Pumpelly Storage Battery Co. vii
Queen & Co..... xvi
River & Rail Elec. Light Co.. ix
Roeblings' Sons Co., Jno. A... xix
Sawyer-Man Electric Co..... xii
Schoverling, A..... xxiii
Schuyler Electric Co..... xx
Shultz Belting Co..... vii
Southern Electrical Supply Co. xxi
Sperry Electric Co..... xviii
Standard Electrical Works... xvi
Standard Paint Co..... xiv
Standard Underground Cable Co. i
Standard Carbon Co..... xx
Stephenson & Co., Jno xxiv
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co.. xxi
Sunbeam Incandescent Lamp Co. xv
Taussig, S..... xvi
Taylor Mfg. Co..... xxv
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxvi
Triumph Compound Engine Co..... xxv
Turner Brass Works..... xv
Union Hardware Co..... xiv
United Electric Traction Co.... vii
United States Electric Lighting Co..... xiii
Van Nuis C. S..... i
Wanted..... xvi
Western Electric Co..... xviii
Western Power Construction Co. xxiv
Westinghouse Electric Co. xiii
Weston Electrical Instrument Co..... xiv
Wollensak, Jno. S..... xxi
Woodbridge & Turner..... xvii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Hazazer & Stanley.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Hazazer & Stanley.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Hazazer & Stanley.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Hazazer & Stanley
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrancer & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Hazazer & Stanley.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Brooks Underground Telegraph Co.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brooks Underground Telegraph Co.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Const
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eng. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Mitchel-Vance Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Mitchell-Vance Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Contd.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Western Electric Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

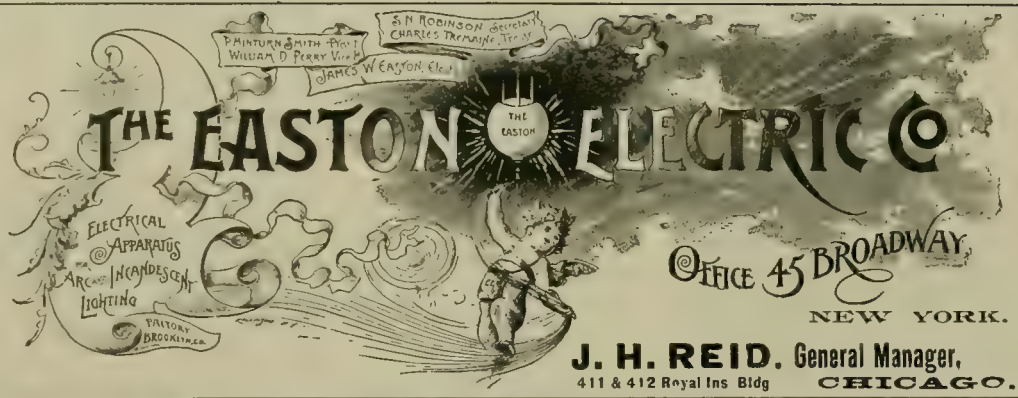
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



J. H. REID. General Manager,
411 & 412 Royal Ins Bldg CHICAGO.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

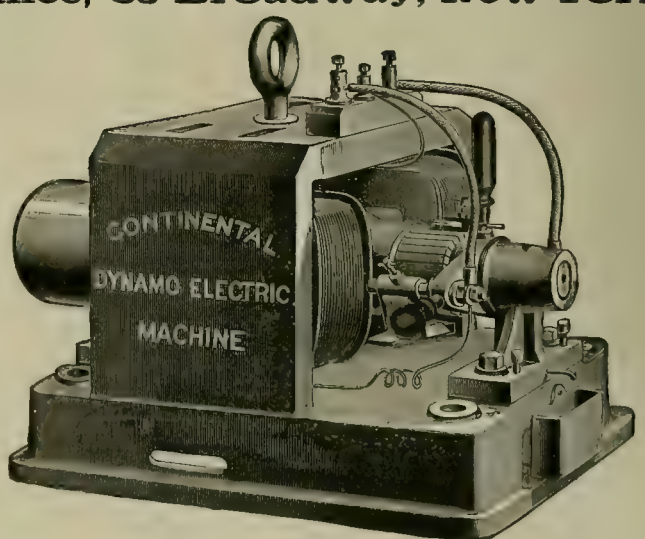
JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 68 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2 Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. B aid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192 FIFTH AVE., CHICAGO.

Makers of the Choicest Electrical Supplies.

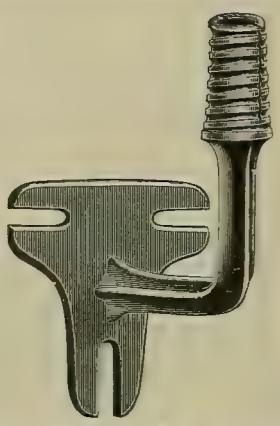
CHUBBUCK BREAK ARM.
Malleable Iron. PATENTED.

GENERAL WESTERN AGENTS:

Pettingell, Andrews & Co., *K. W. CUT-OUTS.*

Massachusetts Electrical Engineering Co., *TESTED FUSE WIRE.*

The Electric Gas Lighting Co., *Gas Lighting Apparatus, Samson Batteries.*

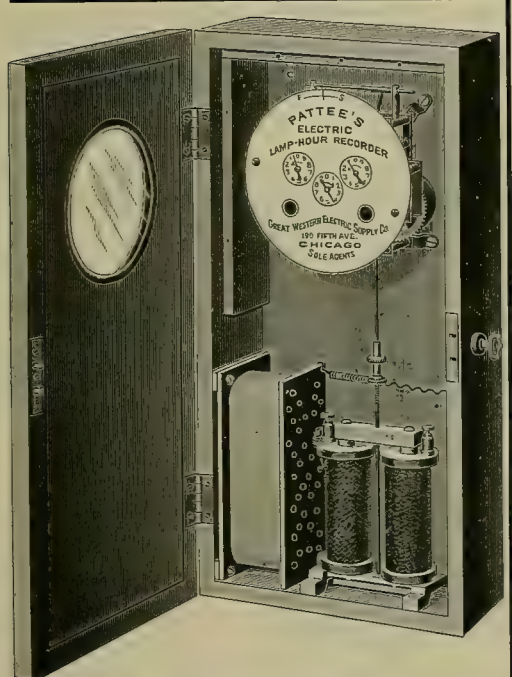


CHUBBUCK BRACKET.
PATENTED Sept 9, 1890.

THE WIRE THAT GIVES THE HIGHEST LINE INSULATION.

SIMPLEX

THE WIRE THAT PAYS BEST IN THE LONG RUN.

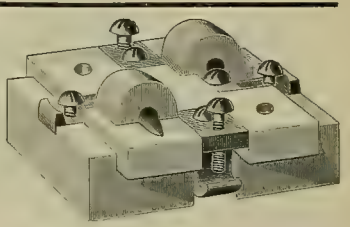


PATTEE'S LAMP-HOUR RECORDER.

TREBLE CURVE INSULATOR.
Greatest Strength and Highest Insulation.

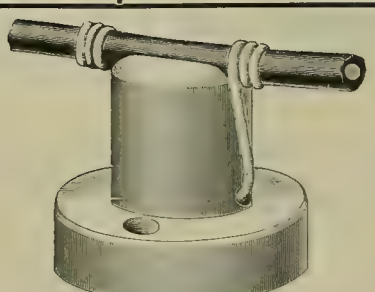
POLE TOPS, RAIL BONDS, ARMATURE PINIONS, and other novelties of merit, with a full line of all the standard

Electric Railway Supplies

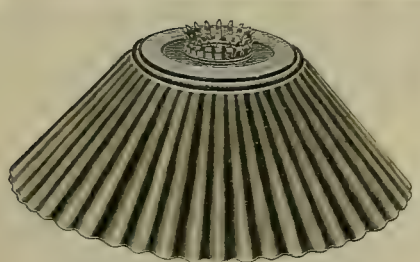


CUTTER'S PORCELAIN BRANCH CUT-OUT.
Fuse Covers and Base made out of one solid piece.

ELECTRIC FIXTURES, Many New Designs.
ELECTRIC SHADES, Large and Complete Stock.
ARC GLOBES, Good Figures in Quantities,
TELEGRAPH APPARATUS, A Fine Line.
ANNUNCIATORS and BELLS, All Sizes.
LINEMAN'S TOOLS, Choice Assortment.



CUTTER'S E. L. INSULATOR.
Gives High Insulation even on Damp Ceilings, and the Unsightly Blackening Prevents.



COMBINATION CONE SHADE.
PATENTED.

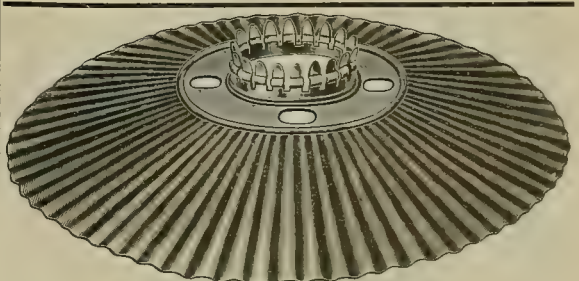
CUTTER'S COMBINATION SHADES.

Fit T-H., Westinghouse or Sawyer-Man Sockets.

ALSO MADE FOR EDISON SOCKETS.

No Tools, No Trembling, No Holder.

THE MOST ECONOMICAL SHADES MADE.



COMBINATION TIN SHADE.
PATENTED.

Send for Special Circular describing any of the above, or write us of your needs, and we will cheerfully give our advice.

IF YOT HAVE NOT YET GOT A COPY OF OUR
Sketch Catalogue,
BE SURE TO SEND YOUR BUSINESS CARD FOR ONE.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

403-405 Sibley St., ST. PAUL, MINN. PORTLAND, ORE., Branch, 266 First St.

SOLE NORTHWEST AGENTS FOR

Thomson-Houston Apparatus.

ARC AND INCANDESCENT LIGHTING.

Electric Street Railways.

COMPLETE CENTRAL STATION PLANTS.

Arc Plants, Alternating Incandescent Plants, Direct Current Incandescent Apparatus for Isolated Plants.

ELECTRIC STREET RAILWAYS

INSTALLED COMPLETE.

SEND FOR CATALOGUES AND ESTIMATES.

We carry the largest and most complete line of Electric Supplies in the Northwest. Send for catalogue and discount sheet.

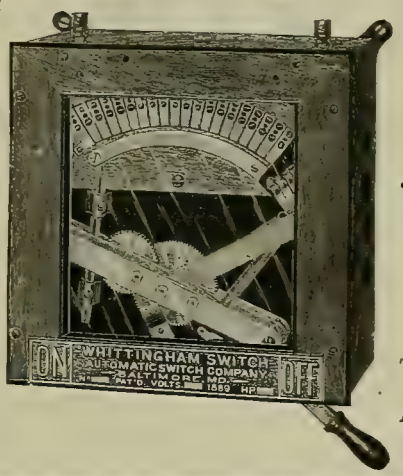
Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction. Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices. Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

BRANCHES: 161 Summer St., Boston, Mass.; 225 Pearl St., New York City; 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St. Louis, Mo.

AUTOMATIC SWITCH CO.,



No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

W-A-T-C-H-E-S.

The World's Exposition in Paris, 1889, awarded a prize medal to The Giles Anti-Magnetic Shield for watches. It has been proven to be the best practical and permanent solution to the trouble electricians have with their watches.

The shield can be applied to any watch, or is furnished in new watches by

GILES BROS., - CHICAGO.

TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,

149 West 18th Street, - - NEW YORK.

UNITED Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS. STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago. 111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

CINCINNATI HEADQUARTERS

ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.

WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE · FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·

THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.

The JONES-BROS-ELECTRIC-CO. 28 30 & 32 West Court St.

EDISON GENERAL ELECTRIC CO.,

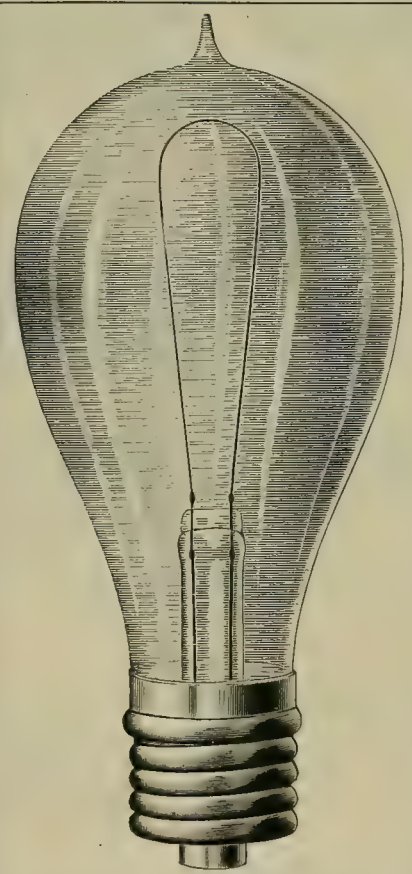
EDISON BUILDING, Broad St., NEW YORK.

EDISON LAMPS.

For Series Burning on Electric Railway and Power Circuits.

No. 1.
No. 1 is the Standard Edison Base.

No. 2.
No. 2 is the Thomson-Houston Base.



The Edison Incandescent Lamp.

No. 3.
No. 3 is the Westinghouse Base.

No. 4.
No. 4 is the United States Base.

BASES. Unless otherwise specified, all Railway lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 or 4 will be placed on lamps, when so ordered, without extra charge. **BASES.**

DURABLE. EFFICIENT. ECONOMICAL.

NOTE---These Lamps have been designed Specially for burning in Series on Power Circuits, and particularly for the use on the 500 volt Electric Railway Circuit.

VOLTAGE - - 95 to 100.

Please address for Circulars and Prices the nearest district office as below.

Main District Offices:

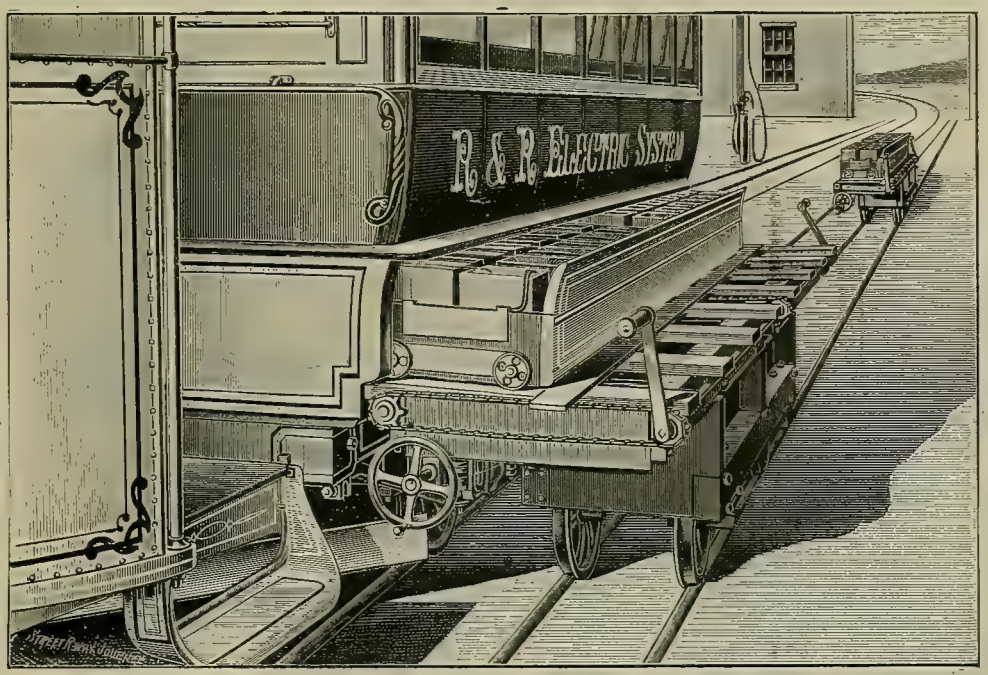
Eastern District, 16 and 18 Broad St., New York.
Central District, Rialto Building, Chicago, Ill.
Southern District, Cotton Exchange Bldg., New Orleans, La.
Mountain District, 730 Seventeenth St., Denver, Colo.
Pacific Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Northwestern District, Fleischner Bldg., Portland, Ore.
New England District, 38 Pearl St., Boston, Mass.
Canadian District, Toronto, Canada.

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



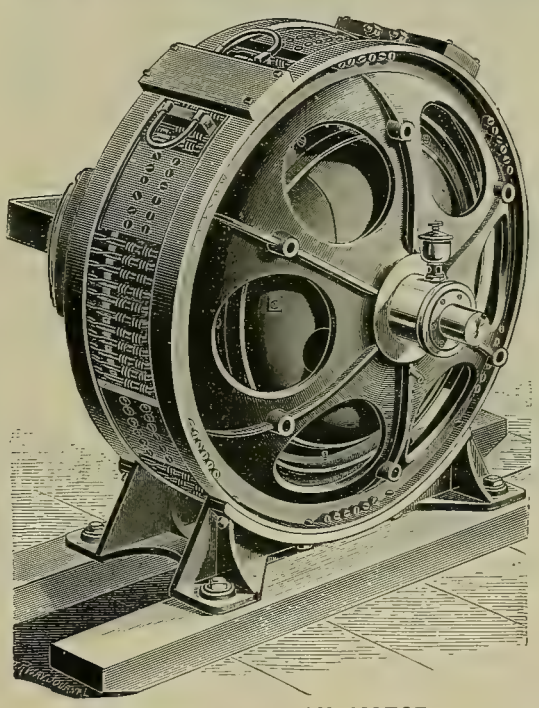
METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

Cars are Lighted by Batteries That Propel The Motor.

THE MAIN Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

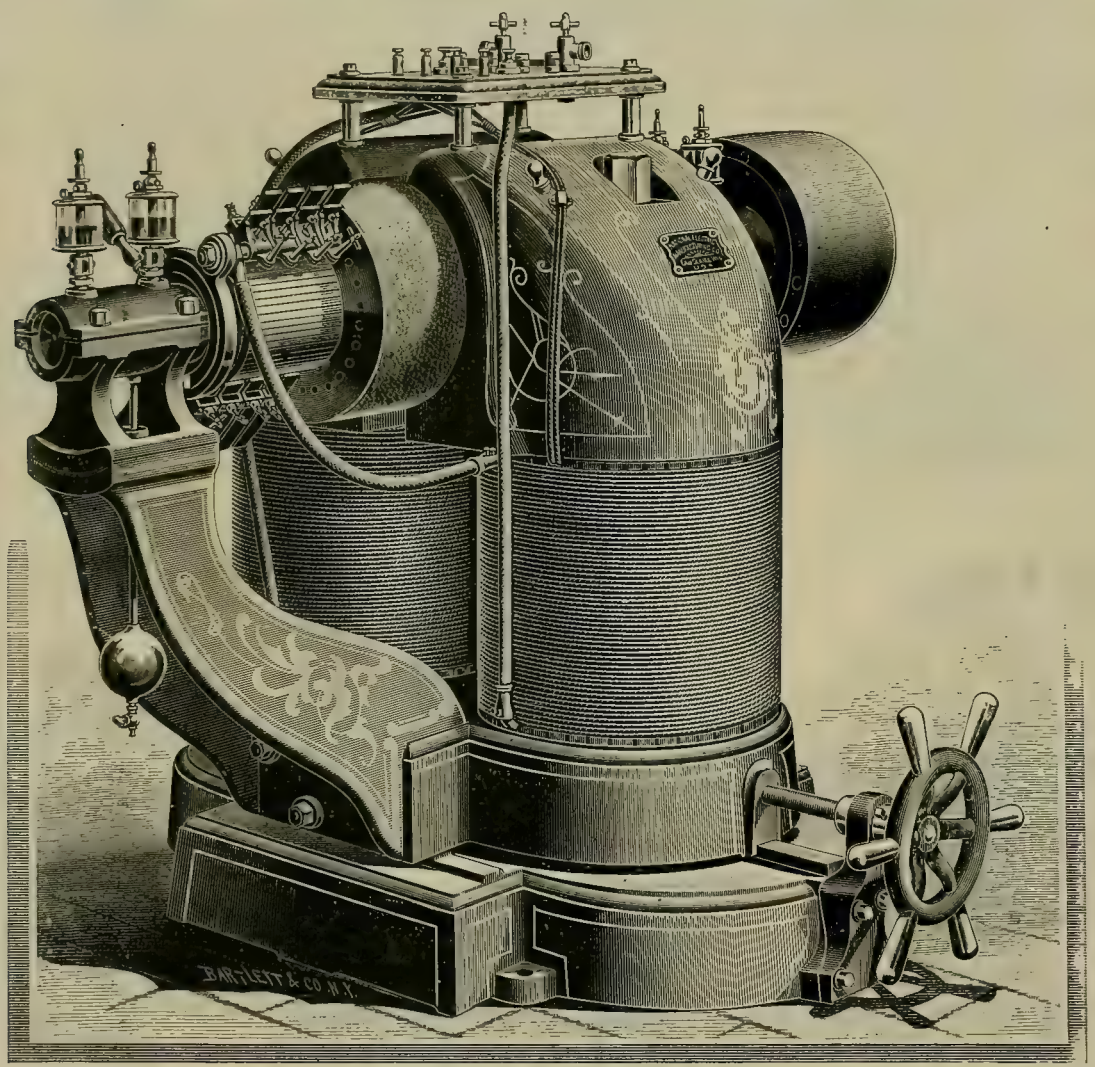
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMOS, CAPACITY 500-16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

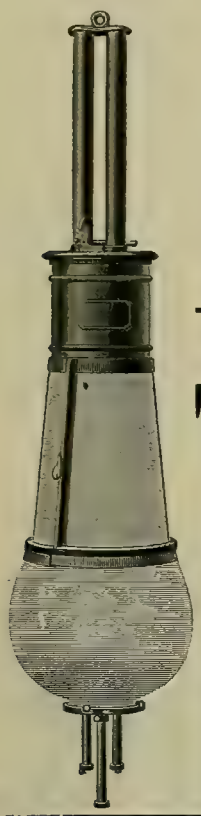
BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building. St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Co.



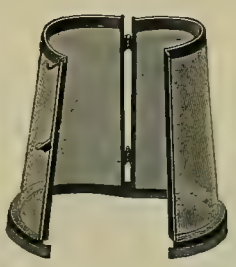
OKONITE TRADE MARK.

GENERAL WESTERN AGENTS FOR

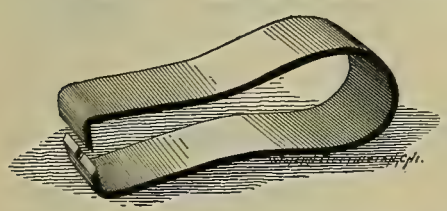
OKONITE AND CANDEE WIRES.

The Central Spark Arrester

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting to the globe.



THE PERRY WIRE PEELER.



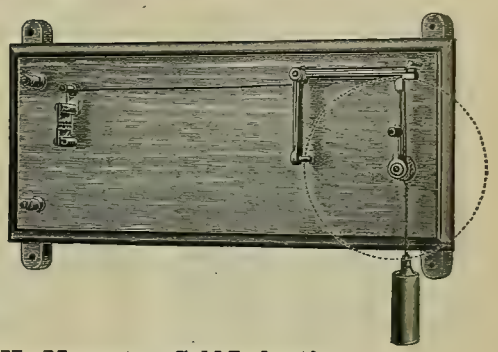
This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs.
Cleveland Switches, Paiste Switches, Branch Blocks,
And all kinds of Electrical Supplies.

THE HOT WIRE

Lightning Arrester.



No Magnet or Self-Induction.
Furnishes Absolute Protection,
And is Automatic in its Action.

OUR PRICE ON THESE INSTRUMENTS IS VERY LOW.

ANTI-MAGNETIC WATCHES.

We have completed arrangements with the Electricians' Time Company by which we are enabled to offer to Electrical men a thoroughly first-class watch, absolutely protected from magnetic influence, and at a very low price. Each watch is accompanied by a guarantee, stating first what it is, and in cases where desired, payments are made easy. Send for a descriptive circular.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

A
B
C
And Everything
Up To
Z

OCTOBER 1st, 1890.

IN

ELECTRICAL SUPPLIES

WILL BE FOUND AT

Alexander, Barney & Chapin,

20 CORTLANDT STREET,

TELEPHONE, 1139 CORTLANDT.

NEW YORK.

SAWYER-MAN LAMPS,

Any Candle Power,

To Fit Any Socket.

NEW SERIES LAMP AND SOCKET FOR

ARC CIRCUITS.

SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

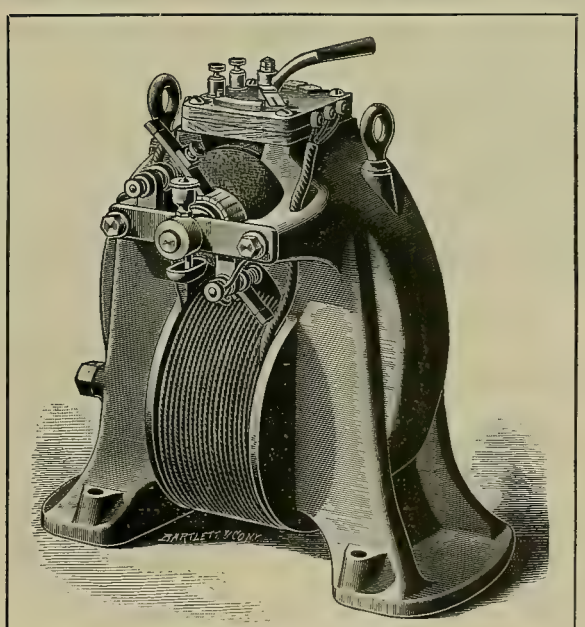
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

Cheaper than Overhead Wires,

MORE THAN TEN TIMES AS DURABLE.

Guaranteed to stand a pressure of 100,000 volts when used for Electric Light Mains. Write for Estimates to the

Brooks Underground Telegraph Co., 207 Walnut Place, Room 5, Philadelphia.

THE E. S. GREELEY & CO.,

GENERAL ELECTRICAL SUPPLIES,

5 and 7 DEY ST., NEW YORK.

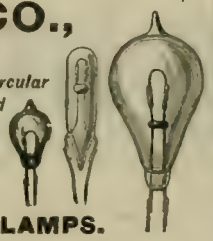
ELECTRICAL MEASUREMENT

Instruments and Batteries of the Very Highest Grade,

Precision and Constancy, Quality and Finish, the Best in the World.

Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.



MINIATURE INCANDESCENT LAMPS.

HAZAZER & STANLEY,

ELECTRICAL HOUSE FURNISHINGS,

32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

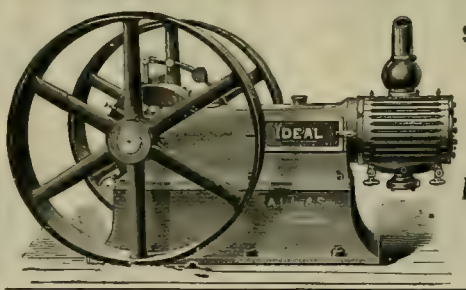
Messrs. Hazazer & Stanley.

GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

Yours truly, *CHAS. E. GOODRICH, Electrician, 503 Eighth Avenue.*

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETT, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

THE IDEAL ENGINE.



Self Oiling.
Unequaled Regulation.
Simplicity,
Perfection.

SEND FOR CATALOGUE.

A. L. IDE & SON, Manufacturers
SPRINGFIELD, ILL.

Chicago Office: 89 Lake Street.
St. Louis Office: 313 Olive Street

THE WESTON STANDARD

Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,
Newark, N. J.

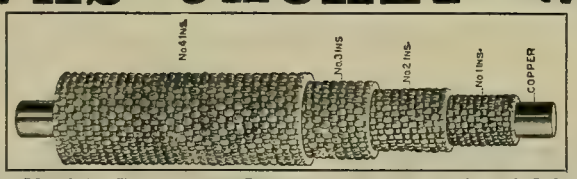
POLES

CANVAS JACKET WIRE.

POLES

PATENT WOVEN INSULATION.

ELECTRIC LIGHT AND RAILWAY SUPPLIES.



HIGHEST INSULATION, ABRASION AND TENSILE STRENGTH WIRE ON THE MARKET.

Outlives any other "high grade" wire.

SEND FOR CATALOGUE TO **THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg, CHICAGO.**

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

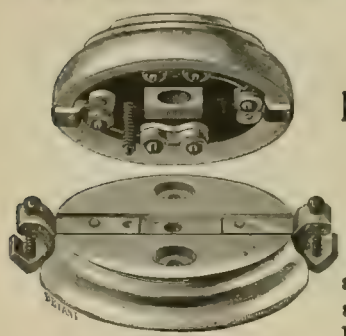
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.



Patented.

DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.

Kept in Stock and for Sale by all Prominent Supply Houses.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co.

MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

GET THE BEST!

P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, SEPTEMBER 27, 1890. No. 13

Constructing an Electric Road.

As familiar as most of the readers of the WESTERN ELECTRICIAN are with electric railways, it is doubtful whether a large majority of them have had an opportunity to acquaint themselves with the details of the methods of preparing a road for operation. Through the courtesy of George K. Wheeler of the railway department of the Thomson-Houston company, the WESTERN ELECTRICIAN is enabled to present a description of the manner in which work is now being executed by that company.

The rapidity with which poles and electric wires have loomed up along much traveled thoroughfares has been a constant source of wonderment. What was one day an unhampered street would be the next hemmed in with long rows of poles and lines of wire. On a straight stretch of roadway, it is not unusual to put up in one day a mile of the superstructure. One instance is recorded on the Cambridge electric road of a double-tracked mile of the electric system being re-equipped in three hours, including the placing of frogs and switches. This was done, too, without interrupting travel on the rails for a moment. In fact, the entire ten miles of this division was equipped in the same manner.

The first step in the process of construction is the locating of the position of the poles, which are set in most instances from 120 to 130 feet apart. The poles, composed of three sections of wrought iron pipe, 6, 5 and 4 inches in diameter, are 30 feet in length. Six feet of this are buried in the ground just inside the curbstone in a packing of rubble and cement. At the apex is an iron cap, through which extends a wooden pin running about 8 inches into the topmost and smallest section of pipe. This acts as an insulator. To the poles along one side of the street are attached brackets with porcelain insulators to sustain the feed or supply wire. By the terms of the contract the pole-setting is usually done by the railway corporation, as is also the new track laying.

Having the poles planted, the electric company's employes take a hand in the work, and begin by stretching the span or supporting wires, from pole to pole, across the street. These wires are made of steel, and are about a quarter of an inch in diameter. Attached to these, so as to be directly over the center of each track, are iron-shelled insulators, weighing from 3 to 5 pounds each. These insulators are spherical in shape with double spurs at each side by which they may be bolted to the span wires. Into the holes drilled in these pieces of cast iron fit cap-bushings of composition insulation, and through the bushings run bolts which screw into grooved sections of copper about a foot in length. These latter are technically known as "ears," and into their grooves are soldered the trolley wire. At curves, where it is more difficult to preserve the trolley wire in perfect alignment, devices known as "arch insulators" are used. These insulators are in principle the same as those already described, except that they are semi-circular in form, and the span wires, instead of being continuous from pole to pole, are cut and fastened to eyelets bored in the sides of the arch insulators. It will be seen that by this construction the poles are protected from charges of the electric fluid. Some idea of the method employed in constructing a curve in the trolley wire on a Thomson-Houston electric railway may be obtained from the cut presented herewith. To the left is shown a "tower wagon." This wagon or car is most important and essential in the construction of the overhead work of a road. Its general appearance is like that of the pier of a wooden bridge on wheels. On top of the heavy timbers which compose the tower proper, 18 feet in height, is an overhanging platform large enough to hold a dozen men. On this the mid-air labor of construction and repair is done. The overhanging portion makes it practicable to get at the trolley wire without obstructing the traffic on the track below. The first wagons of the kind introduced were without an overhanging stage. In constructing the span gangs of 20 men and a foreman are employed. Four men, as a rule, work at each span-wire reaching the tops of the poles with ladders, and it usually takes from 5 to 15 minutes to hang each span. Sufficient headway having been made by this gang, the more important labor of stretching the trolley wire is commenced. The trolley wire, three-eighths of an inch in diameter, is carried on reels on a wagon made for the purpose. Each reel contains a mile of wire, weighing from 1,800 to 1,900 pounds. The trolley wire is attached to the first span wire by means of clamps. It is then carried over a tower wagon and run out for a distance of 600 or 700 feet. The wheels of the reel wagon are then blocked, the slack wire is pulled taut and made to conform to the direction of the track, and three men on the tower wagon solder the copper conductor to the "ears." These operations are repeated until the end of the route is reached. The next thing in order is the stringing of the supply wire. This conductor is of copper, and is heavily insulated. It is strung along the pole brackets, and connected to the trolley wire. In these cases there are, of course, no insulators at the trolley wire, but the span-wires and posts are protected by a composition insulator between the post and the point where the branch feed-wire comes in contact with the span.

CONSTRUCTING AN ELECTRIC ROAD.

While progress is being made on the construction of the overhead work, still another gang of men is engaged in the slower and more laborious occupation of disinterring paving stones and making shallow excavations between the rails. Between the tracks they bury a naked quarter inch copper wire, which acts as an electrical ground, and from it to each end of rail they run smaller wires. The ends of the latter are provided with plugs which are driven into holes drilled in the rails. This construction insures a rail return of good conductivity.

The work on the electric overhead equipment is finally completed when the guard-wires are placed in position. The weight of the trolley wire and insulators sags the span wires about a foot in the center. That leaves room for supplementary steel span-wires above the trolley-spans, and attached to the same poles. To these upper wires are fastened the two steel guard wires running parallel with the trolley wire, about a foot above and the same distance outside of it.

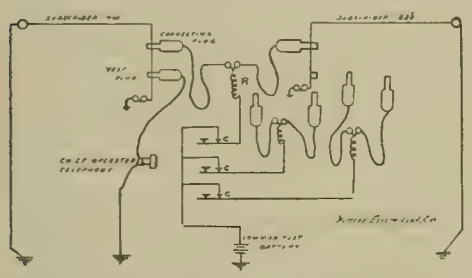
Minneapolis Exposition.

The electrical display at the Minneapolis exhibition is the leading feature this year. The most conspicuous figure is the tower of light which looms up seventy feet, and contains 7,700 incandescent lamps. Inside this tower is an elaborate switch-board which enables the operator to produce almost any desired effect with the colored incandescent lamps. There is also in the exposition a miniature railroad operated by electricity, and an electric signal device in practical operation. The Edison display proper contains all kinds of apparatus and devices pertaining to electrical work, showing numerous fields which the great inventor has explored. The Edison lighting system is thoroughly displayed from the generators to the incandescent lamps. Specimens of tubing, cable, etc., are on exhibition and in connection with the experimental work is a sample board containing specimens of filaments and the substances from which it has been and is now made. The progress of incandescent lighting can be traced step by step through this valuable collection yet no idea can be gained from looking at this display, of the patience, persistence and labor which alone surmounted the difficulties on the part of the inventor. The same may be said of the telegraph and other departments represented in the Edison exhibit. They establish the reputation of the inventor for industry among all who visit the exposition.

Next to the Edison display the most attractive is that of the welding apparatus of the Northwestern Thomson-Houston company. The exhibit consists of four welding machines constantly in operation. This is the most attractive display in the building for electricians and mechanics. Everybody seems to be interested in it, however.

The Carpenter-Nevans company show what can be done in the way of utilizing electricity for domestic purposes. Cooking, ironing, etc., by electricity is an interesting study for the ladies, and many expressions of approval were heard.

The Interior Conduit & Insulation company had an excellent opportunity to display the advantages of its system in connection with the Tower of Light. The conduit of this company is used throughout this great piece of work. It



LABOR-SAVING OUTFIT FOR CHIEF OPERATORS IN TELEPHONE EXCHANGES.

is one of the most complicated pieces of wiring imaginable. The company also has an excellent display in the exhibition hall, showing the principal features of the system. This exhibit, as may be readily imagined, attracted considerable attention among representatives of construction companies.

Among other attractions are the phonograph, talking dolls, long distance telephone, etc. The telephone company granted the phonograph company the privilege of operating a long distance telephone on the lines and transmitting phonograph selections over it. During the exposition therefore, residents of Minneapolis can have music, recitations, selections of all kinds on tap at all hours of the day and up to 10 o'clock at night.

Labor-Saving Outfit for Chief Operators in Telephone Exchanges.

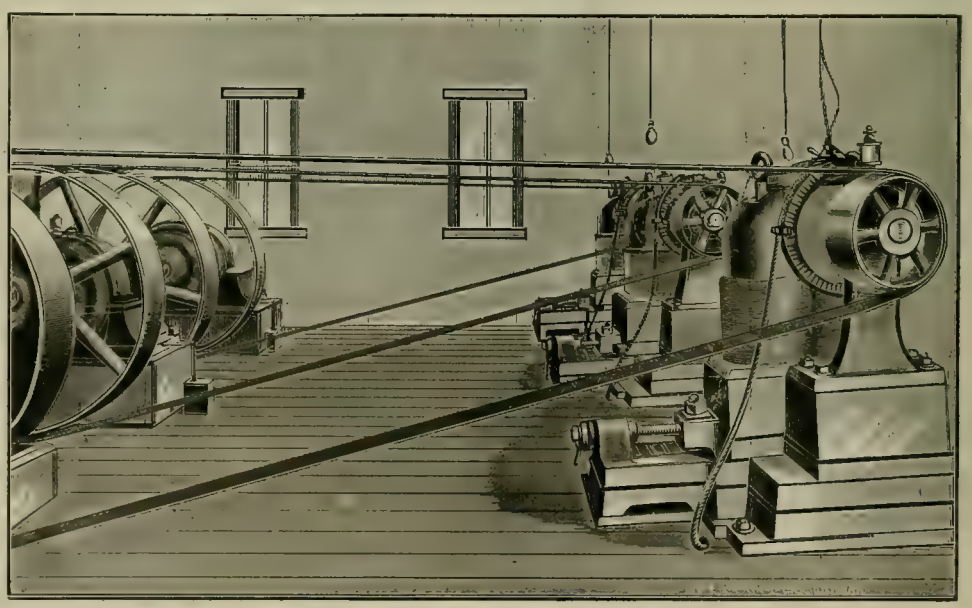
It is well known by those familiar with multiple telephone exchanges that it is by no means an easy task for the chief operator to locate a section on which two subscribers are connected. As there are innumerable calls from subscribers who complain that such and such a line "is *not* busy," or "some one is breaking in on me," etc.; and as these calls occur continually during the day, it is of the greatest importance that the work of the chief operator be facilitated as much as possible by labor-saving apparatus.

As multiple exchanges are now equipped, complaints of this kind can only be investigated by the chief operator walking from section to section, and examining the condition of the circuit about which the complaint has been made. Such a system as this is inconvenient at best, and it was with a view of lessening the work of the chief operator that the outfit illustrated in the accompanying diagram was devised.

This arrangement, which was worked out by J. J. O'Connell of the Chicago Telephone company, is secured by constructing the chief operator's board, so that she has before her a key for each section of multiple switch-board in the exchange, and then connecting these keys in the common test battery circuit in such a manner that the current from the test battery may be broken by the depression of any key. In other words, every 36 pairs of cords in a section, after being connected in the usual manner with their respective retardation coils, as at *R* in the figure, instead of running directly to the test battery, connect with the circuit breakers *C* at the chief operator's desk, and then connect with the common test battery. The convenience of this equipment will be appreciated. Suppose for instance, referring to the diagram, that a subscriber has called up the chief operator, or "the manager" as she is sometimes called, and has asked whether "460" is busy. The subscriber complains that he has been told that such is the case, but he has reason to believe that the operator answering him was mistaken. Now this complaint under the present system necessitates oftentimes in order to finally adjust the difficulty, a trip around the operating room. With Mr. O'Connell's proposed arrangement the chief is provided with what might be best described as a key-board, in addition to an operator's outfit and a section of multiple switch-board. When a complaint comes in and the chief has applied the "busy test," and found the line to be in use, as was reported to the subscriber by the regular operator, she then desires to ascertain which operator has this connection on her board. To do this she plugs into the line called for and runs her finger over the rows of keys (similar to the keys on a piano.) This action causes a click in her telephone the moment the circuit is broken by the opening of the key corresponding to the section containing the looked-for connection.

Central Passenger Railway Company's Power House at Louisville, Ky.

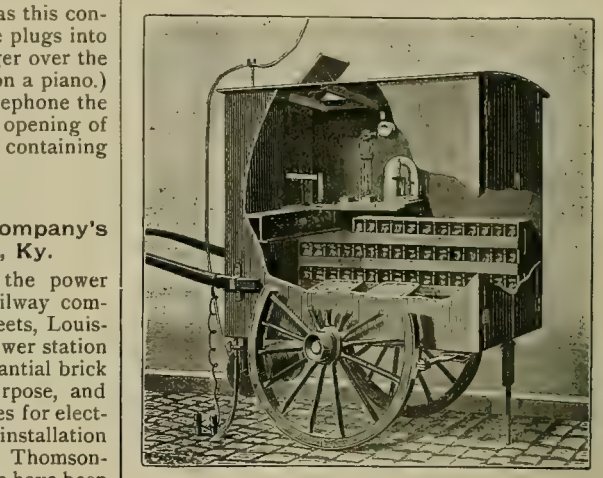
The accompanying cut illustrates the power plant of the Central Passenger Railway company at Walnut and Seventeenth streets, Louisville, Ky., the only electric railway power station in that city. The building is a substantial brick structure well adapted to the purpose, and equipped with all necessary appliances for electric railway service. The original installation consisted of three 80-horse power Thomson-Houston railway generators, and these have been in operation a year. The success attending the operation of the road under the electric system soon convinced the company of the advisability of extending the system and enlarging the plant. Accordingly it was determined to triple the original electrical installation and six new 80-horse power Thomson-Houston generators were ordered. It was also decided to erect two more electric power houses to operate other lines. The steam plant of three Heine safety boilers was correspondingly increased in the original plant. As soon as the plans can be executed all the principal street car lines will be operated by electric power, including Fourth, Bank and Walnut, Seventh and Brook, Belt, Market, Eighteenth, Shelby, Second and Sixth Streets. The Green street line, on which electricity was first substituted for horses, is eight miles long, and the cars make the round trip in an hour. The line extends through Walnut street from Twenty-sixth to Fifteenth, to Green, to Gordon, to Baxter avenue. Twin motor cars, each equipped with two 15-horse power Thomson-Houston motors, are operated on this line. These motors do eighteen hours' service. Each motor car carries at least one trail car, and during the busy portion of the day an extra trailer is attached. The equipment for the Market, Fourth, Brook, Seventh, Shelby and Bank street lines has been ordered, and will be in readiness within ninety days. When this work is completed the power plants will be supplied with eighteen 80-horse power generators. The stations now in course of construction will be so arranged that the generating plants may be enlarged without modifying the original plans as occasion demands.



CENTRAL PASSENGER RAILWAY COMPANY'S POWER HOUSE AT LOUISVILLE, KY.

Portable Laboratory.

Those whose duty it is to test cables in the streets realize the difficulty of securing the best results. The conditions are not conducive to accuracy, in fact, the jarring caused by heavy teams passing over the pavement is alone sufficient to make the use of delicate testing apparatus impracticable. In order to overcome these difficulties an electric light company in Paris put into use a few months ago a portable laboratory which has proved so successful that several other light companies in that city, it is said, have decided to employ a similar device. The laboratory, as shown in the cut, is located in a little two wheeled cart. It is large enough to accommodate two persons. It is so supported by springs that the jarring caused by teams passing over the streets does not interfere with the use of the instruments. The laboratory is equipped with a reflecting galvanometer, resistance box, battery of 100 cells, etc. In order that a good ground may always be secured two iron stakes are always carried, which can be pounded into the earth between the paving stones. A little stream of water from a reservoir in the laboratory flows upon the stakes, as the cut shows and thus insures a good contact. It is said that since this portable laboratory has been in use the company has been able to maintain a much higher insulation in its underground mains and its service has been much more efficient. The cut is reproduced from *La Nature*.



PORTABLE LABORATORY.

Fischinger Differential Arc Lamp.

The Fischinger lamp illustrated in the accompanying cuts, though not materially different from other well known types of differential lamps, still embodies several new features which are worthy of note.

The current coming in by the binding post *f*, Fig. 1, divides in the regular way, one part going through the heavy wire on the magnet to the upper carbon *d*, thence to the lower carbon *c*, and the other binding post *a*. Another part of

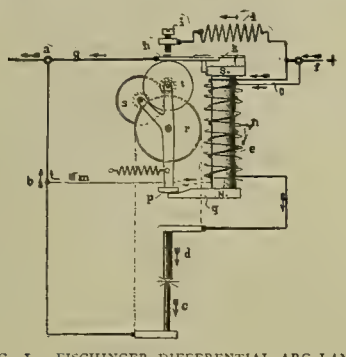


FIG. 1. FISCHINGER DIFFERENTIAL ARC LAMP.

the current passes through a finer wire on the same magnet having considerable resistance and wound in a direction opposite to the winding of the first, and unites with the main current at *b*, thus serving as a shunt to the main. A third branch is led from *f* through a resistance *l* to a braking contact *i*, and serves as a path for the current when switched on. When the current is passing from *f* through *e*, *d*, *c*, to *a*, a part of it will go through *o*, *n*, *m* and *b* to *a*, and the difference of the electric influence on the magnet will keep the arc between the carbons adjusted.

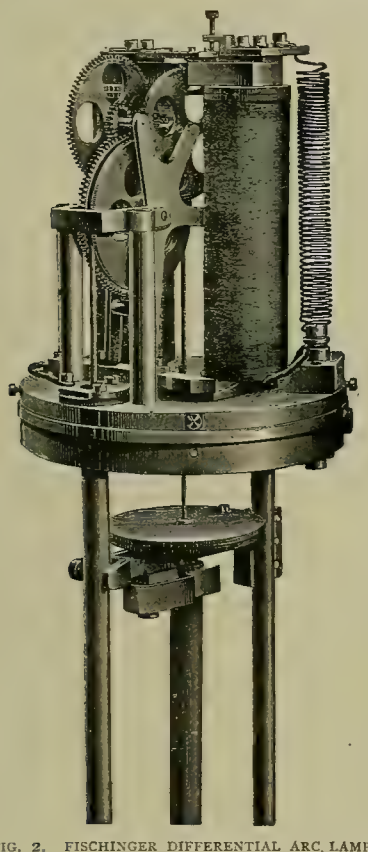


FIG. 2. FISCHINGER DIFFERENTIAL ARC LAMP.

Both carbons are movable, and joined by a cord over a wheel *r*; the upper carbon holder being heavier, tends to approach the lower. The wheel *r* is pivoted in a revolvable frame which has a heavy soft iron armature on its lower end exposed to the influence of the lower pole *p* of the magnet. The wheel *r* has a gearing which transfers and multiplies its rotation through the wheel *s* to a brake wheel *t*. The contact *h* is fastened on the spring *k* and is provided with an armature forming a brake under the influence of the pole *s*. This brake device is very light and sensitive to the least variation of the magnetism.

The working of the mechanism is now easily understood. As soon as the current is turned on the main part will pass through the windings on the magnet, throw the armature *h* tightly on the brake wheel, thus preventing the guide wheel from turning, and at the same time the armature *q* is drawn up against the lower pole *p*, producing a lifting of the frame and parting of the carbons; and thereby forming the arc. The regulating and constant maintaining of the arc is performed on the same principle as in all arc lamps, constructed on the differential principle. Fig. 2 gives a perspective view of the lamp.

It is claimed that this lamp is very sensitive in its regulation, and being less complicated than most other arc lamps, is easily adjusted and not likely to get out of order. The cuts are reproduced from the *Elektrotechnische Zeitschrift*.

Alternating Incandescent System in the Lyceum Theater, Chicago.

One of the first theaters in Chicago lighted by the alternating current supplied from a central station is the Lyceum, on Desplaines street. About a week ago the new system was introduced in this theater, and the current for lighting the entire house is now furnished by means of Thomson-Houston apparatus from the Market street station of the Chicago Arc Light & Power company. The station is about a half mile from the Lyceum, and the service is underground.

A representative of the WESTERN ELECTRICIAN inspected the equipment through the courtesy of Gerald E. Fish, electrician of the company. The first impression of the Lyceum's outfit is that it certainly possesses the advantage of compactness. In a room, or more properly speaking, a hallway, beneath the stage eight transformers are stowed away in a roomy closet. These are all connected in multiple. Within a few feet of this nest of converters is another and smaller closet, inclosing an iron stand carrying the resistance coils which, when it is desired to lower the lights, are cut into the primary circuit of the converters by levers worked in the wings above. It may be mentioned that Mr. Fish prefers to use ordinary German silver resistances introduced into the primaries rather than employ choking coils. The wire used for coils ranges in size from No. 24 to No. 19 B & S, and the entire space occupied by the iron and porcelain resistance-stand measures in the rough about 14 x32x36 inches.

The neatest and simplest piece of apparatus in the entire equipment is the resistance lever stand located at one side of the stage. This box contains eight levers in all, and is in charge of an employe who used to be called the "gas man," but who now believes himself entitled to be designated as "the electrician." The eight levers controlling all the lights in the house and on the stage, are of wood. Connections with the resistance coils in the closet below, are made by means of concealed conductors. From the fact that each of the eight levers carries a contact piece in direct electrical connection with the primary wires operating at a pressure of 1,000 volts, the proper insulating of all conducting parts about this stand is most important. The contacts, therefore, are cased in a wooden box which entirely covers them, and as a consequence the only parts which can be handled are the wooden levers. The lamps in the theater are all supplied at a pressure of 104 volts. The total number of lights is 320. One 75-light converter supplies the lamps for the three balconies; a 40-lighter furnishes the boxes and a number of groups; another 40-lighter connects with the footlights and sounding board; six 25-lighters supply the lamps in the borders, offices, stairways, etc., and one 15-lighter feeds the dressing room lamps.

Charged with Stealing Wire.

For several months the American Telephone and Telegraph company has suffered considerably from the depredations of wire thieves in the vicinity of Chicago. A large amount of dead wire has been skillfully removed from poles, and for a long time no track of the thieves could be found. It is estimated that at least 3,000 pounds of copper have been stolen. Last week five men were arrested on the charge of appropriating the wire. All the men are employes in the Chicago fire alarm department. They were held to the criminal court in $1,000 bail each.

The Convention of the Association of Edison Illuminating Companies.

The annual convention of the Association of Edison Illuminating companies was held at the West Hotel, Minneapolis, Minn., Sept. 16th, 17th and 18th. The attendance was much larger than usual and considerable interest was manifested in the proceedings. At 11:30 A. M. John I. Beggs, president of the association, called the convention to order, and the delegates presented their credentials.

The Edison General Electric company was represented by the following named gentlemen: Samuel Insull, second vice-president; H. Ward Leonard, general manager light and power department; John Muir, general manager railway department; Francis R. Upton, general manager lamp manufacturing department; F. E. Jackson, inspector lamp manufacturing department; Wilson S. Howell, inspector lamp manufacturing department; W. J. Jenks, legal department; M. J. Sullivan, official stenographer; L. Stieringer, and E. A. Hammer, lamp department.

Following is a list of delegates from the illuminating companies: John I. Beggs, director Harrisburg Electric Light company, Harrisburg, Pa.; George H. Finn, secretary and treasurer Edison company, St. Paul, Minn.; C. H. Maxcy, secretary Edison Light & Power company, Minneapolis, Minn.; Oscar Ericsson, superintendent the Cascade Milling company, Sioux Falls, S. D.; Edwin R. Weeks, general manager Edison Electric Light & Power company, Kansas City, Mo.; Frederic Nicholl, manager and secretary Toronto Incandescent Electric Light company, Toronto, Canada; F. G. Kurz, superintendent Appleton Electric Light company, Appleton, Wis.; B L. Smith, assistant secretary and superintendent Laramie Electric Gas Light & Fuel company, Laramie, Wyoming; Wm. D. Kurz, superintendent Electric Light & Power company, LaCrosse, Wis.; Wm. L. Church, superintendent Chicago Edison company, Chicago, Ill.; John R. Markle, director Electric Light & Fuel Gas company, Grand Rapids, Mich.; M. A. Beal, secretary and treasurer Forest City Electric Light & Power company; W. H. VanSickel, manager Edison Sault Light & Power company, Sault Ste. Marie; W. F. Wollin, superintendent Edison Electric Light company, York, Pa.; Leigh Carroll, president Edison Electric Illuminating company, Birmingham, Ala.; C. L Edgar, general manager Edison Electric Illuminating company, Boston, Mass.; J. A. Colby, secretary and manager Des Moines Edison Light company; W. S. Barstow, assistant superintendent Edison Electric Illuminating company, Brooklyn, N. Y.; H. J. Smith, general operating superintendent Edison Electric Illuminating company, New York; C. Wuestenfeld, manager Elgin City Railway company, Elgin, Ill.; A. L. Smith, president Appleton Edison Light company, Appleton, Wis.; C. P. Gilbert, secretary and manager Edison Illuminating company, Detroit, Mich.; Hoyt Post, director and attorney Edison Illuminating company, Detroit, Mich.; H. G. Balkam, Edison Electric Illuminating company, Brockton, Mass.

President Beggs welcomed the delegates in a few appropriate remarks and congratulated them on the prospects for the advancement of the Edison interests. He explained that the delay in calling the convention this year was due to the fact that it was desired to hold it during the Minneapolis exposition in which the Edison interests were so well represented. The executive committee accordingly had decided to suspend the clause of the by-laws providing for holding the annual convention on the second Tuesday of August.

ELECTION OF OFFICERS.

The president announced that the first order of business would be the election of officers for the ensuing year. The following selections were made:

President, John I. Beggs, Chicago.
Vice-President, C. L. Edgar, Boston.
Secretary, W. J. Jenks, New York.
Treasurer, Wilson S. Howell, New York.
Executive Committee, John I. Beggs, Chicago, ex-officio; A. L. Smith, Appleton, Wis.; Thomas P. Merritt, Reading, Pa.; E. R. Weeks, Kansas City, Mo.; C. P. Gilbert, Detroit, Mich.; Leigh Carroll, Birmingham, Ala.

ARC LAMPS ON EDISON CIRCUITS.

An informal discussion took place on the subject of operating arc lamps on Edison incandescent circuits. Many of the delegates participated in this discussion and related their experience in this department. It appeared from these informal reports that the experiments made thus far had been very satisfactory to the companies.

TUESDAY AFTERNOON'S SESSION.

At the afternoon session Mr. Insull made an informal explanation of the status of the patent suits now being pressed by the parent organization, and the recent consolidation of all the licensed manufactories with the General company. By this statement it appears that the effort will be madeto furnish electric light and power apparatus of any variety. It is also the purpose of the company to furnish an Edison motor, and thus by keeping a stock of armatures and other supplies at each of the district centers, render it more easy for the companies to secure promptly anything of this kind than heretofore. Mr. Insull also assured the delegates that Mr. Edison, who was unavoidably detained at the laboratory, is and will in the future be actively engaged in perfecting and developing apparatus for electric lighting and power purposes.

A discussion of the effects of crosses from high pressure circuits with Edison three-wire conductors was engaged in. Wilson S. Howell, who has for some months been gathering statistics on this subject, reported that in no case thus far noted has a cross with a high pressure direct or alternating circuit proved damaging to the Edison wires

or apparatus. A committee was appointed to further investigate this subject with special reference to the possible future interference of electric power systems, such as street railways. The committee was appointed by the president as follows: C. P. Gilbert, Detroit; Wilson S. Howell, New Brunswick, N. J.; C. L. Edgar, Boston; H. Ward Leonard, New York; J. H. Vail, New York.

NEW STANDARD EDISON ELECTROLYTIC METER.

The secretary announced that the following paper on the new standard electrolytic meter, had been prepared by A. E. Kennelly of Mr. Edison's laboratory, and R. S. White of Brooklyn:

ON THE NEW STANDARD EDISON ELECTROLYTIC METER.

BY A. E. KENNELLY AND R. S. WHITE.

Since the last meeting of the association, the new and improved pattern of the Edison meter has been decided upon, received Mr. Edison's approval, and has been completed by the Edison General Electric company. It has already been introduced into two stations, Brooklyn and Winnipeg, and the reports upon its behavior in each case are excellent. There are four standard sizes of these 3-wire meters, Nos. 1, 2, 4 and 8, designed to supply 40, 80, 160 and 320 lamps respectively. Meters of larger capacity than these are made specially. In all sizes, however, the bottles and plates are alike and of the pattern shown. The spools, too, are alike, making the resistance of the bottle circuit the same in every meter, and the drop of potential in the shunt at full load is the same, namely, four-tenths of a volt.

It is arranged that in the smallest or No. 1 meter, each milligramme of weight transferred represents one ampere-hour of supply, and the transfer is ten milligrammes per hour on full load. Similarly every meter transfers ten milligrammes per hour at full load, so that each milligramme of transfer in a No 8 meter represents eight ampere-hours, and in a No. 4 meter four ampere-hours, the number of the meter being the index of the supply in each case.

This greatly simplifies the system, reduces the weight of bottles that have to be daily transported, reduces the stock that the station has to keep in hand, makes only one balance requisite instead of two, and with reasonable care the use of a separate multiplier for each size of meter is not found to be an inconvenience. The objection has been urged against the system that there is danger in making one milligramme of transfer stand for so large a unit as eight ampere-hours in the No. 8 meter, since an error in weighing or in the proportions of the meter would result in an error in the bill eight times as great as the same discrepancies would produce in a No. 1 meter. Even granting the validity of the objection, however, it is evident that since meters are introduced in the capacity proportionate to their duty, the error in the No. 8 meter bill will only bear the same ratio to the whole amount charged, that the smaller No. 1 error bears to its bill. As a matter of experiment, taking for instance, a series of tests made with the meters by one of the writers at Brooklyn, the records of a set of Nos. 1, 2, 4 and 8 meters worked in series and at intervals for a week on half load for the smallest, or five amperes, one-sixteenth of the load for the largest, showed practically the same result, the No. 8 meter under indicating about 2 per cent.

This high degree of relative accuracy, setting aside all questions of care and skill, is secured by three things: The first is a higher degree of absolute accuracy in general. The old pattern meter is universally admitted to be a faithful and accurate instrument, but the intrinsic accuracy of the new pattern is about three times as great. The only chance for error in the operation of the electrolytic meter, accidents aside, is the variation of resistance in the bottle whereby the true ratio between the currents in the bottle and shunt circuits is upset. The extent of such a disturbance of course depends upon the relative proportions of resistance in bottle and spool. Suppose it were possible for the new bottle to even double its resistance and to become five ohms instead of 2.5 ohms. at normal temperature. In circuit with a spool of 46½ ohms, such a change would only upset the balance, and make the record in defect 5 per cent. In the old pattern meter the doubling of the bottle resistance, were such a variation to be expected, would make the readings 15 per cent. in defect.

The second preventive of error in the larger sizes is due to the uniformity in the size of plate. A cause of discrepancy has always existed in a slight gain of the plates in weight independently of the current's action and due to their oxidation superficially. With care this source of error has always been minimized, but with the old meters it increased with the size of the meter, since a larger plate offered a larger surface to oxidization. In the new patterns it is of course a fixed amount in all sizes, and owing to the small area of plate, is in any case very small.

The third precaution against error in the larger sizes is the use of duplicate bottles in the Nos. 4 and 8, as mutual checks which are not required in the Nos. 1 and 2.

Another improvement is in the plates. These are castings of pure zinc alloyed with 2 per cent. by weight of pure mercury. This amalgam has the advantage of being more readily brought into good condition for use than the rolled plate; the trouble of varnishing is also saved.

The only other noteworthy change has been in the solution, which is about twice as dense as in the old bottles.

Mr. Edison has recently completed a mechanical meter on the pattern of one of his early patents in that direction. This instrument is a small motor delicately constructed. The armature commences to rotate as soon as one lamp in the supplied circuit is turned on. The rotation accelerates as more lamps are lit, until at the full load of twenty lamps the speed is 600 revolutions per minute. A counter worked from the armature shaft records the number of rotations, and on duly proportioned dials the supply. The field magnets are kept charged by a feeble current from the mains, while the main current passes through a shunt as in the electrolytic meter, and from the shunt terminals wires pass to the armature. The drop of potential in the shunt at full load is 1.5 volts. The model, though complete in itself, will be slightly modified in detail to suit commercial use, and will then be available for such cases where a mechanical meter is desirable. Mr. Edison does not consider that a mechanical meter can possibly be as cheap or as reliable as the electrolytic meter, firstly, owing to the necessary frictional error which makes the record too low for very light loads and low speeds and secondly, owing to the mechanical wear and tear of the working parts which will need attention and exchange from time to time; but there are cases in which a direct reading mechanical meter will be an advantage, and he expects that from the tests and behavior of this model it will serve the purposes.

The conclusions, drawn from an experience of one year with the standard Edison meter, are as follows: During the year's work with the new standard meter, we have taken 4,088 incandescent, 853 arc lights and 244 motor readings —a total of 5,185, and have obtained uniformly good results. In a large number of cases customers have kept tally of lamp-hours and in every instance expressed themselves as satisfied. A considerable number of tests have shown marked accuracy. The greater dispatch and care with which the meter work can be performed has been abundantly shown. The use of small and uniform plates secure, by the balance method, doubled accuracy in weighing and the elimination of the oxidization error. In brief, our experience with the standard meter shows improved ease and economy in operation with more uniform and accurate results. In so far as a chemical meter "fills the bill" little remains to be said.

It may be interesting to note the use of four Aron meters on our circuit for the past year. The frank, open countenances of these meters have won the favor of the meter man and the confidence of the customer. We may conclude, then, it is in the line of a direct reading dial meter that we are to look for the next advance in the commercial treatment of the meter question.

The secretary made a report on the grounding of the neutral wire in three wire system. The report was accepted, and the topic was made an order of business for Wednesday.

Special assignment was also made for Wednesday at 10 A. M., of the questions of central station insurance and the proposed national code of insurance rules for electric light and power work.

A paper on "Comparative Statistics on Electric Lighting in the United States," was read by P. R. Upton.

Wednesday's Proceedings.

The convention was called to order by the president Wednesday morning at 10:30 A. M.

INSURANCE OF ELECTRIC RISKS.

By special assignment the question of insurance of electric risks was made the first order of business. The special committee on insurance of central stations, consisting of C. L. Edgar, Thomas P. Merritt, W. J. Jenks and John I. Beggs, *ex-officio*, reported substantially as follows:

"This committee, which was appointed about two years ago to investigate the feasibility of some plan of mutual central station insurance, made a somewhat careful report at the Niagara Falls meeting last year, and subsequently in the minutes of that meeting made an additional report from material gathered after the meeting, by which it appeared that the published proceedings of the Niagara Falls convention had stimulated, at least in one direction, healthful action upon the subject of this mutual insurance of central stations. In one of the appendices to the report, there was printed in full a prospectus of the Electric Mutual Insurance company, of which S. E. Barton is the president. That brought the matter up to so late a date and outlined so clearly to the committee the probability of a fruition in the direction of their work without any further effort on their part, that the committee have not considered it necessary to render this morning any formal report, but merely to call attention to the fact that this prospectus of the Electric Mutual Insurance company, was followed up by the projectors of that enterprise in the development of an organization and the beginning of business, with which facts most of you gentlemen are more or less familiar; and the committee desire, in view of the mutually useful and profitable results which appear to be coming forward, in the interests of the central stations, to report at this meeting that their work has practically been accomplished, so far as they understood their instructions. The committee also decided that, as Mr. Barton was in this vicinity, they would secure from him a statement somewhat in an historical way, and somewhat in explanation of the business methods of the insurance company in which we are all interested or likely to become interested, so that we might receive in a more intelligent way than could be otherwise devised by the committee what the work has resulted in. Mr. Barton is, by special invitation, present this morning, and he will supplement this informal report of the committee by important facts and figures which the committee would not be able to present."

The president then introduced S. E. Barton, who made the following statement:

MR. BARTON: I am indeed grateful for the privilege extended to me of meeting you all in this session. By this system of insurance there is no profit. There is nothing to be gained by any person, with the exception of course of those engaged in its business management who may receive a salary. The system is to deal directly with the insured, with the owners of the property themselves, and not by the stock insurance plan. It might be well for me to say a word in this connection in an historical way. I have been connected for about sixtedn years with the insurance interests of the country, being ten years with the stock companies of New England, and I have had for a number of years the idea that in view of the unjust discrimination against electric light risks by the insurance companies, the electrical interest should have a system of insurance of its own. I am aware that while there is a strong prejudice in the minds of the underwriters against electrical risks, that prejudice has been due absolutely to their lack of knowledge, and to a few fires that occurred in consequence of the early imperfect construction. I did not, however, take any steps in the matter or intimate my views to anybody until I chanced to see the work of Mr. Jenks and your committee. I immediately communicated with him and we went to work and formed a prospectus which was submitted at a meeting in Mr. Beggs' office in New York city last fall, and that was the beginning of the Electric Mutual company. Copies of this prospectus were at once sent out and we received such flattering responses to it from all sides that we went to work and organized a company in Boston in April last. We began business on the 15th of May by issuing policies and putting on our books such risks as we could secure immediately to make a beginning. We have in four months secured and put upon the books of the Electric Mutual company nearly $2,000,000 worth of insurance. About $300,000 of that has been put upon first class manufacturing property, and $1,700,000 has been written on electric stations.

As soon as we started with the company several of the Manufacturers' Mutuals of New England, who had up to that time written very sparingly upon electric stations and had met with but a single loss—Fall River—came to me and desired to co-operate with us. These companies were the Mercantile Mutual of Providence, together with the Enterprise and the American Manufacturers' Mutual of Providence, also the Cotton & Woolen Manufacturers' Mutuals, the Rubber Manufacturers' Mutual, and the Industrial Mutual of Boston.

They had particularly expressed themselves as being willing to undertake the insuring of central stations, particularly those operating the Edison system, if the Edison parent company would undertake the electrical supervision of these risks. That was something of course that no parent electrical company would want to do, but the question was entirely settled by the formation of the Electric Mutual. Then they announced that they would be entirely satisfied with our selection and supervision and were very willing to write policies on any station part'y insured in the Electric Mutual, and I am very happy to say that to-day all of the companies are co-operating with us.

We have up to the present time turned into them, surplus insurance that we are not in a position to absorb ourselves, amounting to something like $400,000 on the larger stations, and they in turn have reciprocated by turning over to us about $350,000 upon their risks, particularly those having isolated plants, requesting us to undertake the inspection of those plants, and offering to give us sufficient business to warrant us in doing the inspection. This makes the alliance between the mutual insurance companies and the Electric Mutual all that could be desired, and we are to day in a position to provide for any amount of insurance on electrical risks that may be offered.

Permit me in a few words to explain the system of insurance which we have adopted, and the basis upon which we have made our calculations. It is not an untried field with us by any means. We have the experience of the Manufacturers' Mutuals covering forty years or more in insurance upon manufacturing property, of what might be called "standard" manufacturing property, having the best of construction, the most efficient fire appliances, automatic sprinklers—in a word, all modern fire appliances. We have also the experience with this class of risks in the early days when construction was more imperfect and the very crudest fire appliances were in use, so that we are able to form an intelligent idea of the working of the system. At present the risks of these insurance companies include cotton and woolen mills, all textile mills, rubber manufactories, metal factories, foundries, paper mills, and everything included in the large manufacturing industries of New England and the Middle States. They have not gone very largely into the Western and Southern States until within the past few years. Their experience is that they are giving insurance to the amount of something over $500,000,000 to-day, at a cost of less than 1-5 of 1 per cent. per annum. Their average rate is about 1 per cent. Their lowest rate is about 8-10 of 1 per cent., and they vary from that upward, according to the risks, so that it brings their average rate on the $500,000,000 to about 1 per cent. They have returned in dividends, after paying all losses, all expenses and everything pertaining to the conduct of the business, on an average more than 67 per cent. You will bear in mind that this average includes their operations since they were first organized, when the construction of factories was very inferior, and before the introduction of modern fire appliances. At the present time the lowest dividend paid by any one of the companies is 60 per cent., the htghest 95 per cent., the average being about 85 per cent. Thus we have this valuable experience as a basis to guide us, and I do not think that we are wrong in assuming that an electric light station as it is conducted to-day, with all the safeguards and the same adequate amount of fire appliances in the way of protection constitutes just as good a risk, and in most cases, a far superior one, as those that the Manufacturers' Mutuals have made their showing upon. That is the only uncertainty, if indeed it may be called an uncertainty, that we have to deal with. Such being the case, I can see no reason why we cannot show just as good results as they have done, and in time when our business shall have assumed proportions so that our expense ratio will be reduced, we are in hopes that we shall show better results than they have done. Their whole expense ratio, including all expenses of conducting the business, traveling, inspections, office incidental expenses, and everything, is on the average about 8 per cent. of their premiums, as compared with the system of stock insurance, when 30 per cent. of every dollar they take goes in the way of commission to general agents and subordinate agents. That 30 per cent. covers, with the mutual system, not only the expenses, but all the losses in their business.

In this connection however, it is well to say that we have had many mutual insurance companies that have sprung up like mushrooms in the night and have gone down with the first frost. It has been due wholly to the fact that they have undertaken to insure a miscellaneous class

of property without requiring any particular improvements or fire protection, and also largely to the fact that they have gone into cities where individual risks formed most of their business which risks have been subjected to the exposure hazard, and where a large fire has destroyed everything. In other words they have been subjected to the "conflagration hazard" and this has been the cause of their early demise. Then again, a great many, in fact a large majority of mutual insurance companies that have come up and gone down in our country have done a very small volume of business and their expense ratio has been very large. Their volume of premiums has been so small that their expense account has unavoidably been from 35 to 50 per cent. of their whole premiums. Their ordinary losses have taken the other 50 per cent., and the conflagration hazard has wiped them out, or compelled them to assign.

The Manufacturers' Mutual and the Electric Mutual have, as a guarantee, adopted an assessment feature which is uniformly fixed at five times the amount of the premium. That is precisely in the nature of an unpaid subscription to the capital stock of the company, Therefore every policy-holder in the mutual company is nothing more or less than a subscriber to the capital stock to the extent of five times the amount of premium which he pays upon the policy or policies which he holds. That is the guarantee in case of unexpected losses. The premiums that are charged are about five times what experience has ever shown losses and expenses to require, and therefore they have returned the other four-fifths in the way of dividends, so that the chances for assessment are almost as remote, by reason of the class of business and the method of conducting the same, as possible. The state laws, particularly in New England, are such that they permitted the "contingent liability," or what we might call subscribed capital, to be considered an asset, and consequently any company is authorized to carry on any individual risk 10 per cent. of its whole assets, which would be this subscribed capital and the cash in hand. The result is that of those who are to co-operate with us the smallest is possessed of $60 000 cash in hand, and a contingent liability of about five times that sum, which shows the loss-paying ability. The American and Enterprise have about $180,000 each cash in hand The Cotton and Woolen has about $165,000. The Rubber Mutual has about $140,000. The Electric Mutual has, in four months' operation, about $20,000, and we have every reason to hope that we shall have a premium income the first year, of very close to $75,000. If that proves to be so, it will be the most extraordinary record that has ever been made by any mutual company.

The Mercantile Mutual started in 1884, and has now about $6,000,000 of risks. The Cotton and Woolen, American and Enterprise started along in 1871, 1872 and 1873, and they have each of them in the neighborhood of $20,000,000 of risks

As I stated to you, there are no agents employed with the Manufacturers' Mutual or the Electric Mutual, consequently it has never been deemed desirable, by the Manufacturers' Mutual, to comply with the laws of the several states, by getting regular legal admission to these states. The laws in most all the states are different. Some of them were enacted absolutely and solely in the interests of stock companies, for the purpose of keeping out all competitors, and there are many unfair, and I might say unconstitutional laws which have been enacted with this in view. The only thing that we could gain, if it might be called gain by complying with the laws of any state, take Minnesota for instance, would be that a policy holder in Minnesota, suffering a loss in the Electric Mutual, could bring suit against the company in his state. We hold that that is not an advantage to the insurer at all, simply because we are not the class of insurance companies that have to be sued. There is not on record to-day a suit between a policy-holder and any one of the Manufacturer's Mutuals, and it is due simply to the fact that they are composed and organized on such a basis that each individual policy holder is a member and partner in the concern. Every risk is taken with due deliberation, and every member of the company is entitled to know the character of every risk assumed. The directors of all those companies are men who are policy-holders themselves. There is never any risk that is contested, or rather there is no contest over any claim made, and for this reason there has never been a suit brought against them. So, as I have stated, that is the only advantage, if it is an advantage, to the policy-holder by having the company admitted to his own particular state. On the other hand, the company has to pay in the way of licenses a considerable amount every year, and in the way of taxes not less than 2 per cent., and from that to 5 per cent. on the premium. In some states this is paid into the state treasury; in others, to the counties, and in still others it is paid to the state and county both. In some states this amounts to nearly one-third of the whole cost of running the entire mutual system, which, as before mentioned, amounts to only 8 per cent. So that you have before you the advantages and the disadvantages.

Two or three of the companies have complied with the laws of two states, namely, Ohio and Illinois, because they have been doing considerable business in those states during the past two years.

Having thus entered the state, they have an agent of their own on the ground, who can be reached in case of any need without delay, and this is certainly a desirable arrangement.

You will doubtless often hear it stated that the Electric Mutual company is an unsafe company to insure in because of the fact that it is not admitted to your own particular state, and that if you want to sue it you must go to Boston to get at its property. If it were not for the fact that this is a company in which you are interested yourselves—in fact, a company which you control—there might be some weight in such a statement; and as to its location in your own state, considering the foregoing facts, I do not think any of you will regard that as a very important matter. This whole question, however, will come up before our directors at the next meeting, and I have no doubt but that we shall decide to make an entrance into Ohio and Illinois, possibly Michigan, and maybe some other states.

In many of the states the laws are such that it makes it a misdemeanor for any representative or inspector to in any way negotiate or transact insurance business in that state without having entered it legally, and upon arrest will subject the person to a fine. In two states, New York and Pennsylvania, the laws, passed deliberately in the interest of stock companies, make it a misdemeanor on the part of the representative of the insurance companies, and also of the assured who accepts the policy, and if there ever was an unconstitutional law, I hold that is the most positive example of it. Take it in the case of an electric light station, it has been found to be almost impossible to secure insurance in companies admitted to the state. In such places the law says that the assured has no right, without liability to fine and perhaps imprisonment, to undertake to protect himself by securing insurance outside of the state. As a matter of fact, there has never been a decision on those laws. In the state of Pennsylvania, however, some little time ago, one of the directors of the Keystone Manufacturers' Mutual of Philadelphia, openly secured insurance in the New England Mutuals for the purpose of testing the case. He was arrested and fined, but the case has been carried to a higher court, and I do not know whether that court has yet rendered a decision. Some few policy-holders in Pennsylvania, not wishing to assume any chances of being annoyed, "have beaten the devil around the stump," or evaded the law, by appointing an agent outside of the state to procure the business for them. They transact their business through that agent. Their money is deposited in a bank outside their state, subject to the agent's draft, but ostensibly for no particular purpose, and therefore the whole transaction is covered up, and they are not amenable to the law, because there is no proof of their having violated it

MR. POST: What is your rate of premium?

MR. BARTON: Nine-tenths of 1 per cent. is our minimum rate. Our rates have averaged a little over 1 per cent. up to the present time. Of course this rate of nine-tenths applies to a station of the best construction, built of brick or stone, not over two stories high, having the electrical apparatus arranged in strict accordance with the requirements, and all necessary fire appliances. This building must be free from any wooden construction inside, such as sheathing or anything of that sort. It need not, however, be necessarily a fireproof station. It shall not have any exposures, but if there are any, the same must be cut off by fire shutters on all openings. The station shall have what we term a "standard or fire protection," with pumps and hose attached. The hose shall be small or large, according to the size of the station, but preferably small, the idea being that any part of the station can be reached instantly with a small stream. In connection with this hose there must be constant water pressure, which means that the supply of water shall always be on hand without having to start a pump. In case this pressure cannot be secured, fire extinguishers must be provided. In case the station is exposed, the exposure charge must be specially made according to the conditions. Our desire is to issue policies in every instance in blanket form—that is, covering the building and its contents without specific divisions. It covers in this way the main building and projections, if any, which constitute a single station or risk, and all the contents thereof, consisting of boilers, steam engines, shafting and belting.

MR. SMITH: Do you make any reduction for water power?

MR. BARTON: We find no particular difference for the reason that, generally speaking, water power stations are farther removed from the fire department than the steam power, in which case matters are neutralized. There is another insurance that we have considered, and that is the insuring of the plant outside the station. Up to the present time we have issued about one dozen of such policies. We have given blanket policies covering every article of property connected with all the outside circuits against loss or damage by fire, including everything connected with the circuit, from the time it leaves the station until it returns—wires, poles, lamps, converters, meters, fixtures, etc. On this class of insurance we have fixed the rate at three-fourths of 1 per cent., and at the end of the year we will be in a position to judge whether this is an equitable rate. It is a class of insurance in which we are liable to a great many small risks, but I believe should be taken care of by our company.

THE PRESIDENT: I desire to add to what Mr. Barton has said, that having been for several years in the insurance business myself, both in the capacity as local agent and as a special agent and adjuster for several companies throughout Pennsylvania, that I have given this matter a great deal of attention. As an illustration of the methods that have prevailed in the past I will cite the case of the Harrisburg company. I fixed that rate at 1% some six years ago. It was a fair rate both to the companies carrying it and to the electric light company. After I surrendered control, the agents thought they could secure more by increasing the rates, and they ran the risk up to $2.60 on the hundred. I took the position that I would not be swindled, and I insisted upon the Harrisburg company dropping the insurance, making arrangements in New York by which I had the risk carried at the rate of 1%.

On motion of Mr. Balkam a vote of thanks was extended to Mr. Barton and the Electric Mutual company was indorsed.

Mr. Markle, Detroit, chairman of the committee on fuel gas, made a brief report as to the progress made since the Niagara Falls convention in the experimental work of adapting this fuel to electric light and power stations.

MINIATURE INCANDESCENT LAMPS.

F. E. Jackson, of the lamp department of the Edison General Electric company, presented the following paper on the use of miniature incandescent lamps in decorative work:

SOME SPECIAL LAMPS MADE AT THE EDISON LAMP WORKS.

BY F. E. JACKSON.

It is desired to call the attention of the managers of the illuminating companies and others to a few lamps provided by the lamp works, which are designed for special uses; with the exception of the "small battery lamps," the lamps to be described have not been long on the market, and are but little known.

The small low-volt lamps, which are made for use with primary batteries, have been manufactured for several years, and are more or less known to all, although comparatively few have been used in central stations; until recently comparatively few have been made, but now the demand is increasing rapidly.

The one purpose for which these lamps were made was, as their name indicates, for use with batteries, and particularly with primary batteries. The e. m. f. of the lamps is very low, varying from ten to twelve volts in the 6 c. p. lamps to as low as two and a half volts in the small ⅛ c. p. lamp made for the use of surgeons and dentists. The e. m. f. is purposely made low so that the lamps can be used with the least number of cells of batteries. It should be noted that not less than two cells can be used with any of the lamps.

The lamps vary in candle power from ⅛ to 6 candles, they are also made of ½-candle power in the special forms of "dental" "surgical" and "pea" lamps. The efficiencies are high, as they should be where current is as costly as it is when primary batteries are the generators.

It was stated that not many of these lamps had been used until within a short time; the reason no doubt is that they were not advertised in a way that would bring them to the notice of possible purchasers.

A small pamphlet descriptive of the lamps and of cheap batteries that can be used with them, is now issued by the lamp works, and the lamps have lately been advertised more extensively in other ways; the results are easily seen in the number of lamps ordered. Also there have been so many orders received for material for making the batteries described in the catalogue that it was decided to make up complete outfits, and these are now made and kept in stock.

About a year ago there was a demand for small lamps suited for burning in series on the regular 110 volt lighting circuit; before the time mentioned there had been no special demand for lamps to be burned in series, and no lamps had been made for that purpose. The "battery" lamps were used in this way in a number of cases, but they did not always give satisfaction; it was found that to give the best results when used in this way, the carbons in the lamps should be made of different proportions and different dimensions.

The lamps then made for burning in series on the dynamo circuit have given very satisfactory results; they are the lamps which were used in the electrical exhibition at the Lenox Lyceum, New York, during last winter, and which are used here at the Minneapolis Exposition, where they speak for themselves.

The "small series burning lamps" are made higher in voltage and of lower efficiency than the battery lamps. They are made from 1 to 4-candle power. The voltage of all lamps is about fourteen volts, so eight lamps of any one candle power can be burned in series on the 112 volt circuit.

The lamps are made of efficiencies varying in different lamps from three to five watts per candle. The lamps are tested and marked for the current they require when burning at normal candle power, and those taking the same amount of current are selected for burning in series together. When a dynamo is used as the generator the cost of producing current is low as compared with the cost of the current from a primary battery; therefore high efficiency is not so great an object. As the lamps are burned in series the breaking of one lamp stops the flow of current in several others, making it appear as though the lamps broke more frequently than they actually do; the comparatively low efficiency of the "series" lamp is an advantage as the increased lamp life which comes with a decrease in efficiency reduces the number of renewals proportionally, and also prevents the annoyance which would be the result if the lamps broke more frequently.

Some tests in order to determine the best efficiency to give these "series burning lamps" are now being made at the lamp factory. So far the results are very satisfactory. At the time of this writing only one lamp has broken and that was at the end of 320 hours. The number of lamps burned in the test was twenty-two. Another set of thirty-three lamps has been burning for 250 hours and no lamps have been broken.

The lamp which it is believed will become the most popular one for decorative purposes and for producing scenic effects has not yet been used outside of the factory, the lamps having been made only during the past few weeks. The lamp referred to is the 1-candle power, fourteen volt or "eight in series" lamp. For use in fancy designs and in producing effects where it is the effect only and not illumination that is wanted, the results obtained with the 1-candle power lamps are quite as good as those obtained with the lamps of higher power.

The decided advantages in using the 1-candle power lamps are that less current is required than for the 3 and 4-candle power lamps, and the heating effects are less also.

In the exhibition we have an illustration of some of the uses to which these small lamps can be put, but there are many ways in which they can be used with profit on a smaller scale by the illuminating companies. A profit can be derived from the sale of current to light them.

At the lamp works several fancy designs have been gotten up when called for, in which the small lamps are arranged in the form of letters spelling words and names; the lamps have also been arranged in other forms, such as stars. With suitable switches the lamps forming letters, words or different parts of designs, can be lighted or turned off at will, attracting the eye and producing pleasing effects.

The lamps are made of different colors; the colors in

(Continued on page 171.)

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building. - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Constructing an Electric Road. Illustrated 165
Minneapolis Exposition 165, 166
Labor Saving Outfit for Chief Operators in Telephone Exchanges. Illustrated 166
Central Passenger Railway Company's Power House at Louisville. Illustrated 166
Portable Laboratory. Illustrated 166
Fischinger Differential Arc Lamp. Illustrated 167
Alternating Incandescent System in the Lyceum Theatre, Chicago 167
The Convention of the Association of Edison Illuminating Companies
Election of Officers 167
Arc Lights on Edison Circuits 167
New Standard Electrolytic Meter, by A. E. Kennelly and R. S. White 168
Insurance of Electric Risks 168, 169
Some Special Lamps made at the Edison Lamp Works. By F. E. Jackson 169, 171
A National Code of Insurance Rules Affecting Electric Light and Power Installations. By W. J. Jenks 171
Convention Notes 171, 172
New York Street Railway Association. Report of Eighth Convention.
President's Address 172
An Electric Street Railway Motor. By John W. McNamara and Discussion 172, 173, 174
Reunion of the United States Military Corps and the Old-Time Telegraphers Society 174, 175
The Duty on Mica 175
Liquid Insulation for Underground Conduits. By David Brooks 175

DEPARTMENTS.

Correspondence 175, 176, 177
The Electric Light 177
The Electric Motor 177
The Telephone 177
Electrical Patents 178

THE present number of the WESTERN ELECTRICIAN contains a report of the conventions of three organizations, the Association of Edison Illuminating companies at Minneapolis, the New York State Street Railway Association, and the Military Telegraph Corps and Old Time Telegrapher Society at Kansas City.

THE savage attack of Fred DeLand on the National Electric Light association, as published in *The Electrical Engineer* of September 10th, should not be allowed to go unnoticed. A worse lot of rant never was admitted to the columns of an electrical journal. A considerable part of it sounds suspiciously like some of the childish statements which were issued in such abundance from a certain quarter at Cape May. In fact, if we were inclined to do so, we think we could account for the appearance of Mr. DeLand's communication in *The Electrical Engineer* instead of in his own paper, *The Electrical World;* and this too, without regard to the more apparent reason, that the publishers of the latter named journal would, in all probability, have refused to print the trash had it been offered them. However, we do not believe it is true, as Mr. DeLand would seem to infer, that the central station needs to protect itself from the National Electric Light association; neither do we believe that his suggestion regarding the formation of a rival association is likely to be followed.

THE Military Telegraph Corps, whose annual convention is reported in this issue, seems to have made some progress toward the one great object of the organization, the recognition of its services during the war by the National government. There is no apparent reason why the demand of the society should not be granted, and undoubtedly if the corps continues its hard work its just demand will in time be acceded to.

THE question of insurance occupied a prominent part in the Edison convention at Minneapolis. It is a subject which at the present time is of special interest to those whose money is invested in electric light and power stations. In his paper on this topic W. J. Jenks reviewed the entire subject. There is certainly every reason to believe that the earnest work performed by electric light men will before many months result in the formation of a national code of insurance rules which will prove entirely satisfactory to both insurance and electric interests.

SOME time ago reference was made to the question which has arisen in Rochester, N. Y., over the style and character of electric railway poles to be adopted by the company on the principal residence streets of the city. The company was ready to put in metallic poles in accordance with the wishes of the residents, but the council ordered wooden poles instead, basing its action on the ground that wooden poles were safer than steel or iron supports. The mayor vetoed the action of the council but that body passed the resolution over the mayor's veto. In the controversy that has been in progress pending the final settlement of the question the most remarkable fact seems to be the lack of information possessed by those engaged in the discussion. The aldermen and their advisers do not appear to realize that the whole matter is merely a question of mechanical construction. If the poles are put up properly and the wires thoroughly insulated it does not make the slightest difference whether wood or metallic poles are used, while on the other hand if the work is not properly performed there will be danger in any event. Instead of seeking information from competent electrical engineers whose opinions would be valuable the aldermen were guided by the opinions of mayors of three cities in which electric roads were in operation—Boston, Lynn and Pittsburg. These gentlemen favored the wooden poles—why, does not appear.

THE report of the convention of the New York State Street Railway association, in this issue, will be of special interest to street car men throughout the country. It is a significant fact that almost all the papers and discussion related to the operation of electric railways. Rapid transit is demanded by every city in the country, and street railway men now almost without an exception concede that it is to be secured only by some system of electric propulsion. It is now only a question as to what system shall be adopted. To aid members of the association in determining this all-important point, the representatives of three companies which are installing electric railways, were called into the convention hall and were given an opportunity of speaking of the relative merits of the several systems with which they are identified. These gentlemen presented their views briefly and clearly. Their work was done so well that, we think, the street railway men will find it difficult to find just which system, all things being considered, should especially commend itself to them. The speakers were not allowed to depart after making their remarks. They were subjected to a thorough cross-examination by gentlemen who are now sufficiently acquainted with electric railways to frame pertinent questions. Such conventions as this give striking evidence of the fact that street railway men have changed their ideas in regard to electricity. A year ago many of the conservatives were shaking their heads and saying they would wait some time before adopting the new system. Such men are not to be found to-day; if they are they do not express their views in street railway conventions.

"IN the year ended June 30, 1889, 5,823 persons were killed on the railroads of the United States and 26,309 injured," says an exchange. A glance at these figures causes one's thoughts to revert to the list of those killed and injured by electricity. To those who like to harp upon the deadly nature of everything electrical and, it might be added, to write column after column descriptive of the sensational features of the few accidents of this kind which occur, such a comparison must be odious. Every time an accident occurs, say, to an employe of an electric company, we are regaled with an extraordinary mass of nonsensical information purporting to be descriptive of all the gruesome details of the tragedy. While we fully appreciate the value of sensational news, the fact seems shameful that the daily press, while ranting about the horrors of an electrical death, should forget that the railroads calmly continue their work of killing and maiming. These tragedies and casualties seem for the most part to receive but a passing mention. It is an old saw that for every one man who tries to rise in the world there are a hundred men ready to pull him back. It seems to be this way in the case of electricity. A new force of the greatest benefit to mankind is being rapidly developed, and we find that one power, the daily press, which should above all others naturally be electricity's friend, in almost every case through ignorance of the subject, pitted against it. Perhaps this state of affairs is not now so marked as it was some months ago, and perhaps the American people as a whole are too sensible not to discount reportorial exaggerations, but we join with a contemporary in the suggestion that the daily papers submit their electrical news to the scrutiny of a man who has education enough to save his sheet from printing nonsense.

THE convention at Minneapolis, Minn., last week of the Association of Edison Illuminating companies was largely attended. Both the parent company and the central stations were well represented. More than ordinary interest attached to the convention as it was the first meeting since the consolidation of the Edison interests and the absorption of the Sprague company. As usual the association went into executive session, but several of the papers and a synopsis of the proceedings are presented elsewhere in this number. A casual perusal of the report will reveal the fact that the convention was of more than ordinary interest. As was expected, the position of the Edison General Electric company was defined by Mr. Insull, and although a full report of this portion of the proceedings was not presented for publication it may be said that the statement was entirely satisfactory. The parent company proposes a most liberal course toward the illuminating companies and with their co-operation hopes to advance the Edison interests even more during the coming year than in the past. One point of interest appears in the statement of Mr. Insull to the association that the Sprague stationary motor will no longer be made; the motors hereafter manufactured by the company will be of the same type as the Edison generator. This step had long been contemplated, it was known, but the statement before the convention was the first authoritative announcement of the decision of the company. The convention devoted considerable time to the discussion of the topic of insurance of central stations. Mr. Barton's explanation of the position of the insurance companies toward the electric light companies will be read with general interest. The remarks of President Beggs whose experience in insurance matters places him in a position to fully comprehend the situation, will also command attention.

(*Continued from page* 169.)

which they are now made are red, blue, violet, green and amber. These colored lamps have been made only during the last few weeks, and they have been used only to a limited extent as yet. It is hardly necessary to say that with the colored lamps the number of combinations and effects that can be produced is greatly multiplied.

Another lamp to which it is desired to call attention is that specially designed for use on power circuits where lamps are burned in series, and particularly for use on the 500 volt street railway circuit; in fact the lamp is called the "electric railway lamp," and it is so labeled.

When the electric railway business was first started it was intended, of course, to use incandescent lamps, but the question of the proper lamp to use was of small importance in comparison with others, and it was neglected in consequence. The lamp generally used on the Sprague roads when they were first started was the regular 100 volt 16-candle power lamp, the lamp of highest resistance and highest efficiency.

The importance of selecting lamps taking the same current when they are to be burned in series, was not considered, and very often, I think, I may say that on almost every road, lamps of different sizes and of different manufacture have been placed in the same series, with results not always explained or accounted for, but apparently unfavorable, by comparison, to the lamp taking the least current under normal conditions.

If a lamp of higher candle power, or if any lamp of equal voltage and taking a greater current is burned in series with a high efficiency 16 candle power lamp, the result is that the 16 candle power lamp receives the greater pressure; and if the pressure is normal for burning two similar lamps in series, the 16 candle power lamp would be forced above normal candle power and would soon be broken, if not broken immediately.

The Edison lamp has been the lamp of highest resistance on the market, and therefore it has been the one to suffer most for the above reason. As before stated, the Sprague roads have generally used these lamps at starting. No special lamp was made for the use of the railway companies, and no particular lamp has, in most cases, been recommended, consequently all lamps have been considered as being alike and suited for burning in series, particularly if they had the same marks for voltage. The natural result has been that dissimilar lamps have been placed in the same series, and the 16-candle power Edison lamps have often given a very short life when, if they had been used alone, they would have given the best results. For the reason that the causes mentioned have not been understood, a large part of the lamp renewal business has been lost to the lamp works and to the illuminating companies.

The difficulty has been recognized by the lamp works, and we believe that it has been effectually provided against in the "electric railway lamp," which has but lately been put on the market.

These "electric railway lamps" are designed particularly for the use of railways, but they are equally well suited for use on other power circuits, or in all other cases where lamps are burned in series on circuits of 200 to 500 or 600 volts. The lamps are made to give 16-candle power; the voltage ranges from 95 to 100 volts, and they take currents varying in different lamps from .60 to .75 ampere. The lamps have a special label, and the normal currents, the fractions of an ampere required to bring the lamps to 16 candle power, are marked on the labels.

The lamps are selected for voltages ranging from 95 to 100 volts, but the voltage is not marked on the lamps; the marks for voltage have been found to produce confusion, customers, in some cases at least, have supposed that all lamps having the same marks for voltage were suited for burning in series as well as for burning in parallel circuit, whether the lamps were of the same resistance or not. For this reason the marks for the voltage of the lamps are omitted altogether.

As the regular 16 candle power lamp has a very fine and delicate carbon it was thought best, in designing the "railway" lamp, to give it a stouter carbon such as would not be so easily injured by the mechanical strain to which the carbons of the lamps are subjected. Also very high efficiency is not to be desired in these lamps on account of the constant variation in the e. m. f. on the circuit. The efficiency of the lamp as determined on is about four watts per candle; lamps of this efficiency will give the best results; the voltage on the circuit can fall considerably below the 500 volt limit, as it is constantly doing on the railway circuits, without bringing the lamps to a very low incandescence; also an increase in pressure of 10 per cent. will not cause the lamps to break at an abnormal rate.

Although the lamps in the regular stock will vary so as to take currents varying in different lamps from .60 to .75 ampere, it is not supposed that the lamps taking this whole range shall be sent to any one place. For any one plant the range of currents taken by the lamps will be limited to about 3-100 ampere, or all lamps sent to any one plant will be practically identical.

At the lamp works and at other places where the "railway" lamps will be kept in stock, records of the amperage or the currents taken by the lamps sent to the different plants will be kept so that it will always be known just what lamps are wanted when lamps are called for by the railway company's renewal orders, and lamps of the same resistance will always be sent for use on the same circuits.

Electric railways are being introduced very generally now, and such a large number of lamps are being consumed by them that it is well worth the while of those interested to look after the lamp renewals, and see that the best lamp is used.

Where there are different roads in the same town, or where there are several different branches of the same system, it would be an advantage to have signal lamps of different colors on the different cars to distinguish those on one branch from those of another. Such colored lamps will be provided by the lamp works; we can now provide them of five different colors; when colored lamps are ordered by the railway companies, the lamps will be selected for the currents taken in the same way that the plain lamps are selected, so that all will be suited for burning in the same series.

On the street cars colored lamps can be placed on the front and rear platforms and in conspicuous positions to serve as signal lamps, while the remaining three lamps in the series are used to illuminate the interiors of the cars.

It may be added that the lamps will be made with bases other than the Edison bases, but, unless some other base or plug is specified, all lamps will be made to fit the regular Edison socket.

L. Stieringer gave additional information on the possibilities in the application of small lamps. He gave an interesting and valuable talk upon the general subject, referring among other things to the effects produced by the tower of light at the Minneapolis Industrial Exposition.

E. R. Weeks of Kansas City, introduced the subject of the heating of buildings from central stations by exhaust steam, and a discussion on this subject was engaged in by Messrs. Edgar, Beggs, Markle and Vail.

National Code of Insurance Rules.

The secretary read the following paper upon the formulation of a code of insurance rules which it is proposed shall be adopted by the underwriters throughout the country:

A National Code of Insurance Rules Affecting Electric and Power Installation.

BY W. J. JENKS.

It has often been noted as one of the evidences of the incomplete development of the present system of electric light and power construction that the rules enforced by the underwriters in the different sections of the country are so widely different as to make it impossible for a construction firm in Boston to be at all certain of being able, without further education, to do work in Philadelphia acceptable to the insurance inspector, or for a supply man in Chicago to be sure that he is furnishing material which the underwriters of Cincinnati will approve.

From the time of the formation of the original rules for wiring of buildings for incandescent lamps (resulting from the conferences of the New York Board with the practical people of the Edison company) to the present, all codes used by the insurance fraternity have, while annually growing nearer to a standard, embodied so many uncertain quantities and individual notions that it has been hard to predict what a year might bring forth in modification of existing requirements. Very much has been done by the earnest efforts of the inspectors of the New England Exchange, and the New York state board, as well as by the practical labors of the Philadelphia fire patrol and the Chicago city officials; but it has been reserved for the present year to evolve a plan which promises to speedily revolutionize the chaotic condition of matters of this kind by harmonizing all the minor distinctions which exist in the codes heretofore enforced by the insurance inspectors of different sections in one national code, which by reason of the authority by which it is supported, will be adopted by a large majority, if not by the entire fraternity of the insurance men in the United States.

At the Kansas City meeting of February last the National Electric Light association chose a committee for the purpose of conferring with the insurance people, and if possible of setting on foot such measures as might result in this uniform code.

Pursuant to this plan the secretary of the committee, George Cutter of Chicago, entered into correspondence with the representatives of the active executive insurance associations, and with the leading electric light companies of the country, and the result of his persistent and intelligent endeavors in this direction appeared at a meeting of the committee and representatives of the two interests which convened at the Stockton hotel, Cape May, August 16th, three days in advance of the first session of the convention of the National association.

The committee held its first meeting on Saturday evening, Mr. Cutter in the chair, and the names of the remaining gentlemen present were as follows: C. M. Goddard, inspector New England Insurance Exchange, Boston, Mass.; E. C. North, chairman electric light committee, New England Insurance Exchange; S. E. Barton, president of the Electric Mutual Insurance company, Boston; Wm. Brophy, chief inspector Electric Mutual Insurance company, Boston, and representatives of the Mutual Fire Insurance companies of New England; F. E. Cabot, inspector Boston Fire Underwriters' Union; W. B. McDevitt, inspector Philadelphia Fire Underwriters' association; J. P. Barrett, city electrician, Chicago, Ill., and also representatives of the Chicago Board of Fire Underwriters; W A. Anderson, secretary New York Board of Fire Underwriters, and also secretary of the National Board of Fire Underwriters; W. De L. Boughton, chairman electric light committee, New York Board of Fire Underwriters; H. C. Kline, chairman of the electric light committee of the Underwriters' Association of the Middle Department, Philadelphia, Pa.; J. J. Babcock, chairman light committee Insurance association of the state of New York, Binghamton, N. Y ; C. E. Bliven, chairman electric light committee, Western Union Fire Underwriters' association, Chicago, Ill., and representatives of the Fire Underwriters' association of the Northwest; J. S. Alfred, inspector Southern Tariff association, Atlanta, Ga.; R. H. McMath, representative St. Louis Board of Fire Underwriters; J. R. Lovejoy, Thomson-Houston Electric company, Boston, Mass.; P. H. Alexander, Westinghouse Electric company, New York; and W. J. Jenks, Edison General Electric company, New York.

Mr. Cutter was chosen secretary, and the chairman stated the object of the meeting as being the securing of a harmony of ideas between the electric light and insurance interests.

An extended discussion of the proper basis of a code of generic or fundamental rules, extended through several sessions, and resulted in an outline representing practically the unanimous views of the gentlemen present. Exhaustive statements of the reasons for the positions assumed in this initial code were made by the electric light representatives and agreed to by the insurance inspectors as embodying the results of their experience. A special committee presented at the second session a code of by-laws as the basis of a permanent organization, which was, early in the deliberations of the meeting, decided upon as the only practical method of securing and perpetuating an influence sufficiently positive and controlling to be permanent. A concise summary of a few of these by-laws will illustrate the scope of the work to be done, the solidity of the basis upon which the organization was effected, and the standing of the insurance representatives composing the organization is a guarantee of the important work in that executive direction in which former efforts have been lacking.

The name decided upon was: "The National Electric Insurance Bureau," and the object is stated by the by-laws to be "the harmonizing of the electric interests and the fire insurance interests in the United States."

It is also provided that in addition to the membership indicated by the names of those in attendance, one member may be chosen by the National Telephone association, one by the Western Union Telegraph company, one by the Postal Telegraph company, one by the National association of Fire Engineers, one by the Underwriters' association of the Pacific Union States, and such other insurance representatives as may apply for membership, and be deemed eligible.

It was settled that as a method of completing an organization for the opening year, the gentlemen of the committee chosen by the National association, and representatives of the other organizations above named having been called together by the original committee, should be members of the bureau until the next meeting, or until their successors were chosen.

Officers were elected as follows: President, Major C. E. Bliven, Chicago; secretary and treasurer, George Cutter, Chicago; executive committee, Messrs. Bliven, Brophy, Lovejoy, Jenks, Anderson, McDevitt and Cutter.

A committee, consisting of Messrs. Barrett, Goddard and McMath, was chosen to gather information regarding city and state laws bearing upon electric interests.

After a very careful discussion of the best method of attaining the primal object of the meeting, namely, a uniform code of rules which shall be national in their application, the following members were chosen a committee to outline such a code: Messrs. Bliven, Cutter, McDevitt, Cabot and Jenks.

The deliberations of the meeting consumed six sessions, and an adjournment was made on Monday evening, Aug. 18, subject to the call of the president or to the time of the annual meeting, which by the by-laws was fixed to be held some time during August of each year, at such day and place as the executive committee may determine.

The committee charged with the work of codifying rules were instructed to secure as many different sets of codes as may be at present in force by any of the state or local boards throughout the country, and by such light and power companies as may have given careful thought to this matter. It is proposed that these shall be, if possible, harmonized and condensed, and that a draft embodying whatever may be desirable from all, be sent by the committee to the organizations from which the different codes emanated for criticism and suggestion. Also, that on return of such criticisms a final arrangement may be made and an improved code, thus prepared, submitted to a future meeting of the bureau for adoption.

It will at once be seen that from the fact that the large majority of the members of this bureau are executive insurance officers, and that as they represent 150 or more of the leading insurance companies doing business throughout the United States, the adoption of any code of rules by such a body will mean the immediate enforcement throughout the territory over which they have control. Copies will be at once sent to the representatives of these numerous companies, including contract agents and local boards, and the inspectors will be provided with the code as a method of instruction, simply forming an addition to their previous duty, for the general inspection of buildings, and thus a most effective plan of determining whether or not proper methods have been pursued, will at once be adopted by the underwriters. Hence by the operation of a logical and mandatory plan, a rigid surveillance will be exercised over all constructing lines, and a great advantage immediately gained by the application of a uniform standard throughout the country.

The significance of the action taken and the probable results may be better understood when it is remembered that this is the first systematic effort made to secure the adoption of a uniform code of rules by the executive managers of a large number of the different insurance organizations, represented by the several associations of the United States.

Mr. Carroll, of Birmingham, Ala., then offered a resolution expressing the interest of the association in the work of the National Electric Insurance bureau and bespeaking for the codifying committee of the Bureau the cordial co-operation of all electric illuminating companies, which may be able to contribute to the result which the committee has in view.

A resolution approving the senate bill entitled "A Bill to Amend an Act Entitled, An Act to Provide for the Taking of the Eleventh and Subsequent Census," approved March 1st, 1889, was adopted.

Mr. Van Sickel of Sault Ste. Marie, inquired as to the proper construction of submarine cables for electric light and power works, and the subject was discussed by Messrs. Stieringer, Edgar, Beggs and Nichols. The secretary was instructed to request Mr. Kennelly, of the Edison laboratory, to prepare a paper on the subject to be incorporated in the minutes of the meeting.

On motion of Mr. Edgar the association adjourned to

meet on the Atlantic seaboard next year, the exact date and place to be designated by the executive committee.

Convention Notes.

Most of the delegates returned home Wednesday night or Thursday morning.

The electric welding display of the North Western Thomson-Houston company divided the attention of the delegates with the Edison exhibit

The Edison exhibit at the exposition was the center of interest of course for the delegates. This is the most elaborate display of the kind that has ever been made, and while it was of more than general interest to all, it possessed a special attraction for the Edison men.

The delegates and visitors were extended many courtesies at the exposition. William M. Regan entertained the representatives of the press. He was ably seconded by all the other officials and employes. E. Theo. A. Wangemann, one of Mr. Edison's assistants, who was in charge of the phonograph exhibition, piloted the delegates and visitors through the phonograph and art departments and entertained the visitors handsomely.

In addition to the delegates to the convention there were many representatives of other departments of electrical interests Among those who made the West Hotel their headquarters during the convention were the following: Forec Bain, F. W. Cushing, A. C. Durborow, Jr.; John B. O'Hara, D. B. Dean, W. F. Collins, E. L. Powers, John Roberts and Fred DeLand, Chicago; Thomas R. Taltavall, T. I. Skelton, E P. Greenfield, Robert Coleman, H. L. Lufkin, R. B. Corey, New York; A. D. Newton and M. E. Baird, Windsor, Ct.; S. E. Barton, Boston; C. L. Olds, Fort Wayne.

Tuesday afternoon President Lowry of the street railway company invited the representatives of the Edison General Electric company to inspect the work of construction in the lines now being transformed into an electric system, and ride on the newly equipped electric roads. The invitation was accepted and the delegates, under the guidance of Mr. Lowry and Force Bain, passed several hours in examining the system. Mr. Bain explained several modifications in the plan of construction. The electric system of Minneapolis and St Paul will be the finest in the country when completed, according to the electrical engineers who have thoroughly examined the system.

It will be observed in the report of the proceedings of the convention that Mr. Insull, in his remarks on the future policy of the Edison company, speaks of the "Edison Motor." In the course of a conversation with a representative of the WESTERN ELECTRICIAN, Mr. Insull said that it was the intention of the company to adopt the present form of Edison generator for stationary motors and to abandon the Sprague type as soon as possible. Of course the company will replace parts of motors of the Sprague type whenever there shall be a demand for them. Mr. Insull says there have been a large number of motors of the Edison pattern in operation at the Edison lamp works for years. It has not yet been decided what changes in form, if any, shall be made in the Sprague railway motor. The Edison company will adopt the plan of using one motor on the street cars. Mr. Insull contemplates the electric railway field as one of the most promising departments of electrical activity. He anticipates many changes in the next few years and expects the advancement in this department will surpass anything that has yet been witnessed, even in electrical development.

There was much disappointment when it was learned that Mr. Edison would not be present at the convention, as it was expected that he would participate in the proceedings. When the Eastern delegates arrived at the West Hotel, they found a large delegation awaiting them, as it was not known in Minneapolis that Mr. Edison had been unavoidably detained. All day long there was a throng of visitors at the hotel to see Edison, and many of the local reporters mistrusted the statements of the delegates that Mr. Edison was at home. This became so apparent that it was decided to play a trick on one young inquisitor, whose chief characteristic seemed to be persistence. He was directed to Mr. Muir and immediately began his interview, fearing evidently that unless he made the most of his time he would not secure the coveted "scoop." The you h approached Mr. Muir, and after making himself known, said: "Mr. Edison, will you kindly give me a popular definition for what you term Ohm's law?" Mr. Muir immediately saw there was a chance for a joke, so he said gravely that it would take too long to comply with the request as it would necessitate the education of the "dear public" in electrical science to a certain extent. Any way, he added, his time had been occupied so much of late with a new line of investigation that he could not give such little matters attention. The reporter eagerly caught the bait and begun a series of questions with a view of learning what the latest Edison invention was. His curiosity was satisfied, for Mr Muir confided to him to the extent of a half-hour talk on an electrical system for prolonging human life. Mr. Muir talked fluently and enthusiastically about his "discovery," the young man worked as he had never before worked, and strained every nerve in his effort not to let a word of the great inventor escape him, and when Mr. Muir, finding it impossible to repress his merriment, excused himself, the young scribe hurried away and "spread himself" to the extent of a three-column article and "scare head." Then he proceeded to the city editor's den and proudly placed the copy before that august personage, stepped back in order to get a better view of his chief's countenance when he realized what a "scoop" he had. The surprise was not on the city editor's countenance, it was on the reporter's, for the chief dropped the copy in the waste basket without a word, and handed the reporter a note from H. Ward Leonard to the city editor. In this communication Mr. Leonard explained the circumstances attending the interview, and commended the young man for his persistence. Although the "interview" was not published, it became generally known that Mr. Muir had been mistaken for the great inventor, and when the delegates visited the exposition, they found ample opportunities to continue the fun. Every time they would stop to inspect a piece of machinery, they would appeal to "Mr. Edison" for his views on the subject. The mention of the name acted like magic. Instantly a crowd would gather and stare at "Mr. Edison," and follow him about until he would be obliged to hide himself.

New York State Street Railway Association.

The eighth annual meeting of the Street Railway association of the State of New York was held at the Powers Hotel, Rochester, N. Y., September 16th. President John N. Partridge of Brooklyn, was in the chair. The following delegates were present: John W. McNamara, president Albany Railway, Albany; Samuel Cowdry, president Watervliet Turnpike Railroad company, Albany; Wm. Richardson, president, and Wm. J. Richardson, secretary, Atlantic Avenue Railroad company, Brooklyn; Daniel F. Lewis, president and E. W. Bliss, director, Brooklyn City Railroad company, Brooklyn; John N. Partridge, president Brooklyn City Newtown Railroad company, Brooklyn; Henry M. Watson, president Buffalo Street Railroad company, Buffalo; Porter Morton, director, East Side Railway company, Buffalo; C. Densmore Wyman, vice president, Central Park, North East River Railroad company, New York City; George Green, president, and Charles P. Emmons, secretary, Forty-second street Grand Street Ferry Railroad company, New York City; Daniel B. Hasbrouck, secretary Houston, West St. & P. F. Railroad company, New York City; W. R. Lambertson, president, and Sherman T. Pell, director, Pelham Park Railroad company, Pelham, N. Y.; Arthur G. Yates, president, John N. Beckley, secretary, Arthur Luetchford, treasurer, and Norman McD. Crawford, assistant manager, Rochester Railway company, Rochester; Charles Cleminshaw, president, and Charles H. Smith, superintendent, Troy & Lansingburgh Railroad company, Troy.

There were also present J. H. McGraw, C. B. Fairchild and B. H. Chapin, E. V. Cavell, Edward Caldwell, F. L. Blanchard, J. L. Taltavall, E. E. Higgins and F. R. Chinnock, Edison General Electric company; Norman McCarty, Thomson-Houston company, and Frank A. Rogers, Short Electric Railway company.

PRESIDENT'S ADDRESS.

The president of the association then delivered his address, from which the following extract is taken:

Marked progress has been made since our last meeting in the substitution of mechanical and electric devices for the propulsion of street cars in the place of horses. In New York City the Third avenue company is about to extend its cable system down town, through the busiest thoroughfares to the City Hall, this extension having been made possible by a recent decision of the Court of Appeals.

In many of our cities and towns where the electric car was unknown a year ago it is to-day a familiar sight. Its coming has been opposed by a few alarmists, who predicted that it would bring with it death and destruction. Similar predictions were made of the locomotive and even of the horse cars in their early days. But public convenience was served by both and their use has been marvelously extended. Wherever the electric car has been introduced it seems to have met with general favor.

Its noiselessness, its cleanliness, and its capacity for attaining a high speed whenever a high speed is safe, commend it to the riding public as a welcome substitute for the horse car, with the clatter of the hoofs and the slow jog of the horses.

Some of the brightest minds in this and other countries are actively working to develop improvements in the various systems known as the conduit, the storage battery, and the "overhead wire." Who will dare to say what they will accomplish, in view of the great progress made during the last decade in the telephone and electric lighting!

What we, as street railroad men want, is a system which is simple and economical in its construction, in its adaptation to our existing equipment, and in its operation.

The introduction of the electric car, with its greater weight, creates a demand for a heavier rail and a more substantially constructed road. Inventors are looking after our needs in this direction and new patterns of rails and new methods of laying them are constantly brought to our notice.

The following paper was read by John W. McNamara, president of the Albany street railway:

AN ELECTRIC STREET RAILWAY MOTOR.

BY JOHN W. M'NAMARA.

Soon after the road-bed of the Albany railway was completed and during the summer of 1864 when the directors and projectors of that road often saw four horses vainly endeavoring to draw the passengers contained in a twelve feet car up a grade of eight per cent. on State street, their attention was very naturally turned to the solution of the problem of transmitting the power of steam to the car.

Device after device was tried, but all proved failures, but still the directors never lost hope that at some time the problem would be solved. The successful use of the cable in San Francisco stimulated the stockholders to an effort to secure capital enough to construct a cable road; but the large amount of capital necessary to lay a cable road, and the want of faith in its working in this climate during the winter months, proved formidable obstacles.

More than twenty years had passed since the road was opened, and horses were still being used to draw the cars, when the attention of the managers of the road was called to certain experiments made by Leo Daft, who had for many years been a resident of two adjacent counties. Those of the managers who saw what the Daft electric motor did, felt that the day of emancipation of the State street car horses was rapidly drawing nigh. The experimental roads which are familiar to us all were earnestly examined, and the time when the obstacles to smooth operation would be overcome hopefully expected.

The time came much sooner than the most sanguine of us dreamed of; Baltimore, Scranton, Meriden, Richmond, Hartford and Boston followed in rapid succession, Scranton and Meriden demonstrating that it was possible to operate electric motors in winter. Our sister city, Troy, joined the electric band, and our sister company, The Watervliet Turnpike Railroad company, also contracted for electric equipment, before the Albany railway could determine which of five systems was the best and make a contract. It was finally made with the Thomson-Houston Electric company on the 30th day of November, 1889, and cars began running on the State street line April 29, 1890, and on May 1st all the horses on that line were withdrawn.

None of our drivers had had any training until the evening of April 27, 1890, yet we were able to begin running schedule trips with three cars the next day. Over four months' experience has taught us that the electric motor is efficient and reliable. We have yet to learn, by experience, that it will ascend State street, an eight per cent. grade, at the rate of five miles per hour in winter, as it has during the summer. We have also to learn, by experience, for it seems to be impossible to learn it in any other way, whether operating cars by electricity is more economical than by horses.

At the time of the introduction of the electric motor, the ordinary street car drawn by horses was the most convenient vehicle in public use. It was easy to enter one and easy to alight from one. The various makers had vied with each other, until one was able to step as easily from the street into a car, as he could ascend the steps of his own stairs The early builders of electric cars endeavored to retain this feature of the street car, and placed the motor proper *on* the car, communicating motion to the axles by means of sprocket wheel and chain; but the mechanical difficulties, and the noise made by the chains and wheels led to their abandonment, and the motor or motors were then placed on the axles and *under* the car, where we find them to-day.

At first the easy-of-access feature was retained, but as the necessity for larger motors and more room for them became apparent, the car body was gradually raised until it is too high for children and elderly people to enter readily, and a great deal of time is consequently used in receiving and discharging passengers.

The car body has been raised at the expense of comfort, without, it seems to me, improving the condition of the motor. It is still under the car near mud, dust, snow and slush, and is as difficult to get at as it ever was.

With these exceptions the electric motor of to-day is well nigh perfect, but these exceptions, as time rolls on, will become more serious. When the novelty of being regularly and rapidly carried to their homes and places of business ceases, then passengers will call attention to the difficulty of entering and leaving cars.

The size of the motor, especially for use on grades, should not exceed the standard—sixteen feet for box cars and about twenty five feet for open cars. On level and suburban roads, where the headway is not less than twenty minutes, larger cars with eight wheels might probably be economically used; but for populous cities where headway is less than five minutes, the old standard car body is, in my opinion, the best.

How the motor is to be arranged with reference to the car body so as to admit of easy access to it for examination and repair may, or rather must be left to mechanical and electrical engineers. That we will continue to drag them in the dust and mud very long, I cannot believe.

I think the opinion of all who are unprejudiced is, that the overhead single trolley under contact systems is the most reliable and efficient. With good overhead construction the loss of power in transmission is but slight, and the conductors are always where they can be seen and kept in place.

The ideal motor is one which is independent of every other motor or other engine, and contains everything necessary to make it go. This motor exists and seems to work fairly well on grades of not more than five per cent.; but that it is capable of doing the work now being done by motors of overhead system, is still problematical. However, as we have already witnessed such wonders in propelling cars by electricity, may we not hope for a storage battery electric car which shall be equal to any now in use?

We are justified, I think, in recommending to all who think of changing from horse to electric motors, or to all who think of building new roads, the overhead single trolley system. All the manufacturers of motors and generators have their systems in use in cities which can be readily visited, and the merits of all can be compared.

The question as to whether the electric motor is as economical as the horse car cannot yet be answered and need not be answered. Just as certainly as the horse car supplanted the omnibus, the electric motor will supplant the horse car. The horse car, however economical must go, and the electric motor, no matter how expensive, must come.

THE DISCUSSION.

FRANK A. ROGERS, of the Short Electric Railway company of Cleveland: I desire to say a few words in behalf of our system, and to call the attention of the gentlemen to some of the principal points of our motors, in the armature especially. We use an armature that is large in diameter, and is run at a slow rate of speed. When the car is running at the rate of twelve miles an hour, the armature revolves at about one thousand revolutions per minute. We use very large pinions, $6\frac{1}{2}$", which are made of the best machine steel. The large gears are made of cast steel, and have wooden webs between the rim and the hub, which are put there for the purpose of deadening the noise, and also to serve for insulating the motor itself from the ground; the ground connection being made directly from

the motor to the car axle by flexible cable connections. The axle part of the motor is insulated by heavy wooden beams, connecting the motor itself with the axle portion. We do that in order to deaden the noise and to get perfect insulation from the ground to the armature. The series system has been practically abandoned by our company; we are now using what is known as the parallel system, similar to that of the Thomson-Houston and Sprague; that is, in connection with the distribution of current and the style of overhead construction. The Short motor differs greatly in mechanical construction and electrically from any other. The field magnets, which are four in number, are "series" wound in one coil on each magnet, and the coils on the armature are entirely separate from each other. If one of the coils should happen to burn out it does not touch any other coil on the armature, and is very easily repaired, as there is but little of it.

We have a great deal of apparatus here in Rochester at present. It is mostly in boxes in storehouses. The company has been hindered somewhat in getting its construction under way, its poles set up, and this fact caused some delay in setting our cars in operation here.

MR. LEWIS, of Brooklyn: What was the reason of your abandonment of the series system?

MR. ROGERS: It was not a success with a large number of cars.

MR. LEWIS: Why was it not a success?

MR. ROGERS: The trouble came in the generators. It is a success with two or three cars, but with from five to a hundred it is not so successful. We think the parallel system is better.

MR. LEWIS: I understand the series system to be composed of a main conductor carrying the current of electricity, and being shut off in sections. That you say is not successful. How does it act generally?

MR. ROGERS: Not well with a large number of cars.

MR. LEWIS: I understand that the abandonment of the system is because it acts unfavorably upon the generator. Is that due to any great complication through this series system?

MR. ROGERS: The trouble is that it is a hard matter to manufacture a constant current generator that can be operated with little attention. The generator fluctuates, so that it does not take care of the current. In the parallel system the electromotive force is constant. In the series system the current should be but is not constant, and for that reason it is not adapted for a large number of cars. Then the construction, the overhead work, is more complicated. A switch is used in it and the cars could not be bunched. Professor Short has been through that very carefully, and has spent a great deal of money in trying to work the system up and make it a success, and has also experimented largely in underground work before the new company was organized; but since the organization of the new company the parallel system has been adopted.

MR. LEWIS: Mr. McNamara's report suggested the single wire under contact system. Do you prefer that?

MR. ROGERS: Yes, sir; a single overhead wire with rail return.

MR. LEWIS: What is the reason?

MR. ROGERS: It is not so complicated, and in a large city where there is one line crossing a number of tracks, it lessens the number of wires overhead. At Cincinnati we were obliged to put in the parallel double overhead wire, on account of the telephones there, and because the street railway managers are largely interested in the telephone companies.

MR. RICHARDSON, of Brooklyn: Why?

MR. ROGERS: To overcome induction in telephones. At the time we did not care to put it in, but they desired it, and seemed to be entirely satisfied with it, and we took the contract to put it up. There is only one other company in Cincinnati, the Thomson-Houston, using the double overhead system. The Sprague, I believe, is using a single overhead wire.

MR. CLEMINSHAW, of Troy: Will you not give us an idea of your line construction as differing from the Sprague or Thomson-Houston?

MR. ROGERS: In the parallel system we use practically the same plan and principle as in the other systems that are parallel. By "parallel" it is meant that the cars are in a circuit so that the current divides through each car as the amount of power is required to drive it. In the series system the same amount of current passes through each car. It does not divide proportionately. For instance a quantity, say, what we call 40 amperes, all goes through each car, where in the parallel system it divides proportionately through each car. If you have a generator that is producing 160 amperes, and you have five cars on the track, each one of the cars takes its proportion of current, and it may not be all of the output of the generator. It depends, of course, on the road, grades and load being carried.

MR. CLEMINSHAW: Give us some idea of the line construction as you propose to put it up here in Rochester.

MR. ROGERS: As I said before, it is parallel and we use feeders in our construction work. We do not employ solder where there is a strain on the line. The connections are all mechanical. We have a patent device for making connections of the trolley wire splices without using solder.

MR, CLEMINSHAW: I understood you last evening to say that you insulated your trolley wire at points on the line. The Thomson-Houston has no such system as that. Will you please explain that feature of your system.

MR. ROGERS: The idea is that we can "feed in" from one feed wire running the length of the trolley line, which is divided in sections, each section bein insulated from the other. The wiring has all to be figured for carrying capacity and equal distribution over the line, and what one road would require, another road would not. On some lines we do not use any feed wire at all.

MR LEWIS: I think you just said that you feed into a sectional trolley wire.

MR. ROGERS: Yes, sir; where we use only one feed wire, that is also parallel. While a car is going through a section it is merely using current in that section, and after the car has passed through there is no current running through that section. The other plan is to use a number of feed wires running along and feeding in, the trolley wire or trunk line not being in sections.

MR. RICHARDSON: I ask whether in your judgment, what you have said in regard to five cars in operation on a road is just as applicable to a system of fifty cars running three minutes apart over a road from four to five miles?

MR. ROGERS: Yes, sir. You understand that all the variations in the wiring for different places must be figured out for the several carrying capacities of the roads, and for equal distribution over the lines. There are hardly three cities out of five that have the same wiring.

MR. RICHARDSON: What is the minimum and maximum size of the wires used?

MR ROGERS: Any wire from 00 up to 5.

E. E. HIGGINS of the Edison company: The Sprague company is now a part of the Edison General Electric company. There is one point I want to mention first, and that is that at three o'clock on the 4th of September, 1882, the old Pearl street station of the Edison company started out. On January 2, 1890, it burned out from an accidental spark. Between those two dates that station turned out current twenty-four hours in each day without stopping. I mention this for several reasons. In the first place, it ought to do away with some of the objections that have sometimes been raised to electrical systems on the part of the public on the ground that they are not reliable. The generation of electricity is reliable. When the first station of the kind ever built can run for nearly eight years it is true that the stations that are now built can do even better work. The old Pearl street station demonstrated the fact that you can turn coal into steam, turn it from steam into electricity, transmit electricity through an expensive underground system of conductors, and can turn it again from electricity into light at a price which will compete with gas made from coal. That is an example of the advantage of steam and electricity over steam even, which has made the electric railway what it is to-day. It costs to run a car with electricity for the "provender" about seventy-five cents, and to feed eleven horses for the same service, the same number of hours per day, costs a little over $2 a day. You can see again that there is an enormous intrinsic advantage of steam and electricity over horses. The Edison company proceeded with the electric light business, and about 1885 or 1886 Mr. Sprague, who was then with the Edison company, came out with his electric railway system. The principal things brought out by Mr. Sprague, and copied ever since, were the placing of motors underneath the cars and attaching them to the axles on one side and to a spring support on the other, and this spring support was the one feature which enabled the Sprague company to use spur gearing. Previous to that time sprocket wheels and chains and worm gearing had been used. Spur gearing had been used and discarded, for the reason that the lack of flexibility in the motor caused the strains put on the gearing to be so severe as to strip the teeth and cause other difficulties. Then the control of both motors of the car from two platforms was another important point. The claim to the conception of the under-running trolley, I believe, is disputed. I presume it is one of those early contrivances, which may have been brought out by several persons at the same time. It has been adopted everywhere, and is the only true way of getting at the thing. The method of winding the Sprague field magnets is entirely different from all others. They are wound in three sections each; the coils are wound on spools and the spools are slipped on the fields. The control of speed is effected by different combinations of these coils without the use of wasteful resistances. In some of the systems there are different contrivances in use for varying the speed from zero to full speed. Resistances are put directly in series, and are gradually cut out, as the speed of the car increases, allowing more current to go through the motors. The Sprague company does away with this wasteful resistance by throwing this current, which produces different effects, on the motor. The consequence of this is that the cost of coal per car is less, we claim, than with any other systems. That means a reduction in the operating expenses; it means also a reduction in the original cost. If you can run one hundred cars with seven hundred and fifty horse power in dynamo capacity and engine capacity, it is plain it will be less expensive than if it takes one thousand horse power. The original investment required is, therefore, less than it is with other systems, because the apparatus required is less. The operating expenses are also less. These are the main features of the system.

Since the first of August Mr. Edison has been devoting his entire attention to some changes in the motor. They relate merely to mechanical details. The fields of the motor are now spread slightly so as to allow a little more wire on the field coils, and to vary somewhat the amount of metal in the machine. This makes a somewhat more powerful machine, and in some respects improves the design. The gears have been widened; but the most important advance which has recently been made in electrical railway work is the adoption of the new style of winding the armatures The old armatures of all systems, with the exception of the Short system, are wound with what is called the Siemens winding. The wire is put on in such a way that at the end of the armature there is a large bunch, the wires of which cross and recross each other, and not being fastened in place, there is necessarily some chance for the play of the wires. This results in the frequent burning-out of the armatures, as we know. The first effect of this method is that you may have a maximum pressure wire touch a zero pressure wire, and the slight motion between these two will cause the insulation to become abraded, and a short circuit on one or two coils will follow. In the new armature that we are bringing out there is no bunching of wires at the end. The coils are wound separately, are inexpensive and may be replaced easily. In the event of one of these coils burning out the method of repairing the armature would be to loosen up the coils, withdraw the coil that is burned out and replace it by another. The whole operation occupies only an hour. In the old form the wire is wound in two layers, one over the other. These layers are usually broken, in accordance with the law of things, on the lowest layer, so that you have to unwind the top layer and a good part of the lower. The new winding does away with this entirely. As a matter of fact, we believe our armature will not burn out, unless it may be caused by an actual overloading which will melt out the wires. The coils are insulated from each other by fiber insulation. There is another point, in regard to the car, which ought to be mentioned. In times past there has been some criticism as to the sudden starting of the Sprague car. This is largely a matter of manipulation on the part of the driver, and it is also partly due to the method of winding. Difficulties of that nature have been entirely done away with by the adoption of what we call a slow starting device. It is put in the very instant the car starts, but is cut out immediately and is not in circuit at any time during the operation of the car.

MR. LEWIS of Brooklyn: This contrivance is practically a governor.

MR. HIGGINS: Only for the instant of starting; it prevents too much current going into the motor. When the crank reaches the first notch, then the regular system of operation of the fields commences and is afterward carried out. The switches on the Sprague cars are fireproof; this is a new device recently put on. The feeding-in system, as it has been called, is distinctively and exclusively an Edison-Sprague invention. The system is this: We have a trolley wire in the center over each track, the wire being about as large as a pencil. It is made of a composition of copper, and has a tensile strength equal to that of drawn steel, while its conductivity approximates that of copper. It carries only the portion of current used in the actual operation of the car at given point. The main current is carried by heavy copper feed wires. In the first place, we have the main conductor, which passes along the whole line. That is connected at intervals with a specially insulated auxiliary feeder, as we call it, which maintains the pressure all the way along the trolley wire simply, as it is to be used by the car passing between the poles or between the auxiliary feeders. The car takes from this feeder the current that is required to operate it until it comes on to the next. By our arrangement of feeders we lose ten per cent. only, and frequently less, in the entire overhead structure. Thus, of one hundred horse power coming out of the station, ninety will go into the cars along the line. You cannot obtain this by the use of a single trolley wire carrying the whole current. I have heard of one case, where the system was adopted, where the pressure fell from 500 volts at the station to 250 volts at the car.

MR. LEWIS: This feeder system, in connection with your main conductor, means you can maintain a uniform speed of the car regardless of grades and loads; furnishing the trolley wire, through the feed, with whatever current is required.

MR. HIGGINS: We never advise the running of cars on a heavy grade at full speed, twelve miles an hour. We could arrange to do it, however.

WM. RICHARDSON of Brooklyn: What speed do you recommend on a grade, say six or seven feet to the hundred?

MR. HIGGINS: About eight miles an hour can be attained.

MR. RICHARDSON: Faster than a pair of horses would be allowed to travel on the level?

MR. HIGGINS: Yes, sir; I think so. One other point ought to be mentioned. We put up our line in sections. Every two or three thousand feet, more or less, we break the trolley wire, making each section entirely distinct from the others. A trolley-wire section is fed from the conductors on the side, and is fed through fusible "cut-outs," which, when the current in that line exceeds a given amount, will melt and cut off the entire section of the trolley wire from the source of electricity.

MR RICHARDSON: You spoke of what might be accomplished by electric power at the cost of seventy-five cents a day as compared with eleven horses costing two dollars a day to feed. At what price do you calculate your coal?

MR. HIGGINS: Three dollars a ton.

MR. RICHARDSON: In places where coal costs six dollars, it would be a dollar and a half a day?

MR. HIGGINS: Yes, sir.

MR. RICHARDSON: What other items of expense go into the seventy-five cents?

MR. HIGGINS: I have estimated on the basis of provender for the horses, on the one hand, and coal and water on the other.

NORMAN MCCARTY of the Thomson-Houston company: The Thomson-Houston company has long recognized the fact that the electrical railway apparatus is not so much an electric as a mechanical problem. We have aimed to get it as simple as possible. We use no commutated fields. We made up our minds that it is a good deal better to spend a little more money for coal, and avoid wear and tear, and we are convinced that we have done the right thing Quite a number of gentlemen here know as much about our system as I do, who use our apparatus. Our motors are plain series wound. We use the much-abused rheostat. The peculiar advantage of this is that we can start our car without jar. You can hardly tell when it starts; the starting is so quiet and steady. We can make a good deal better time because of this, not having to wait for old people to be seated. We rarely burn a field, and there is no particular reason why we should have any more trouble with our armatures than other people. There is no reason why our fields should burn out because all changes of resistance are made by the rheostat. I believe that other companies claim that with the divided fields they save coal. We do not care so much about that, as the increased amount of coal is not excessive. We save wear and tear and get rid of annoyances. Our latest construction is perfectly simple. Regarding line construction I would say that we are not limited by any patent, the method of construction varying with the conditions of the circuit. There

is a patent on a system by which you feed your line at regular intervals; there is no patent on the system by which you feed at irregular intervals.

The impression has got abroad that the Thomson-Houston company is high-priced in its charges for electrical apparatus. It seems to me that it is not so much a question of how much per car, as it is how many cars you have got to pay for. If you can operate a road with only one or two per cent. of cars out of service, you can afford to pay more per car than if you have fifteen per cent.

MR RICHARDSON: Will you please tell us what is the superior advantage of the Thomson-Houston over the Sprague system, which makes it economical for those who have to buy to pay the higher price.

MR. MCCARTY: I do not know that I can do that, without criticising the other systems. As for the Thomson-Houston company, our cars and trucks are heavier; motors are heavier and built stronger; the gears are wider, and we have eliminated most of the electrical complications. We do not care about a complicated electrical theory so much as mechanical perfection. I think that is the secret of our success.

MR. RICHARDSON: I ask purely for information. I represent several companies that are contemplating the purchase of electrical apparatus, and have not purchased the first thing yet.

MR. HASBROUCK of New York: Two years ago we were invited to take a ride over the Thomson-Houston road in Washington. I would like to know how that road is working.

MR. MCCARTY: It was the first road we started; it was nearly two years ago I think if you were to talk to the president of that road he will, I believe, tell you that he has the best electrical road in the United States. You can probably get more information from those who are using the system than from me. We consider the electrical railway problem a mechanical one. We do not use a large armature, we use a small one; and we use it for a reason. We do not use a small trolley wire, we use a large one; and we use that for reasons Our reason is that it has a greater conductivity. The silicon-bronze has about sixty per cent. of the conductivity of pure copper; our hard drawn wire has about eighty per cent. We use a trolley wire which has about four or five times the sectional area of the silicon-bronze wire, consequently we get a larger conductivity on that account. We get rid of feed wires along the sides of the street. There is more objection to the wires on the street than through the center. We do feed our lines, but we do not break our circuit, except on extended and complicated circuits. We use the trolley wire as a conductor, and only feed where it is necessary on account of special grades or excessive work.

MR. SMITH of Troy: Suppose your trolley wire should fall down?

MR. MCCARTY: If our trolley wire should fall down any way we immediately get a short circuit.

MR. SMITH: Your line would lie dead till that is repaired?

MR. MCCARTY: Yes, sir.

MR. SMITH: You have no means of cutting out a portion of your line?

MR. MCCARTY: Not on small roads. We do not believe in that, for this reason. The experiment was tried in Boston, and it was found that these complications caused other complications; and while they were a protection in certain respects, they were an annoyance in others.

MR SMITH: Suppose there was a fire at the further end of the road?

MR. MCCARTY: The only way that our road could be shut out would be by a short circuit on the line, and that portion of line would be shut out until the circuit was broken again.

MR. SMITH: If your line should come to the ground you would get a short circuit? That would have to be repaired before you could operate again.

MR. MCCARTY: What are the chances of your line falling to the ground?

MR. SMITH: It depends entirely on your own construction.

MR. MCCARTY: We claim that the chances of the wire falling to the ground are small in comparison with the other contrivances failing to work in their proper time, or of working out of their proper time.

MR. RICHARDSON: I would like to call the attention of the members to the fact—it may be known to many of you, and may be known to but few—that the Boston *Daily Advertiser*, one of the most conservative papers in this country, sent out a letter asking information from all cities, from Portland, Maine, to Galveston, Texas, in which electric railways are operated, inquiring what systems they used, whether there had been any loss of life in connection with the wires, whether there was any objection to the overhead system on the part of the public, and what had been the effect on the street railway service of the particular locality. They published those answers, so far as they have received them, from sixty-four different places. All but four of them were favorable to electricity. Nashville, Tenn., I think was the only place where there was any loss of life reported. The answer from that city was rather amusing. There had been a wire broken in that city, causing the death of a horse, and a negro woman caught up the wire and threw it over, and it gave her a shock that was very amusing in its effects, but it did her no injury. It killed the horse, but did not hurt the woman, going to show that it is easier to kill a horse than it is to kill a human being. Another objection came from Newport, R. I., where the upper ten were objecting to anything which should popularize the riding. The mayor of Rochester responded favorably, as also did the mayors of Troy, Buffalo and Albany.

F. R. CHINNOCK: I have been connected with the Bell Telephone company of New York, the Bell Telephone company of Boston, and the New York and New Jersey Telephone company. I wish to say a few words about this matter of induction. The telephone companies say they cannot do away with induction; that is all wrong. They can do away with it, if they only will go to expense. The method is well known. They should provide a return metallic circuit.

MR. CLEMINSHAW of Troy: We were threatened with injunction suits by the telephone companies. We kept them off until the accidental discovery was made in Albany of a method of overcoming this interference. We put down two supplemental wires, connected them, and ran them through to the station. The thing has worked very effectively, and is an inexpensive method of overcoming the trouble referred to.

ELECTION OF OFFICERS.

Officers for the ensuing year were elected as follows: President, Daniel F. Lewis, Brooklyn; first vice-president, John N. Beckley, Rochester; second vice-president, John S. Foster, New York; secretary and treasurer, William J Richardson, New York; executive committee, John N. Partridge, Brooklyn, Charles Cleminshaw, Troy, C. Densmore Wyman, New York.

At 1 o'clock an adjournment was taken, after which the members enjoyed luncheon at the Rochester Club house. A trip to Charlotte over the electric road followed. In the evening the members were entertained at the Genessee Valley Club house. The entertainment of the members while in the city was conducted by Secretary Beckley of the Rochester Railway company.

The next meeting of the association will be held at the Hotel Metropole, New York, the third Tuesday in September, 1891.

Reunion of the United States Military Corps and Old Time Telegraphers.

The tenth annual reunion of the United States Military Telegraph Corps and the Old Time Telegraph Society was held at the Centropolis hotel, Kansas City, Mo., September 15th. About sixty members were present, and the rear of the room was occupied by ladies, who took a strong interest in the proceedings. On the side table was arranged a number of war relics, among which was nearly a peck of bullets labeled "Unsent Messages."

The meeting was called to order by W. W. Smith, chairman of the committee of arrangements, who announced that Mayor Holmes, regretting exceedingly that administrative duties compelled him to remain absent, had sent the freedom of the city to the visitors, and trusted that they would heartily enjoy their stay in the city.

Mayor W. A. Coy, of Kansas City, Kan., was then introduced, and spoke at length on the great city, of which he is mayor of part. He eulogized the movements of the patriotic men who kept the people cognizant of the events of war. He called attention to the two mayors of the city, saying that such an arrangement had proven beneficial, especially as Kansas City was the only city in the country wherein prohibition and convivial relations were found together, only separated by a state line.

ADDRESS OF WELCOME.

Major William Warner was then introduced, and delivered the address of welcome. He said:

"I think that I may say to you that we, one and all, extend to you the right hand of fellowship and say to you that the latch string, not only of our houses, but of our hearts, is out for you and yours during your stay here. And it is an honor—an honor for any community—to entertain any part of that great body of men who, from '61 to '65 preserved the Union established by the fathers. It seems to me that it is an astounding fact that the application of such men simply to have this government say upon a piece of paper, 'Your services were honorable; your services were valuable; we recognize them and hereby authorize the secretary of war to grant to you a discharge from that service;' has been refused. For what purpose is the application made? Not that you may obtain a land grant, not that you may become pensioners upon the general government, but that you may have something to hand down to your children; that your sons and daughters may say, 'My father was a member of that great body of men that took their lives in their hands and counted not the cost, and went forward to the call of duty bearing the flag, and, as the Israelites of old, followed the pillar of cloud by day and of fire by night until the stars and stripes went up and the stars and bars went down at Appomattox.' I say it is an astounding fact that it should not be done. We have in all our legislative bodies, the great Congress of the United States not excepted, some who pretend to think that if this little handful of men now surviving—less than 500—should be granted this recognition, the first thing you know some of you might become disabled, some of you might show that you lost your health in the service, and that twenty-five or thirty of you, perhaps, would make a raid upon the treasury of the United States. Well, I say, as I stated before, that while you ask for nothing of the kind, if the man, while tapping the wire in the front of the enemy's gun, if, while sending a message from behind a tree, if, while sleeping upon the frozen ground in the discharge of his duty as one of the military telegraph operators of the Union army, was impaired in health, he is as much entitled to the bounty of his government as I was carrying a musket. We were fighing in a common cause, and for a common purpose."

PRESIDENT'S ADDRESS

At the close of Major Warner's remarks Acting Chairman W. W. Smith surrendered the chair to President W. R. Plum, who delivered an address in behalf of the societies assembled. He spoke at length of the great importance of the telegraph to the railroad and commerce, and declared that a stop in its operation would cripple the commercial world to an extent that can scarcely be calculated. He said that the war history of this country had been written as no history of any other country was ever written, all of which was due to the military telegraph corps, and the speaker denounced the action of the government, which is willing to recognize the valuable relation of the corps during the war to the establishment and upholding of the Union, yet refuses to offer anything but a letter of thanks as a token of such recognition. He then continued:

"The record of our services, including the splendid testimonials of the great war secretary; the testimony of Grant, Sherman, Sheridan, McClellan, Burnside, Rosecrans, Logan and other general officers; the five favorable reports of previous congressional committees on military affairs; the resolutions of the Grand Army of the Republic, of the Society of the Army of the Tennessee and of the Ohio legislature, are all disregarded by the house committee on military affairs of the present congress, which reports a substituted bill that strikes out every feature of our bill and simply requests the secretary of war to issue a suitable certificate of honorable service with the army giving dates, if convenient, provided no new liability is created, and that we shall not be deemed by construction to have been a part of the army."

In conclusion the president said:

"Since our last reunion the Society of the Army of the Tennessee at its Cincinnati reunion, at the instance of our good Colonel Fuller and Comrade Sam. T. Brush, adopted a resolution reciting that whereas we had been dismissed at the close of the war without any recognition of our faithful, devoted and vitally important services from the beginning to the close of the war, therefore resolved, that it is the sense of the society that congress should take immediate action and give speedy and substantial recognition to all telegraphers who served in the army during the war.

"Under the administrative skill of the chairman of your committee on congressional action, that committee, aided at all points by your indefatigable secretary and our able Comrade Safford of Washington, has done much systematic and well directed work that would have borne earlier if not better fruit had we sooner suspected the secret enmity in the house committee.

'Comrades, it is for you to say whether or not you will accept this substitute bill or plainly tell congress that you do not want recognition as camp followers with a similar rank."

At the close of President Plum's speech, calling the roll was dispensed with, and Secretary Pettit read the names of seven applicants for membership, and they were all voted into the society.

Secretary and Treasurer Pettit read an annual address showing the condition of the society's finances and present condition, and eulogized highly the action and work of the committee which has had the congressional recognition in hand.

A resolution continuing the present congressional committee with instructions to proceed in the line suggested in the president's address was presented, and Chairman Bliss of the committee arose and explained the work done by the committee. He believed that a resolution should be passed explaining exactly what was wanted, and which should be prepared for presentation to members of the senate and house. He thought if a bill was properly drafted and presented stating exactly the desire and demand of the society it might pass, notwithstanding the apparent opposition of the cougressional committee.

Secretary Pettit read a number of communications giving expressions on the congressional situation, about half being in favor of holding out for an honorable discharge from the army, the other favoring the passage of the proposed amended bill merely granting a recognition in the form of a letter of thanks.

The president was requested to draft a resolution setting forth the exact outline of what the society desired which would leave no chance for misconstruction, and such was embodied in the original resolution, and was adopted, Comrades Cruise and Crittenden being chosen to assist the president.

The afternoon was given over to business for an hour and a half and the rest of the time to sight-seeing about the city. The telegraphers did not go in a body but scattered here and there to the various points of interest.

At 2 o'clock the afternoon session began, and after general discussion relative to the interests of the corps, a committee of three was appointed to confer with the Old Time Telegraphers' Society relative to the time and place of meeting for the next reunion. That committee consisted of E. L. Armstrong, Omaha; B. Byington, Leavenworth; Joseph Hausen, St. Joseph. The committee came to an agreement as far as itself was concerned, and recommended after a few minutes that the reunion of '91 be held at Washington; that of '92 at Omaha, and report for a good time at Chicago in '93, just in time for the World's Fair.

When the order for the annual election was reached the secretary was instructed to cast his ballot in favor of the present incumbent of each office. The old officers will therefore succeed themselves as follows: President, W. R. Plum, Chicago; vice-president, W. H. Wilson, Philadelphia; secretary and treasurer, J. E. Pettit, Chicago.

It appears that Andrew Carnegie, the Pittsburg iron millionaire, some time ago gave the corps a check for $200 to be used in its work. It was desired on the part of many to make Mr. Carnegie an honorary member of their society but a resolution to that effect was bitterly opposed by others, and debate for a time was somewhat warm. It was passed, however, and the great iron manufacturer is now an honorary member of the military corps. The resolution to admit him to this relation was presented by W. E. Wilson.

The following resolution was presented: "*Resolved*, That this association assembled in annual reunion at Kansas City insist that we are entitled to such recognition by the government as will place us as an integral part of the army, which, in fact, we were; and that, while we are entitled to all monetary rights given by congress to common soldiers, we do willingly waive them all." There was considerable earnest discussion, and the resolution was finally withdrawn. The committee which will be at Washington this coming session, will fix the matter up as best it can

General W. G. Veazey, commander-in-chief of the Grand Army of the Republic, who was in the city on his way West, held a reception in the Coates house parlors in the evening. The United States military telegraphers' corps, accompanied

by the attending ladies, drove to the hotel at 7:30 and proceeded to the parlors where General Veazey, Colonel F. M. Sterritt of St. Louis and Major Wm. Warner were waiting to receive them. President W. R. Plum, of the military telegraph corps, made a short address to Commander Veazey in which he said that the society he represented had resolved to do itself the honor of calling upon the general in his official capacity as commander of the living of the grandest army that had ever been organized President Plum spoke of many features of the war and said that one of the most striking was the use of the telegraph on the fields of battle. No army of the world had been without that important adjunct.

"Our corps," continued Mr. Plum, "did form part of the integral whole of the army; we constructed and operated miles and miles of military telegraph lines and we should be recognized by the government." Every campaign, Mr. Plum said, demonstrated the importance of the telegraph in warfare.

General Veazey, in response, said that the society conferred much honor upon him by calling, and that he was pleased to see its members. The general said that he understood something of its efforts and desires to have a certain standing in the army. "We of the Grand Army," he said, "recognize that it is your due and hope that congress will pass the bill now before it." The general closed his remarks by saying that it would give him pleasure to use his official influence to bring about the result so much desired.

OLD TIME TELEGRAPHERS.

At 10:20 on the morning of the 16th the Old Time Telegraphers' Society convened in tenth annual session in the parlors of the Centropolis, Wiley W. Smith, chairman of the committee on arrangements, occupying the chair. There were many ladies present to watch the proceedings, and more active members participated than the previous day. Eligibility consists of apprenticeship at the key at least twenty years before joining, a war record not being required.

T. F. Clohesy of Kansas City, delivered an address of welcome and in eloquent words, tendered them the freedom of the city and the fullest welcome from every inhabitant. The address of welcome was responded to by A. H. Bliss of Chicago, who returned the thanks of the society for the hospitable entertainment offered the visitors.

Colonel R. T. Van Horn was introduced by Chairman Smith and spoke for half an hour in a reminiscent vein.

President Day K. Smith took the chair and delivered his annual address which contained some practical information and valuable advice. At the conclusion of his address President Smith read a letter of regret from J. D. Reid, a member of the society, who is 80 years old, but hale and hearty, and is now consul at Dunfermline, Scotland. A letter from W. J. Dealey, secretary of the society, expressing his regrets at being prevented from attendance, owing to the demand for his presence in New York, where he is connected with the Western Union office, recently destroyed by fire, was read, as were also letters of regret from Vice-president Wilson, Barney Hughes and J. L. Waite.

J. E. Pettit and L. H Karty, delivered addresses devoting themselves to reminiscenses and the pleasant manner in which they revived old incidents and conditions, long since forgotten, was heartily appreciated.

Twenty-four candidates applied for membership and they were unanimously elected, after which the annual report of Secretary and Treasurer Dealey was read and approved.

A committee of three was appointed to select a time and place of meeting and after consultation with a similar committee from the Military Telegraph Corps, Washington, D. C., on the third Wednesday in August, 1891, was reported and adopted. The committee further recommended favorable consideration of holding the meeting of 1892 at Omaha. Resolutions of thanks to their hosts and to the municipality for hospitality extended were adopted, followed by the election of officers for the ensuing year. George C. Maynard of Washington, D. C., and A. H. Bliss of Chicago, were nominated for president, the former being chosen. D. A. Williams was chosen vice-president, and W. J. Dealey of New York, was unanimously re-elected secretary and treasurer, after which the convention adjourned.

At 2:30 P. M. the members of the two veteran telegraphers' societies assembled at the Grand avenue depot, accompanied by the ladies of the party, and, boarding the cars, were whirled away to Swift's packing house, where every courtesy was extended and a thorough inspection made.

Leaving Swift's the visitors returned over the Belt line through Centropolis, Sheffield and Manchester. A short stop was made at two places, after which the Milwaukee bridge was crossed, and the tourists returned to this city over the Burlington, delighted with their trip, and well prepared for the hearty supper which awaited them at the Centropolis. The evening was spent in calling, visiting the theaters, etc., and making arrangements for the trip on the following day.

On the 17th E. Summerfield, general manager of the Kansas City, Wyandotte & Northwestern railroad, and an old soldier, though not a telegrapher, entertained the visitors with a trip over his road to Leavenworth where the Soldiers' Home, the fort and the city of Leavenworth were visited. Colonel Edwin F. Townsend, the commandant of the fort, gave the old telegraphers a hearty welcome. Capt. J. W. Pope took the veterans in charge and showed them through the grounds, prison, sleeping and culinary departments and all other places of interest.

This ended the tenth annual reunion of the Old Time Telegraphers' society and the United States Military Telegraph corps, and from expressions of the visitors it is safe to say they enjoyed every minute of the time.

Herbert Burns, a dynamo tender in San Francisco, according to the press dispatches received 2,000 volts direct from a dynamo at which he was working. The shock knocked him down, but he soon recovered consciousness and aside from the effect on his nervous system the experience caused him little trouble.

The New Telephone Company In Chicago.

In a recent number of the WESTERN ELECTRICIAN was noted the incorporation of a new telephone company in Chicago known as the Subscribers' Telephone & Service Company. Those interested in the corporation are very reticent in regard to their plans. They have started, however, the arduous work of securing a franchise. At a recent meeting of the Chicago city council Alderman Madden introduced an ordinance for the company. The striking provision is that the rate shall be uniformly $75, and each subscriber has the option of becoming a stockholder. The use of telephones by the city in all public departments is granted. Wires are to be underground in a large section of the city, and the franchise is asked for the entire corporation limits. Without the district bounded by North avenue, Wells street to Lake, on Lake to Ashland avenue, Ashland to Sixteenth street, on Sixteenth to Butterfield street and south to Thirty-first street, thence east to the lake, a system of poles may be erected, the tops of which shall be free for the use of the city. Alderman Madden said 5,000 people had already subscribed for the service of the company, and if the council would pass the ordinance the company would begin work at once.

The Duty on Mica.

The manufacturers of electrical machinery will be interested in learning the views of the Chicago *Tribune*, the leading republican paper of the west, on the provision in the McKinley bill, by which a duty of 35 per cent. ad valorem is imposed on mica. That there is no possible defence for this action will be plainly seen by a perusal of the following abstract from a recent editorial in the republican organ: One of the indefensible small jobs of the McKinley bill is the taking of mica off the free list and subjecting it to a duty of 35 per cent. ad valorem. This duty is not laid for revenue, because the value of all the mica imported last year was but about $95,000. It is imposed merely that the owners of a few mica mines may be able to add a third to the cost of their product to the American consumer. This mineral is used extensively by stove manufacturers, is also employed on account of its non-absorbent qualities in the manufacture of certain explosives, and is being used more and more for electrical purposes because it is such a good non-conductor. At the recent convention of electricians there was an earnest protest against the onerous mica duty because it was levying a wholly unnecessary tax on an industry which is developing with astonishing rapidity.

The finance committee of the senate decided to recommend that mica be restored to the free list, but when its amendment came up in the open senate it was abandoned by the committee and defeated. As illustrative of the sincerity of democrats in dealing with the tariff it may be stated that Senator Vance of North Carolina voted to make mica dutiable, because there is a large mine of mica in his state whose owners will fry fat out of the consumers. For the sake of enabling half a dozen mine owners to make a trust, who are not injured now by foreign competition, an onerous tax is placed on three great industries—stoves, explosives and electrical machinery.

Liquid Insulation for Underground Conductors.

BY DAVID BROOKS.

The first work of this system for practical purposes was laid for the English post office in 1880, along the Southwestern railway between Waterloo station and Clapham junction. The process consisted in boiling cotton covered conductors in paraffine oil and drawing them into an iron pipe an inch and one-quarter in diameter and afterward filling the pipe with oil. There were forty conductors No. 18 B. W. G. Reservoirs were placed at elevated positions at Clapham and Waterloo to supply the loss of oil from leakage. The oil used was the ordinary petroleum fluid. The only difficulty experienced was from leakage through the joints of the pipe. This was remedied by the introduction of a heavy resinous oil of the consistency of the thicker grades of molasses. It has been working without interruption for the past ten years.

An improved method was patented Feb. 1st, 1887. In the spring of that year, 53 conductors were laid along the Pennsylvania railroad, between the Broad street station and Thirty-second street in Philadelphia, a distance of one and one-third miles. Instead of the ordinary sockets, a "T" joint is used where the insulation is introduced through a plug hole, which occurs at every length of pipe or about twenty feet apart.

The insulation now used is, at a temperature of 32° F., almost a solid, but as the temperature rises it becomes more liquid and being sufficiently heated in a caldron, is turned in at the "T" joints. No stand-pipe or reservoir is used.

The advantages of this insulation are claimed to be: It is heavier than water and is not penetrated by it; always being liquid it does not crack or contain small fissures for the admission of dampness; it is not easily punctured by atmospheric electricity or currents of high voltage; the insulation expands and contracts with every change of temperature and thereby prevents the current centering upon any weak portion and developing a fault, as is often done in other kinds.

Other advantages of the system are: The wrought iron pipe is proof against penetration or injury by workmen's tools in street repairing; iron pipe has five times the capacity of lead pipe of equal cost per foot, without making allowance for its greater strength and durability. It is often said of conduits as compared with this system, that there are extra ducts for an increase of conductors when necessary. If the total cost of any conduit, including manholes is divided by the number of ducts, the cost per foot is ascertained. Each duct of itself costs twice as much as the total cost, by the liquid system of burying all the conductors that the duct is capable of containing; conductors can be looped out of the pipe at any desired point to street lamps or for house to house purposes, by simply unscrewing a plug and inserting a smaller pipe, very much as gas or water is introduced.

When the cable was laid on the Pennsylvania railroad, they had use for only twenty-five conductors, which left twenty-eight idle. Since then, increase of business has brought five more into use. Provision was made for an increase. Extra conductors can be drawn into the pipe when the cable is laid, much cheaper than providing a place for them, as is done in the conduit system.

The objections incident to the use of conduits are entirely obviated by this system, inasmuch as the insulation is hermetically sealed from the effects of damp air and gases.

The cable laid at Gloucester is now working with a potential of 3,000 volts alternating, between conductors which are in the same pipe. It has twenty-two terminals exposed to the weather, and the insulation, making allowance for temperature, is as high as when first laid.

CORRESPONDENCE.

New York Notes.

NEW YORK, Sept. 20.—Roger M. Sherman has at last won a point in the case of the Japanese murderer under sentence of death at Sing Sing. He has started the case to the United States Supreme Court on an appeal from the decision of Judge LaCombe denying the application for a writ of habeas corpus. Mr. Sherman says he will not question the constitutionality of the law. "I hope to show, though," he added, "that there are many and sufficient reasons why the statute should not be enforced. A universal cry of horror went up from the civilized world after the execution of Kemmler. Do you suppose that the Supreme Court is going to hold that such cruelty is not contrary to the laws of the land? I think not. If it does I shall be greatly mistaken. Should the court decide in Jugiro's favor I don't think that any murderers would be discharged from custody. I ihink it now likely that the court would construe the statute in such a way that they would undergo solitary confinement for life. In the event of a decision in Jugiro's favor the state will be placed in the position of having a statute which has been held by the courts to be constitutional, but which, nevertheless, cannot be enforced. The only way out of this muddle that I see would be the abolition of the death punishment. There will never be another electrical execution in this state, mark my words. Public sentiment is arrayed against death by this horrible method so strongly that it will never tolerate another execution similar to that of Kemmler."

The executive committee of the Western Union Telegraph company has recommended that the directors declare their regular quarterly dividend of 1¼ per cent. It is said that the statement to accompany the dividend will show 1¾ per cent. earned on the stock. This is surprisingly favorable, when it is remembered that the quarter includes the long period in which the company's business was interrupted by the fire in its building here.

A small chapter of accidents from the electric wires is sure to be recorded during such a spell of wet weather as New York has seen during the last few days. One of the electric light wires which ran under the elevated railway on Church street near Park Place, got crossed with another and set fire to the insulation and the wooden supports. The wire separated, but was soon replaced.

The Jersey City Telephone station was the scene of confusion during an electric storm of the week. The cupola of the building through which about one thousand telephone wires run, was struck by lightning, and the wires were completely tangled up. A lively fire ensued and New York and adjacent cities which depended upon the Jersey City exchange for service were entirely cut off from telephone communication for a day. The damage is placed at $5,000.

H. Van Ness of Paterson, N. J., while putting a cornice over a window, found it necessary to take out some wires. He asked whether the current had been cut off and was assured by an employe of the electric light company that it had. He began to cut the wire with a hammer and chisel, and after he struck one good blow he received a shock which nearly ended his life. His arm and fingers were badly burned.

The death of Lineman Kopp on the iron electric light pole at the corner of Thirty-fifth street and Broadway was due to his own carelessness. He undertook to repair an

electric lamp at 11 o'clock at night without putting on rubber gloves. As soon as he applied the pliers to the defective wire a flash jumped from the steel and an instant afterward he fell back across the wires. Charles Phipps, an engineer of the Brush company, ran out of the Park theater near by, and borrowing a rubber coat from a cabman climbed the pole, wrapped the coat around the body of the victim and got it loose from the wires. At first it was thought life was extinct, but a physician at hand pronounced otherwise. An ambulance was summoned, but before it reached the hospital there was no longer any sign of life.

This accident, together with another of not fatal results to the boy Young, who received a severe shock in Fulton street from an electric light wire, has caused Mayor Grant to look into the matter and order an investigation by the Board of Electrical Control.

The mayor has ordered inquiries to be made whether the rules of the board have been enforced, whether the officials responsible for this enforcement have done their duty, and if not, what official is responsible.

The Trenton Electric Railway ordinance has been so loaded down with amendments by the council of the city that President Perrine of the Trenton Horse Railroad company, says that it will not pay to build under the restrictions stipulated. This road, which was intended to relieve the travel to the state fair this fall, could not now be built in time, even though the scheme could be gotten through at the next meeting of the council. The amendment which seemed particularly obnoxious was this: "That the consent herein given to the use of electric motors shall be revocable by the passage of an ordinance without notice to that effect."

It is reported that the extension to the Waterloo electric railway through its main street has been attended with serious disadvantages, and the citizens have gone so far as to call out the fire department to drench the workmen. Arrests have been made, and an injunction is expected to be obtained.

A break in the machinery of the electric light station at Elizabeth, N. J., plunged the city into darkness. It is said that the electric plant is too limited for the demand made upon it.

The Consolidated Electric Light company held its annual meeting at 32 Nassau street this week, and elected the following officers: President, Hugh R. Garden; vice-president, Jacob Hays.

W. H. Fleming of the Edison General Electric company has collected statistics bearing on electric lighting on steamships. It appears that 110,000 electric lights blaze nightly on the ocean steamships of the North Atlantic. The larger part of these lights belong to ships wired upon the same plan as the Etruria, the City of Paris, the City of New York, the Teutonic, the Majestic and others. These steamers are all wired on the English system which differs materially from the American system, and which has long since been coademned by the best electrical engineering talent of the country. W. H. T.

Milwaukee, Wis.

MILWAUKEE, Sept. 18.—Within the last two weeks there have been several developments in the street railway war between Henry Villard's representatives and home capitalists. Not one of the many injunction suits has yet been heard in court, owing, it is claimed by many, to a fear on the part of the street railway owners that all franchises granted by the common council will be placed in question if one of the judges once gets hold of a case involving the validity of permits granted by the municipal body. The legislature, according to the state constitution, has no right to grant exclusive franchises, and the claim is made that the legislature cannot delegate to the common council any power that it does not possess itself.

But the failure to bring any of the cases into court for a decision has not prevented the companies from continuing to fight each other, or from getting out new injunctions. At a recent meeting of the council the Pfister people executed a clever flank movement on the Villard delegation, and while confident of winning eventually in the suits over the disputed right of way, they decided to be prepared in case of an unfavorable decision, and so they applied for a franchise to build on North avenue, Oakland avenue, Cambridge avenue, Brady street and Warren avenue. This line would give them as good a connection between the business center and the present terminus of their line to Whitefish Bay, as the route in dispute. So far as the Villard or Cream City system is concerned, the new route would be worse than the one which is being fought over in the courts, as it would parallel the established line at nearer points. The aldermen are very likely to be guided by public sentiment in the matter.

Messrs. Hinsey of Milwaukee, and Hinckley of Chicago, the owners of the Milwaukee Electric railroad, are now involved in a legal fight with the Villard syndicate. It is the same story. The Hinsey company wishes to build an extension along Teutonia street, and the Milwaukee City railroad heard of it, fished out a franchise on Teutonia street that it had secured many years before, and proceeded to build on that thoroughfare in order to head off the Hinsey people. The latter, having no legal rights to Teutonia street, and therefore no standing in court, got two property-owners to enjoin Villard's agents from doing any more work on the street. The Milwaukee City Railroad company of course obeyed the injunction, but is now running cars right up to the property of the two men who secured the injunction. It cannot go any further, however, until it secures the sanction of the court, and will have to tear up the tracks already laid if the decision is adverse.

It is now settled beyond doubt that the city will advertise for new bids for electric lights. The city attorney has decided that the proceedings which resulted in the old bids being submitted, were illegal, the resolution authorizing the receiving of bids by the board of public works not being signed by the comptroller, as required by law.

The city attorney has delivered another important opinion. He was asked whether the different wards could contract for their own electric lights, and he decided that as the city is the corporation, and each ward only a part of it, the former mus make the contract. It is thought, however, that if the city attorney were asked—and he undoubtedly will be—whether the city could divide the electric lighting contract instead of giving it all to one company, his reply would be in the affirmative. And that is the question that is really in dispute. The Milwaukee Light & Power company, in the event of such a division, would be quite likely to secure a slice of the contract, as in the wards near its plant it can furnish lights as cheaply, if not cheaper, than the Badger Illuminating company.

Still another important decision in the matter of electric lights has been rendered by the city attorney. The Badger Illuminating company, during the several years that it has had the city contract, has been paid, according to the number of lights furnished, out of the ward funds. The city attorney has decided that this method of payment is wrong, and that electric lights must be paid for out of the general city fund, which every ward is taxed to make up. If this is done all the outlying sparsely settled wards will have to help to pay for lighting the wealthy central wards, and the former will probably seize the only chance of getting even, and demand electric lights without end.

A cent a lamp-hour is what two companies are figuring on furnishing incandescent lights to houses, stores and offices by January 1. Both the Edison Electric Light company and the Milwaukee Light & Power company are pushing work on their plants, and their agents are canvassing for business. The companies, in case they secure contracts for a satisfactory length of time, agree to wire the buildings for nothing. They claim that the cost of incandescent lights will hardly exceed the price of gas. The Milwaukee Light & Power company will use the Westinghouse system. Its building is 40x137 feet, four stories high, and a 400-horse power engine will be part of the plant. An arc light plant will be put in if the company secures any part of the street lighting contract. C.

Des Moines, Ia.

DES MOINES, Sept. 18.—The rapid transit street railway lines of Des Moines are now under the management of one company of which J. S. Polk is the principal stockholder. This result was brought about by the purchase on September 1 of the Belt line, a motor system, and all its franchises by the Des Moines Electric Railway company. The Belt line was the pioneer of rapid transit in Des Moines, its line extending from the heart of the city to the northern suburbs past the Zoological Gardens, Lake, Oak and Prospect Parks. It is about four miles in length and well equipped. In addition to this line, the company owning it held the exclusive franchise to the streets of North Des Moines for the operation of an electric railway system. The price paid for the line and its franchises is stated to be $125,000. It is the intention of the purchasing company to equip the motor line with electric cars and connect it with the present system as soon as possible. The whole rapid transit system thus falls under one management, which holds exclusive franchises for a long term of years. The transfer system makes it possible to go to any part of the city for five cents fare.

Work will begin immediately on the electric road for the Holmes syndicate at Davenport and will be pushed forward vigorously, and ere snow flies the mule as a motive power may be a memory of the past in Davenport. The citizens of that city are highly elated over the change, for besides the added convenience and metropolitan appearance it will give the city it means a large expenditure on the part of the company for power plant and equipment.

Des Moines and Iowa citizens made their first acquaintance with the storage battery system during the Seni-Om-Sed trades parades in Des Moines during State Fair week. The handsome floats were all beautifully illuminated by incandescent lights, supplied from storage batteries and a feature of the parade that attracted very much curious attention was a buggy pr pelled by the same system. The result of the trial was most satisfactory.

The first death in years caused by contact with electric wires in Des Moines occurred on Sept. 3. A colored man, who had taken a position upon the roof of Foster's Opera House to watch the Seni-Om-Sed fireworks, inadvertently took hold of an electric light wire and was instantly killed.

The electric railway system of Des Moines was tested to its utmost capacity during the state fair. During the seven days 210,000 persons were carried, an average of 30,000 per day, by a daily average service of 29 electric motor cars or an average of 1,034 per car per day. Not an accident of any character occurred during the week.

F. M. C.

Louisville, Ky.

LOUISVILLE, Sept. 18.—The Consolidated Street Railway company of this city, when its electric lines are equipped, proposes to furnish power and light to public buildings, private stores and residences along the several routes. The construction work is progressing rapidly. At the residence of Mr. Du Pont, one of the stockholders, current from the trolley wire will be used to operate a motor which will drive a dynamo to furnish current for the house. As the Consolidated company will have a large surplus horse power, it is likely it will realize a large sum from the sale of power.

The Thomson-Houston company has closed a contract for eighty lights with Du Pont & Co., to be used in their paper mill here.

The Gooch Electrical company has closed two contracts with the Allen-Bradley company, one for a light plant for its works in the city, and another for the company's distillery at Frankfort, Ky.

The purchase is made both on the score of safety and economy. Oil lamps have been generally used in distilleries. The recent million dollar fire here, which destroyed the Kentucky Distilling company's plant and warehouse, was caused by the overturning of a barrel of whiskey near one of these lamps.

The economy is apparent, as it is quite likely that the rate on distillery risks will be greatly advanced by underwriters if the present method of lighting is continued.

The Standard Oil company is putting in an electric light plant at its oil refinery at South Louisville. It was influenced by practically the same reasons as those which actuated the distillery company.

Lumber men in this section who have been suffering greatly from fires, are beginning to appreciate the value of electric lights, not only on account of safety, but because by their use employes are enabled to work nights. The R. B. Colter Lumber company has closed a contract and will have put in at once a plant capable of running 200 lights. C. B. Paul will introduce a plant in his sawmill.

The Cartwright Wagon company has ordered 270 electric lights, and the Hugh Stafford Cooperage company, which recently suffered by fire, fifty lights.

The Gaynor Electric company has just booked an order for an electric fire alarm telegraph system for the city of San Antonio, Texas. The sum of $25 000 has been set apart by the general council of that city for the purpose. This same company has received orders for fire alarm telegraph systems for Brantford, Ontario, and West Toronto, Canada.

At Lexington, Ky., the Central Electric Light company mortgaged its plant on the 13th inst for $100,000. The money, it is said, is to be used in extending the electric street railway lines.

There has been a rumor here that there will be a strike on the street car lines, including the electric lines, during the fall celebration. The drivers want more pay and different hours. There is some talk, however, of a probable compromise.

J. B. Quin has recently been appointed the general agent at this point of the National Electric Manufacturing company of Eau Claire, Wis. J. W. L.

Nashville, Tenn.

NASHVILLE, Sept. 18.—If the amount of street passenger traffic is any evidence of a city's prosperity, Nashville is certainly in a thriving condition. The increase in passenger travel since the introduction of electric cars is unprecedented. A local capitalist, desiring to make investments, wrote to the Thomson-Houston company for facts and figures in regard to electric street railways. In reply the company referred to a certain Western city of 50,000 popu-

lation, in which the street cars transported annually 2,500,000 passengers, or about fifty times the city's population. The company admitted that this was an exceptional case. This statement led to an investigation here which discloses the fact that the electric cars are transporting about 500,000 passengers per month out of a population of 76,000, or more than eighty times the entire population of the city. It is probable other Southern cities will show equally as large a proportion of passenger travel if they establish as perfect a system of electric cars as exists here. At any rate, electric street car property is the most sought for investment in the South at present.

The telephone service has been extended from this city southward as far as Athens, Ala., a distance of about 100 miles.

The new street cars have been put on the tracks and still a few more are needed to accommodate the travel.

The waterworks pumping machinery has broken down again, and a partial water famine is threatened. Orders forbidding the use of water for certain purposes have been issued, but it is not thought any of the steam plants will be forced to stop operations. B.

Pittsburgh, Pa.

PITTSBURGH, Sept. 20.—One of the local papers has an office in the Pittsburgh exposition building, which is now open, where the visitors are invited to vote upon all kinds of topics of the day. Recently the public was asked to give their opinion on the question: "Do you favor or oppose a law compelling telegraph, telephone, electric light and electric car companies to place all wires underground?" When the votes were counted in the evening it was found that out of ten thousand votes only a hundred opposed the proposed law.

An ordinance has been introduced and will shortly be acted upon by the Pittsburgh council, which provides that hereafter all electric wires of light, heat and power companies must be placed at least twenty feet above the sidewalks, and where there are street railway wires in the same street, the former wires must be placed a sufficient distance above the latter to be entirely out of the way, and must also have guard wires placed under them to prevent any possibility of broken wires falling on street railway wires. The ordinance also provides that underground wires, cables, tubes, conduits or subways shall be placed at least two feet under the surface of the ground, and as near the street curb as practicable.

The Squirrel Hill Electric Railway company of this city, the property of which has been in the hands of a receiver for some time, will be sold to the highest bidder at the Pittsburgh court house on September 27.

The East End Electric Light company, the management of which has been experimenting in drilling a well on its property, has failed to find natural gas or oil, but the company has struck a well of water of sufficient capacity to permit of its use in the plant. This will effect a saving of $2,000 per year to the electric company.

The Duquesne Traction Company of this city, now engaged in building an electric street railway from Pittsburg to Wilkinsburg, has asked the council of the latter borough for the permission of boring a tunnel beneath the Pennsylvania railroad tracks at Penn avenue. The councilmen will meet within a few days and it is almost certain that the request will be granted.

The Birmingham Traction company has had some trouble in putting up its electric poles, and last week the company was obliged to call upon the aid of the police to give the workmen a chance while employed in their task. The company now operates a horse car road from Pittsburg to Birmingham. The road traverses one of two bridges over the Monongahela river, which are the only means of reaching the business portion of the city. It takes the horse cars an hour to cover the length of the road—four miles. By means of the electric motor, however, the people will be able to travel a great deal faster, and they will neither have their roads damaged by the horses. And yet, in spite of this, they make objections, because the company puts up poles along the curb. It is satisfactory to note that the police authorities of the city have taken the part of the company, and the construction of the road is to be pushed as rapidly as possible.

Luther H. Leber, a resident of Allegheny City, is the inventor of a device which is said to be of great advantage to the motor man on the electric car. This appliance is to cause a more easy application of the motor and brake power on the cars, in fact, the rheostat and brake are operated simultaneously. The brake wheel rod is run through the center of the rheostat, and has the spring contact affixed to it in a similar manner as at present. The guide pin showing the amount of current on, operates, as usual on the top of the box. When the brake is applied the current is completely cut off from the motor, and it is on again when the brake force is taken off. The device is to be tried by one of the local electric street car companies.

At the Pittsburg Exposition a vote was taken among the visitors a few days ago on the question: "Should electrocution be introduced in the State of Pennsylvania as the proper method of capital punishment?" The replies were carefully counted, and the result proved that the majority of the voters were in favor of the new method of capital punishment. There were 12,000 people at the exposition during that day.

Dr. Emmens, the well-known physician of this part of Pennsylvania, whose name has become famous on account of the explosive he invented not long ago, and which is called Emmensite, has recently discovered a process of making wrought iron from pig metal without puddling. This is done by electricity and the principal factor in the process is a dynamo. The method is simply this: The pig iron is placed in vats, which are nearly filled with a chemical solution. In this solution a series of thin sheet iron plates are placed. These latter are connected with a negative pole of a dynamo and the pig iron is connected with the positive pole. The current of electricity gradually causes the iron of the pig iron to become separated from its associated carbon, silicon, sulphur, phosphorus and other impurities, and to appear in pure condition in the form of a deposit on the sheet iron plates. When the deposit attains a sufficient thickness it is taken from the plates and forged or rolled into any desired shape. The quality of this iron is said to be superior to any Russian or Swedish iron in the market. It can be bent, rolled or twisted into any form while it is cold. Several experiments and practical tests of the iron have been made and all of them have been pronounced successful. E. H. H.

THE ELECTRIC LIGHT.

The Westinghouse Electric & Manufacturing company has secured the contract for the installation of an alternating current electric lighting plant of 500 incandescent and sixty arc lights in Buchanan, Va.

The central station plant of alternate current incandescent lighting in Windsor Locks, Conn., is being enlarged and the capacity of the plant will be increased 750 lights, making the total capacity 1,250 lights. The company is operating the Westinghouse alternating current system and the Westinghouse company is now engaged in installing the additional apparatus.

The Westinghouse Electric and Manufacturing company has just obtained the contract from the Citizen's Electric Light & Power company of Blairsville, Pa., to light that town. The contract was secured after a committee of seven made a personal investigation in several towns and cities where electric lights were in use. This committee visited Altoona, Elizabeth, Tarentum, Allegheny and Pittsburg, Pa. The plant will start with a capacity of 750 incandescent and 40 arc lights, but the company expects to increase this almost immediately.

The Newark, N. J. Electric Light & Power company has been operating the Westinghouse system of alternating current electric lighting for more than a year. In all this time, the service of the company has been of such a character as to constantly grow in public favor. The company is now obliged to make extensive additions to its plant. When the plant was first operated, 2,250 incandescent lamps seemed to be sufficient to supply all demands. However, the superiority of electric lighting over any other illuminant has since been demonstrated so largely that to-day the plant has to be more than doubled. The contract for three thousand lights was awarded the Westinghouse Electric & Manufacturing company a few days ago, and the apparatus is to be installed immediately.

The newspapers of Rochester, N. Y., want the electric companies to bury their wires. The Edison company's wires are underground, but the arc light companies, as well as the telephone and telegraph companies, operate aerial wires. The telephone company has considerable wire underground, but one of the Rochester papers asserts that it is not using its underground conductors. This paper, the *Herald*, says: "By the way, while it is generally known that the telephone company in this city has complied with the law in the matter of putting a prescribed length of its wires under ground every year, we believe that it is not generally understood that the underground wires of that company are not used at all by the subscribers. We are informed on the best of authority that the telephone company is still using its overhead wires in the district already covered by its underground conduits. In other words, though our streets are torn up to put down these conduits and for the purpose of getting rid of the overhead wires, the latter remain and are used the same as before."

THE ELECTRIC MOTOR.

The Rockport, Tex., town council is considering an application for an electric street railroad.

The Richmond, Va., Railway & Electric company has petitioned for a franchise permitting it to make an extension of its system.

The plans for the belt electric railway through Ballard, Wash., are completed. The West Shore & North End electric railway of Seattle will be completed to Ballard within thirty days. It is then proposed to begin work at once on an extension toward Fremont, while the Seattle electric railway will build from Fremont toward Ballard to meet it.

The Sacramento Railway & Improvement company has been formed to operate the street railroad system in Sacramento and to operate electric light and power plants. The capital stock is $500,000.

The Los Angeles & Pacific road, the unused narrow gauge line from Los Angeles to Santa Monica, is to be transformed into an electric road. A contract for an electric plant and equipment has been signed.

The Sacramento, Cal., trustees last week inspected the electric railroad in San Jose, and found it working so perfectly that all opposition to granting a franchise for an overhead system was withdrawn. Sacramento will soon have an electric road in operation.

A street railway will be constructed across the bridge now in course of construction between Highland Park and the property of the North Side Land company, according to a report from Richmond, Va. The structure will be of steel and iron. Electricity will be employed in the operation of the street railroad.

A special meeting of the finance committee of the Indianapolis board of trade was held recently for the purpose of considering estimates for a water plant for the building. The committee agreed to recommend the awarding of the contract to Messrs. Farrell & Co. of that city, who propose to furnish electric power instead of steam. The work will be commenced at an early date, and completed just as soon as the Perry Electric company can get its wires laid so as to furnish the power in the building. It is expected to be completed in five or six weeks. They guarantee the plant to continue in good order for two years.

The Board of Public Improvements of St. Louis and President Capen of the Lindell Electric Railway company, last week had a conference at which they discussed the plans of the company, over which there had been much controversy recently between Mr. Capen and the Board of Public Improvements. Some concessions were made on both sides, and a compromise was effected which is satisfactory to all parties concerned. The line of poles to carry a "feed wire" which the company wished to erect on Locust street has been changed from Locust street to Locust avenue, where it will answer the same purpose. All other plans of the company were accepted.

Foree Bain of Chicago invited the representatives of the electrical press, who were attending the Edison convention at Minneapolis, to take a trip over the completed portion of the road now under construction, starting from Fourth and Hennepin avenues and running north on what is called the Shingle Creek division. The iron poles of this line, which are placed in the center of the street, are of handsome design. They were purchased of the Walworth Manufacturing company of Boston. The track for the entire distance has been laid with heavy rails well-ballasted, and the construction work has been done in a substantial manner. Beyond Thirty-second avenue wooden poles take the place of the iron poles which extend along the line down into the city. The car which the press representatives occupied was an open one, with the seats arranged facing the front of the car, having an aisle down the center. The trip consumed a couple of hours and was thoroughly enjoyable. The large compound condensing engine, furnished by the E. P. Allis company of Milwaukee, has just been placed in position at the barns of the company. It is a ponderous machine and is handsomely finished. The width of the fly-wheel is 73 inches. The company have several other lines in operation, and expect to have the entire track between St. Paul and Minneapolis completed with the necessary equipment so that cars will be running through from St. Paul to Minneapolis by the first of December.

THE TELEPHONE.

The Bell Telephone company has declared a dividend of $3 per share, payable Oct. 15.

Telephone communication with vessels at anchor has been tried with much success at Havre, France. As soon as a steamer or a large ship drops her anchor in the outer harbor a telephone line is thrown on board, and the captain thus brought in direct communication with Havre and even with Paris.

Many interesting facts are found in the annual report of the Belgian Bell Telephone company just issued. This company works exchanges in Brussels, Antwerp, Charlerio, Ghent, Verviers and elsewhere. During 1889 the number of its subscribers increased 8.5 per cent., and its net receipts amounted to $80,000, on a capital of $680,000 and after transferring nearly $60,000 to the reserve fund, it was able to pay a dividend of 7 per cent. on its paid-up capital. At the end of the year 1892 the Belgian Government will be able to acquire the concern according to the terms of the concession, the purchase price being based upon the average net income of the last three years *plus* 15 per cent,

Miscellaneous Notes.

The Chicago Electrical Supply company has been incorporated at Chicago, to sell electrical goods and patent the same; capital stock $100,000; incorporators, H. B. Hallock, C. F. Chapman and F. W. Parke.

Lightning struck the building in which the offices of the Pennsylvania Railroad company are located at Altoona recently and valuable records and memoranda were ruined. The lightning entered the telegraph room, in which are stored tons of papers, and the fire communicating with these gained great headway. All railroad office business was temporarily suspended, A heavy rain was falling at the

time, and the dense smoke rendered it almost impossible to get near the burning building. There were several hundred clerks employed in the offices, but all escaped, not, however, without much difficulty.

The sixth volume of the series, "Mineral Resources of the United States," prepared by David T. Day, has been published by the Department of the Interior. The work contains valuable statistics, and there are many chapters which will be of interest to the electrical fraternity. An exhaustive review of the copper market and the operations of the French syndicate is one of the most valuable departments in this valuable work. The tables accompanying the article furnish evidence of the care with which the examination of the subject was conducted. Some of the figures presented will be interesting. In 1888, the year made famous by the French syndicate, the total copper production of the United States was 226,361,466 pounds, nearly 45,000,000 pounds more than the previous year. Many old mines that had been abandoned were re-opened. The value of fine copper imported in 1888 was $381,801, nearly double the value of the importation of 1887.

There is an interesting installation at Lake of Lugano, Switzerland, which furnishes power to operate a cable railway on Monte San Salvator, and also illuminates the town of Lugano and the cable railway stations. The power is obtained from a fall of water, which is led down an iron tube 20 inches in diameter, and 370 yards long. The available power is estimated at 700 horse power, but at present only enough is utilized to actuate two Girard turbines which drive two Oerlikon dynamos direct. One of these dynamos is a continuous current machine, and the other an alternator having its exciter placed on the same spindle. The continuous current dynamo is used for transmitting the power, while the current from the alternator is, by the intermediary of transformers, used for lighting the town of Lugano and the cable railway stations. The alternator, which runs at 600 revolutions at an e.m.f. of 2,000 volts, supplies current to 1,500 16-candle power lamps, which are installed in the local hotels, restaurants, etc. The continuous current dynamo is series wound, runs at 700 revolutions, and has an output of 22 amperes at 1,800 volts. This current from this dynamo is conducted to the Pazello station of the cable railway, where it operates a 40 horse power series wound motor running at 700 revolutions. This motor drives, by means of belting, a countershaft running at 138 revolutions. On this countershaft are fixed two bevel wheels and two friction wheels. A second countershaft, placed at right angles to the first, has arranged at one end a bevel wheel, which engages with either the one or the other of the two bevel wheels on the first shaft, and causes the second shaft to revolve in either direction as desired. There is also provided a third shaft, upon which the large driving pulleys revolve. The second shaft carries two brakes, one being for hand regulation, and the other being applied automatically when the cars are at the middle station, by the vehicles pushing over two levers. The working station is in charge of an engineer, who operates the hand brake and a regulating wire resistance, while an ammeter at the upper station controls the current. The two termini and the middle station are connected by telephone, and the latter is also in telephonic communication with the power station at Maroggia. Electric bells serve to announce the arrival and departure from the termini to the middle station, and vice versa. Through out the whole length of the railway is arranged, almost in contact with the outside roof, an electric conductor which, on the driver moving a switch, closes a circuit. This contrivance permits of signals for backward or forward movement of the car being transmitted to the engineer at the working station.

Personal Mention.

Charles H. Haskins has returned from Europe to settle permanently in New York.

Lieut. F. B. Badt of Chicago has resigned his position of district engineer of the Edison General Electric company. It is understood that he is to open a large engineering office in Chicago and London, England, about December 1. Lieut. Badt has long been prominent in the electrical field, and will not lack for strong financial backing in his new venture. His many friends in the United States and abroad will wish him success.

Business Mention.

F. C. Rusling of the Connecticut Motor company will represent that concern at the St. Louis exposition.

The Western Electric Construction company of Kansas City, Mo., will be located hereafter at 125 West Sixth street in that city.

W. M. Dresskell of Brainerd, Minn., was in Chicago last week. Mr. Dresskell is exhibiting a new type of alternating current motor.

The Minnesota Electric company is doing an excellent supply business at Minneapolis. This company has also done a great deal of construction work during the last six months.

The Electric Merchandise company, Chicago, has issued a pamphlet calling attention to the rawhide pinions for armatures and intermediate shafts of which it is making a specialty.

Ames, Wright & Co. of St. Paul, have established a branch at West Superior. They report an excellent business throughout their district. They are engaged now on several large contracts.

W. L. Beckwith, who is well known in Chicago electrical circles as agent for the Belding motor, has accepted a position with the Edison General Electric company, central district. For the present Mr. Beckwith is to have charge of the stationary motor business in Chicago.

The Consolidated Temperature Controlling company of Minneapolis, Minn., is exploiting an automatic electric heat regulator. This regulator is admirably adapted to many manufacturing interests, particularly to curing tobacco.

The Weston Electrical Instrument company of Newark, N. J., has just issued a new catalogue and price list of the Weston standard portable direct reading, voltmeters, ammeters, milli-voltmeters and milli-ammeters for direct current circuits.

The Evans Friction Cone company of 85 Water street, Boston, has just taken the contract for fitting up the entire plant of the Derby Gas company, Birmingham, Conn., with its friction system of driving dynamos. Water power supplemented with steam power together with the Evans system of driving will make the station, it is said, a model in every respect.

Messrs. Baird and Newton, representing the Eddy Motor company, were at Minneapolis, Minn., during the convention of the Edison companies. They report an excellent business. The Eddy company has just installed eleven motors in the building of the Toronto *Globe*. These motors range from two to fifteen horse power and operate all the presses, etc., in the *Globe* building. The Eddy company has motors aggregating forty-five horse power in operation in Toronto, Canada.

The Northwestern Thomson-Houston company, St. Paul, is making several changes in the building it occupies. The offices have been moved to the fourth floor where ample room is provided. This leaves the first floor for a display of the specialties handled by the company. The other floors are divided into store rooms and shops. The company has been unusually busy in construction work during the last few months. It has installed several fine isolated plants in the neighborhood of St. Paul, and several more are now under way.

Among the electrical exhibits at the Chicago exposition, the display of wire, shades and house goods by the Great Western Electric Supply company is most prominent. A sign made out of cleats and another of colored shades are novel, and like the elkhead electrolier which lights this exhibit, are much admired. A full line of testing and telegraph apparatus is shown to advantage, and the assortment of linemen's tools seems to catch the eye of every electrical visitor. The same company has a sample line of goods at the St. Louis exposition, where it is represented by George T. Hewes.

The Columbia Electric company of St. Paul, which recently succeeded to the business of the Acme Electric company, reports a large and constantly increasing volume of business. The company is constantly increasing its facilities and is hardly able to keep up with orders. It is now carrying a large stock of electrical goods of all kinds, and reports that branch of their business as growing far beyond all expectations. Messrs. Handey & Humphrey, the president and secretary of the company, are typical energetic business men of the Northwest, and under their management the Columbia Electric company is destined to become one of the foremost commercial institutions of that section of the country.

The Westinghouse Electric & Manufacturing company's shops are now running at their full capacity day and night and the company has still orders ahead to keep it busy the entire winter. This large increase in the work is especially caused by the success of the street car motor lately brought out. Several roads have been equipped already and their operation has proved to give great satisfaction. The manufacture of alternating current apparatus has also gained considerably and the new Westinghouse system of alternating current arc lighting is rapidly becoming a popular method of illumination. Among the contracts the company has recently obtained are St. Paul, Minn., for an increase of apparatus to the extent of three thousand incandescent lights capacity; Arlington Heights, Texas, five hundred lights; Rochester, Pa., an increase of five hundred lights; and Colorado Springs, Colorado, an increase of fifteen hundred lights.

The Detroit Electrical Works have recently issued a circular letter calling attention to the features of their electric street railway apparatus. This company, as is well known, is exploiting the Rae system. The characteristic feature of the Rae system is a single motor geared to both axles, a construction which permits the use of large wearing parts, slow speed of armature shaft, and therefore, reduced friction and long life. The peculiar manner of mounting the motor secures perfect insulation between the motor and truck, eliminating all electrical strain. The company claims that it has not lost from any electrical cause at any time, an armature or field upon any of the cars it has equipped. The company also states that during the past six months it has not lost an armature or field upon any motor from any cause. The Detroit Electrical Works have their apparatus in use on the following named roads: East Detroit & Grosse Point railway, Detroit, Mich., four cars; Highland Park Electric railway, Detroit, Mich., four cars; Citizens' Street Railway company, Elkhart, Ind., seven cars; Adrian Electric Belt railway, Adrian, Mich, four cars; Decatur Electric Street railway, Decatur, Ill., four cars; Sault Ste. Marie Street railway, Sault Ste. Marie, Mich., five cars; Fort Worth Land & Street Railway company, Fort Worth, Tex., fifteen cars; Saginaw Union Street railway, Saginaw, Mich., twenty-five cars; Calumet Electric railway, Chicago, Ill., three cars.

Electrical Patents.

Issued Sept. 16, 1890.

436,334. Telephone. William Burnley, North East, Pa.

436,335. Telephone. William Burnley, North East, Pa.

436,354 Electric Cigar Lighter. Mortimer M. Hayden, New York, N. Y.

436,371. Railway Signal. Preston C. Morse, Natick, and Henry D. Winton, Wellesley Hills, Mass.

436,387. Socket for Incandescent Electric Lamps. Horace E. Swift, Boston, Mass.

436,408. Dynamo-Electric Machine. Stephen D. Field, Yonkers, N. Y.

The invention comprises a single dynamo electric machine of shunt wound character having its armature composed of two or more independent windings, each complete winding connected with its own separate commutator on the shaft and having its own collecting brushes, the field being composed of a number of shunt windings forming each a proportionate part of the total field and each pair of brushes forming the terminals of one of the working circuits of the multiplex system.

436,410. Electro Magnetic Bell. John Geary, Philadelphia, Pa.

436,412. Electrical Switch. Frederick D'A. Goold, New York, N. Y.

436,425. Electric Railway. Hosea W. Libby, Boston, Mass.

436,432. Electric Conductor. William E. Oehrle, Philadelphia, Pa.

The insulating material is coated with a composition consisting of alum, borax, magnesia, French chalk, plaster of Paris, and silicate of soda.

436,439. Electric Motor Car. William Robinson, Boston, Mass.

436,440. Electric Motor Car. William Robinson, Boston, Mass.

436,465. Arc Lamp. Charles A. Tucker, Islip, N. Y.

Claim one reads as follows:

"A device for regulating electric arc light carbons, consisting of a support for the carbon holder which will retain the same in any desired position firmly but not immovably, a bearing adjusted to such carbon holder, and a suitable part capable of being expanded by heat and contracted by cold, as a rod of metal, one part of which is held rigidly in position and another part of which is adjusted to operate upon such bearing, in combination with a suitable shunt adapted to divert the current from the carbon circuit into the expansible part as the resistance in the carbon circuit increases, and thereby to expand such expansible part and force the carbon rods together to the desired distance."

436,512. Telephone. S. Lloyd Wiegand, Philadelphia, Pa.

436,513. Telephone. S. Lloyd Wiegand, Philadelphia, Pa.

436,514. Telephone Relay S Lloyd Wiegand, Philadelphia, Pa.

436,516. Galvanic Battery. John F. Wollensak and William E. Gill, Chicago, Ill.

The claim is given:

"In open circuit batteries, the combination of a cup having holes through its sides, a carbon stick having a hole in a position and direction to be brought into a line with the holes in the cup, and a pin of non-conducting material passing through the holes in the cup and stick."

436,519. Method of Electrically Heating Bars, etc., for Welding and Working Purposes. Mark W. Dewey, Syracuse, N. Y.

436,560. Electro Mechanical Gong. George Doyle, Watertown, Mass.

436,571. Trolley for Electrical Railways. David A. Ainslie, Richmond, Va.

The invention relates to a contact device or trolley for the separate motor cars of electric railways, and its purpose is to establish electrical connection between the elevated current supply wire or conductor, and the motor of the car.

436,602. Storage Battery. William B. Hollingshead, Bronxville, N. Y.

435 640. Electrical Automatic Fire Alarm System. William F. Singer, Carthage, N. Y.

436,677. Electrical Head Light. James Thorne and Ebenezer B. Burr, London, England.

436,717. Holder for Telephone Receivers. Jehiel T. Moore, Minneapolis, Minn.

436,728. Motor Armature Car Wheels. Edmund Wagemann, Little Rock, Ark.

The second claim reads:

"In an electric car, the combination of car wheels provided with motor armatures lying within the tires of the wheels and attached thereto, and field magnets parallel to the axles of the wheels, and having pole pieces at each end and within inductive proximity to the said armatures."

436,733 Insulating Material. James W. Easton, New York, N. Y.

436,740. Printing Telegraph. John B. Odell, Chicago, Ill.

436,742. Electric Motor Car. William Robinson, Boston, Mass.

Claim two is:

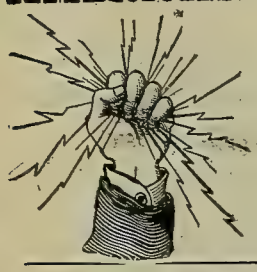
"In a motor car or truck, the combination of the main frame, a driving axle with its wheels, and a motor arranged to drive the same, said motor and axle being arranged to swivel around a vertical axis relatively to said main frame."

436,743. Electric Motor Car. William Robinson, Boston, Mass.

436,747. Municipal Signaling Apparatus. Joseph W. Stover, Brooklyn, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

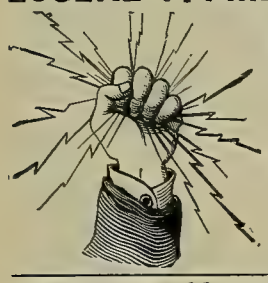
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS
4 LASALLE AVE CHICAGO.
MAKE ANYTHING IN BRASS

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

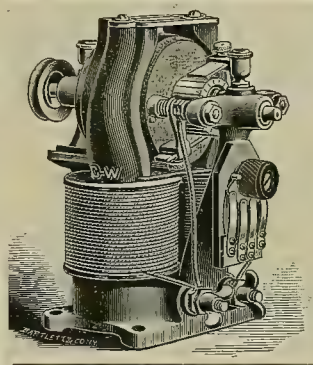
LAW TELEPHONE CO.,

85 John St., New York.

LONG LIFE, High Efficiency, **A CONSTANT** And Beautiful LIGHT.

The SUNBEAM is a SUCCESS.

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.



THE

Crocker-Wheeler

PERFECTED MOTORS

Develop Full Power at Half the Speed of other Makes and are, Therefore, Noiseless.

WORKS:

14th, Washington and 13th Streets,

NEW YORK.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Belt Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK.

INSULATED WIRES AND CABLES,

OKONITE TRADE MARK.

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

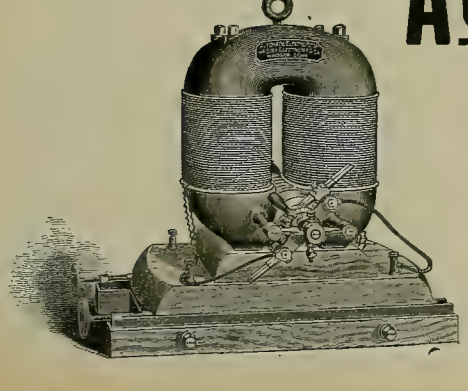
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: *NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 78 Customhouse St. CHICAGO, 329 Rookery Building.*

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

—— Electric Light and Street Railway Goods a Specialty. ——

SEND FOR CATALOGUE AND SPECIAL PRICES.

WANTED.—Draftsman for detailing, principally in electrical work, by electrical manufacturer in Chicago. One with technical education preferred. Wages $12.00 per week. Address, with age and particulars, **Kilowatt,** WESTERN ELECTRICIAN.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 15-light	50	volt Dynamo
One 25-light	50	volt Dynamo
One 50-light	50	volt Dynamo
One 75-light	110	volt Dynamo
One 100-light	110	volt Dynamo
One 150-light	110	volt Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St., CHICAGO.

INCANDESCENT and ARC LIGHTING and MOTORS.

Isolated Lighting a Specialty.

H. H. HUMPHREY,

1034 New York Life Building.

Contracting and Consulting Electrical Engineer. OMAHA, NEB.

Cleverly 1018 CHESTNUT ST. PHILA.

"Improved" Automatic Burner.

PATENT LIFT-OVER PENDANT BURNER.

AUTOMATIC BURNER KEYS.

SPARK COILS.

DESK PUSH BUTTONS

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue **1--66** of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

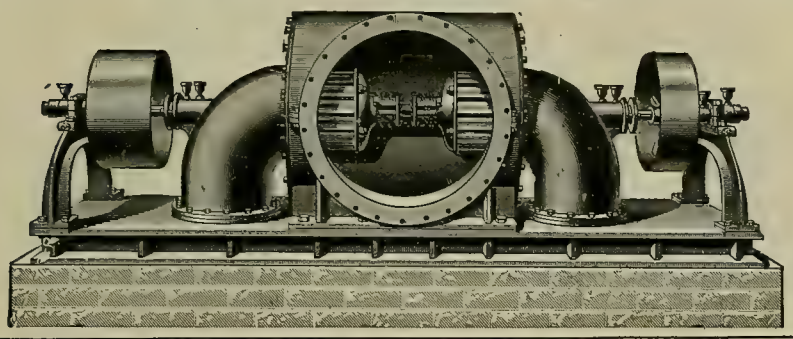
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,

We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

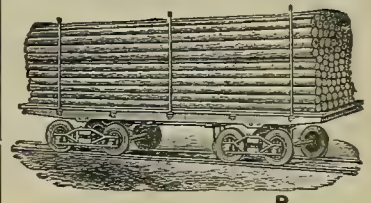
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.

Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

DOUBLE ARC LAMPS.

No finely geared clock work. No close fitting sliding solenoid cores.
No steel pinions or pivots to rust and stick. No gearing to clog with dust.
Practically and Theoretically the simplest and best constructed Double Arc Lamp.

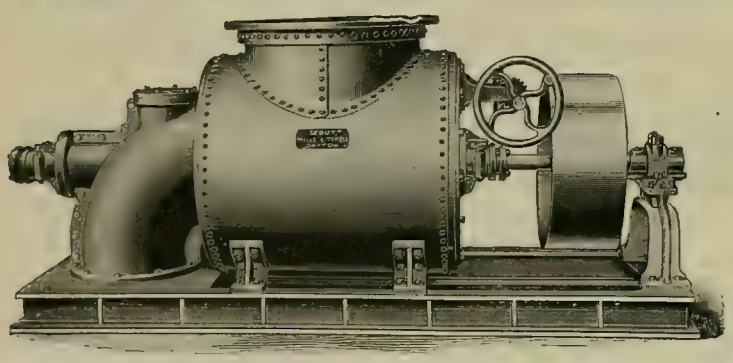
The ONLY DOUBLE ARC LAMP MANUFACTURED for both High and Low Tension Currents.

We offer to furnish Companies using high or low tension systems with new double arc lamps, guaranteed to work satisfactorily, and with guarantee against loss on account of suits for alleged infringement of patents.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the con truction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

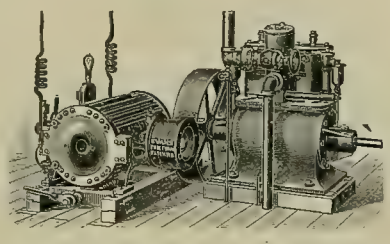
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

LIST OF PARTIES WHO HAVE ADOPTED THIS SYSTEM:

City of Boston, Water Department, Chestnut Hill, Mass.
City of Boston, Sewerage Department, Dorchester, Mass.
Pettee Machine Works, Newton Upper Falls, Mass.
Morgan Engineering Co., Alliance, Ohio.
Fitchburg Steam Engine Co., Fitchburg, Mass.
Portland Steam Packet Co., S. S. Portland.
Metropolitan Steamship Co., S. S. H. M. Whitney.
Chas. L. Seabury, yacht "Aztec."
Shoe and Leather Exchange, Boston, Mass.
Cocheco Manufacturing Co., Dover, N. H.
Hospital Cottages for Children, Baldwinsville, Mass.
Pennsylvania R. R. Co., Shops, Altoona, Pa.
Steamship Naugatuck.
Vanderbilt Building, New York.
William Tod & Co., Youngstown, Ohio.
Am. Waltham Watch Co., Waltham, Mass.



Seamless Rubber Co., New Haven, Conn.

C. F. Hovey & Co., Boston.
P. S. Malcolm, Portland, Oregon.
Chatham Hotel, Chatham, Mass.
Waltham Gas Co., Waltham, Mass.
Union Electric Light Co., Franklin, Mass.
Florence Electric Light Co., Florence, Ala.
Hutchinson Water, Light & Power Co., Hutchinson, Kan.
Walworth Light and Power Co., Boston, Mass.
North Attleboro Steam and Electric Co., Attleboro, Mass.
Jamestown Electric Light and Power Co., Jamestown, N. Y.
Weymouth Light and Power Co., E. Weymouth, Mass.
Leavenworth Electric Light Co., Leavenworth, Kan.
Willimantic Electric Light Co., Willimantic, Conn.
Towanda Electric Light Co., Towanda, Pa.
M. C. Dizer & Co., Weymouth, Mass.
Derby Gas Co., Derby, Conn.

AGGREGATING OVER 8,000 HORSE POWER.

THE EVANS FRICTION CONE CO., 85 Water St., BOSTON. Send for Catalogue D.

E-D-I S-O-N

Miniature Incandescent

ELECTRIC LAMPS.

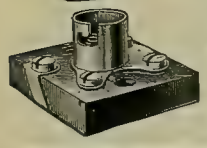
1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.



EDISON LAMP COMPANY, Harrison, N. J.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets

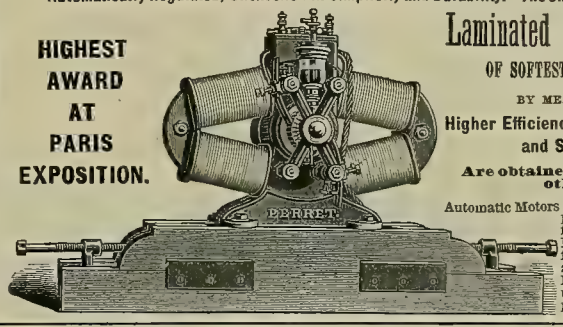
OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable RUBBER INSULATED WIRE none has been so successful as that of the SAFETY INSULATED WIRE. Investigate the merits of this WIRE and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FRANKLIN S. CARTER. CHAS M. WILKINS. E. WARD W LKINS

— TRADING AS —

PARTRICK & CARTER,

Manufacturers of and Dealers in Every Description of

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS,

114 S. Second St., - Philadelphia, Pa.

ESTABLISHED 1867.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

SPECIAL AGENTS

FOR THE SALE OF

PARTRICK & CARTER'S

Patent Needle Annunciators and Supplies.

UNITED EDISON MFG. CO.,	-	San Francisco, Cal.
N. WEST. ELEC. SUPPLY & CONS. CO.,	-	Seattle, Wash.
WOLFE ELECTRICAL CO.,	-	Omaha, Neb.
SOUTHERN DIST. TEL. & ELEC. CO.,	-	Birmingham, Ala.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

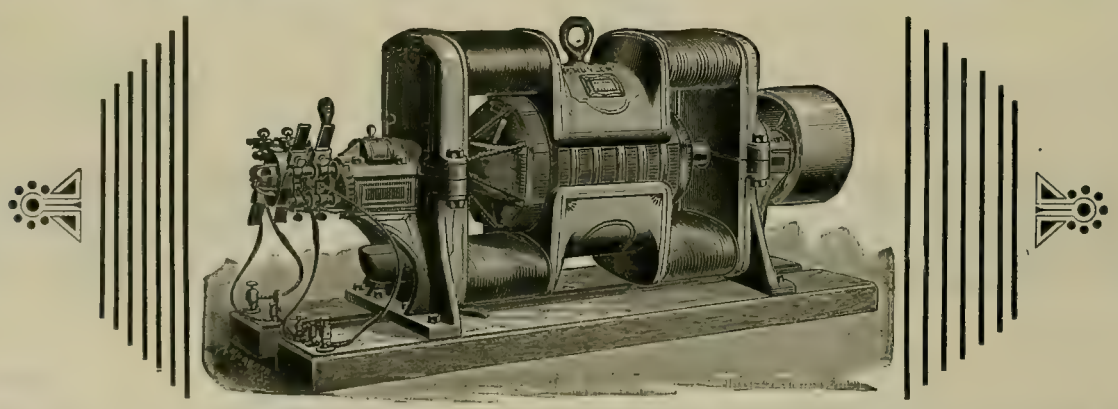
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY,

CHICAGO.

OKONITE
TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

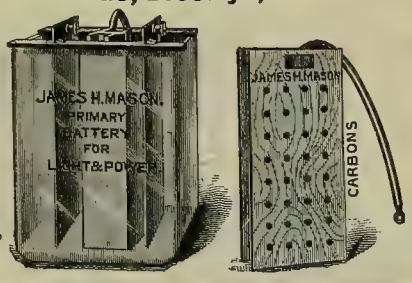
SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

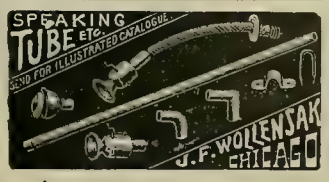
PRIMARY BATTERIES
—FOR—
Household Experimental, Scientific and other Purposes.

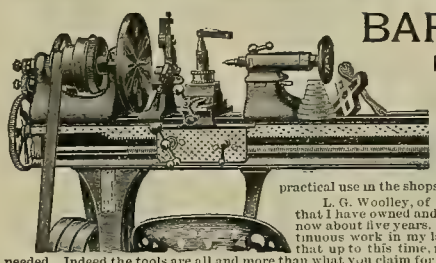
JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.
These Batteries are in practical use, and giving perfect satisfaction.







BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

SAFETY SEAMLESS RUBBER COVERED WIRE
IS THE BEST.

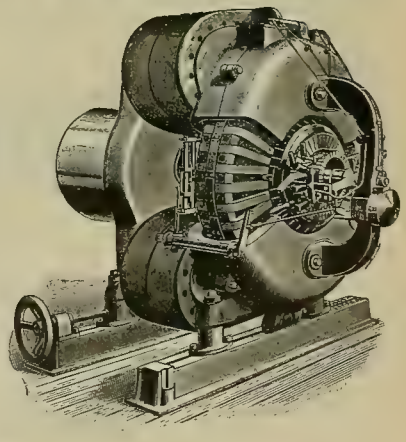
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

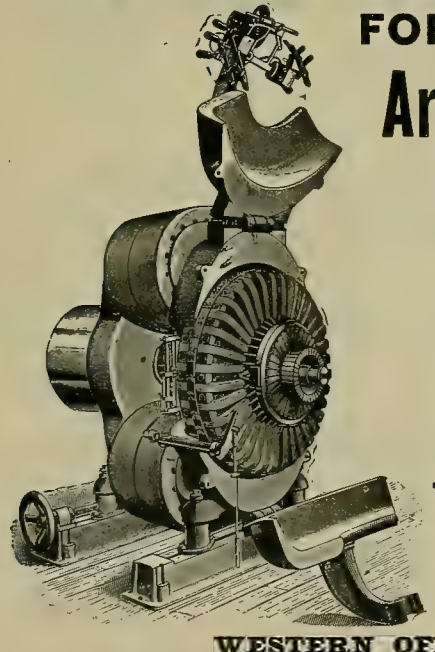
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

Arc and Incandescent Apparatus
FOR LIGHTING,
Arc AND Incandescent Motors,
Electro-Plating and Electro-Deposition Machines.





Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

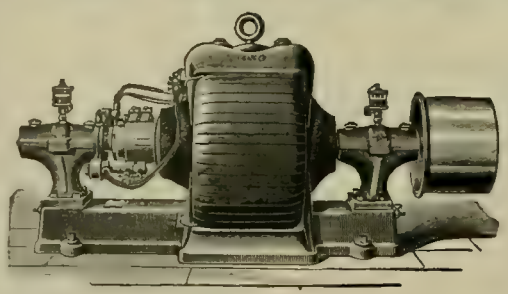
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

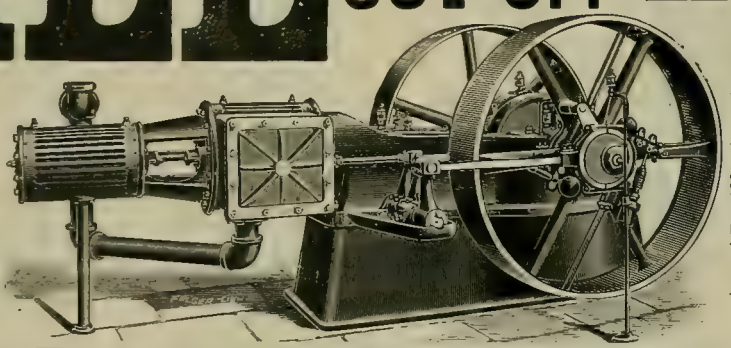
Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

BALL AUTOMATIC CUT OFF ENGINE

Standard.
Cross Compound.
Triple Expansion.
Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO., 15 Cortlandt Street, NEW YORK.

J. W. PARKER, 38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER, 224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON, Room 403 Home Insurance Build'g, CHICAGO, ILL.

OMAHA ENGINEERING COMPANY, Sheeley Building, OMAHA, NEB.

KANSAS CITY ENGINEERING CO. KANSAS CITY, MO.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

PRIMARY BATTERIES for TELEGRAPH "MAINS" and "LOCALS,"
ELECTRIC MOTORS, TELEPHONE TRANSMITTERS,
ELECTRO-PLATING, ELECTRO-MEDICAL INSTRUMENTS,
ANNUNCIATORS AND BURGLAR ALARMS
AND ALL CLASSES OF CLOSED AND OPEN CIRCUIT WORK.

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

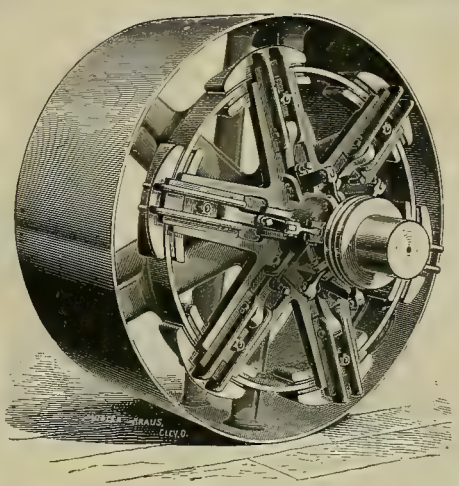
Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.



COPYRIGHTED BY H. W. HILL

HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

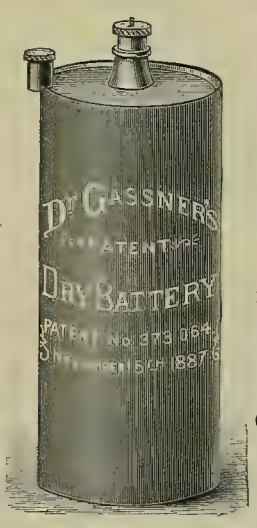
CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.



DR. GASSNER'S DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3½ in.
17.	"	7½ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.

DICTIONARY
—OF—
ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.

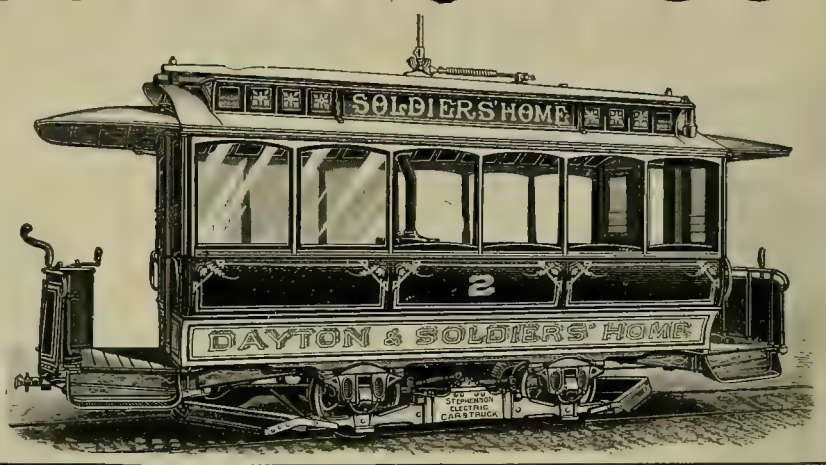
Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
—FOR—
ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.



POND ENGINEERING CO.,
ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

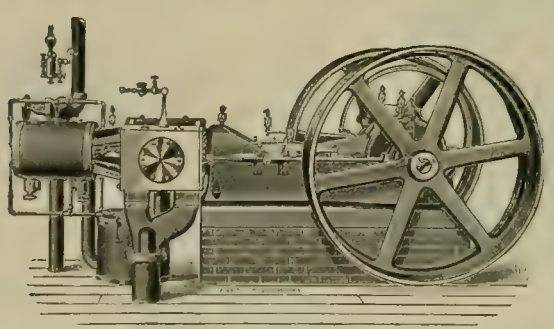
SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Low Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

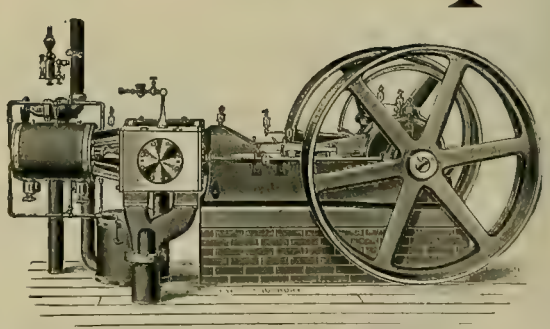
ELECTRICAL BOOKS
OF ALL KINDS.
Send for New and Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO, ILL.

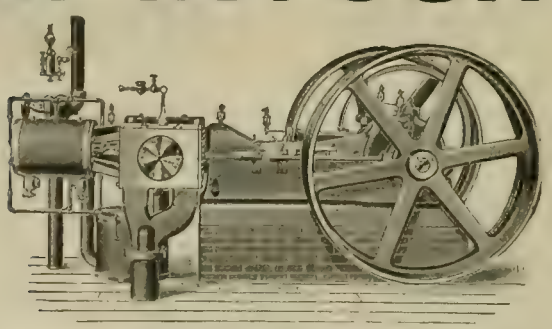
None so Good, None to Equal.



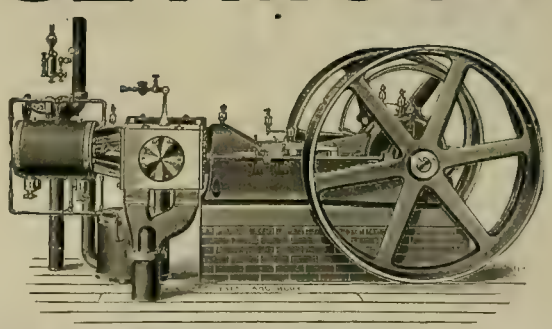
TANDEM



McINTOSH & SEYMOUR.



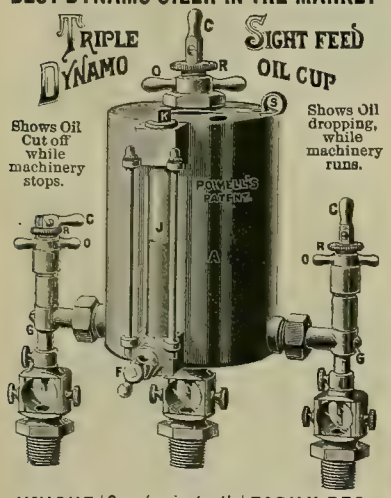
COMPOUND



WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

Endorsed by all users as the BEST DYNAMO OILER IN THE MARKET



UNIQUE APPEARANCE. | *Can be instantly started or stopped at will of operator* | EASILY REGULATED. CONVENIENT TO FILL.

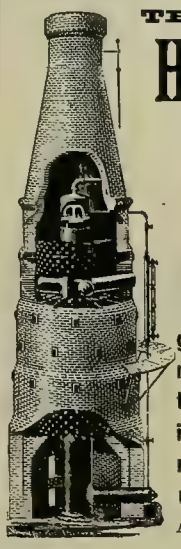
MANUFACTURED ONLY BY
THE WM. POWELL CO., CINCINNATI, O.
SEND FOR CIRCULARS AND PRICE LISTS.

Binders FOR THE Western Electrician **$1.00.**

GEORGE P. BARTON,
LAW OFFICE,
225 DEARBORN STREET,
CHICAGO, ILL.

Patent and Trademark Cases

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.



THE
Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS
Hazelton Tripod Boiler Co.,
170 TWENTY-SECOND ST.,
CHICAGO, ILL.

C., M. & ST. P. R. R.
The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't. J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. **Compound and Valveless.**

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

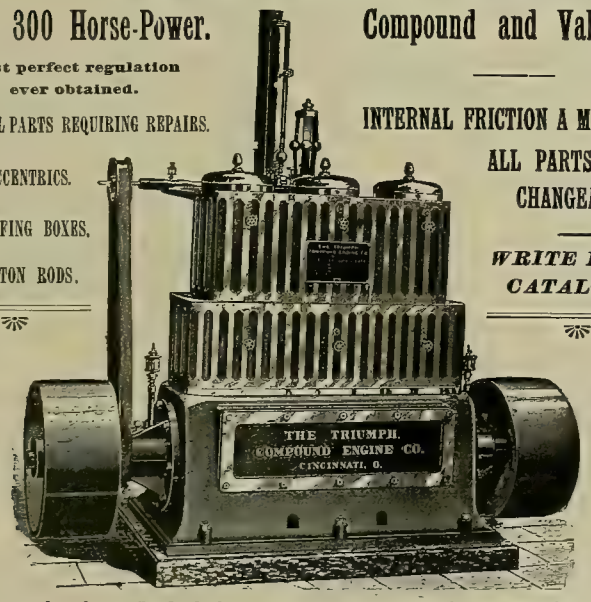
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,
SOLE BUILDERS,
211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.
FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

Over 105 Roads operated under Our System, and that Successfully, both Financially and Electrically.

EDISON GENERAL ELECTRIC COMPANY,

Edison Building, BROAD STREET,
NEW YORK CITY.

ELECTRIC STREET RAILWAYS.

Our Electric system for Street Railways has been found to be the most durable, reliable, economical and convenient.

New roads in course of construction going on in all parts of the country.

Railroad Managers and Others interested in this business are earnestly requested to correspond with us, to *get facts* and *data* showing the advantages and possibilities to be obtained by Electric Traction over any other existing methods.

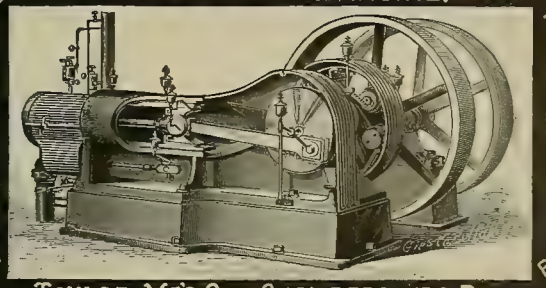
DISTRICT OFFICES:

NEW YORK, Edison Building.
SAN FRANCISCO, 112 Bush St.
PORTLAND, ORE., Fleischner Bldg.
TORONTO, CAN., Bank of Com. Bldg.
CHICAGO, Rialto Building.
NEW ORLEANS, Cotton Exchange.
DENVER, Masonic Building.
BOSTON, 38 Pearl St.

YOU WILL OBLIGE
Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

A MODEL RAILWAY.
The Burlington Route, C., B. & Q R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.
ECONOMY UNEXCELLED
REGULATIONS PERFECT
HOT BEARINGS UNKNOWN
PRICES MODERATE



TAYLOR MFG CO. CHAMBERSBURG, PA.
COMPLETE STEAM PLANTS A SPECIALTY

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

o

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the **ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES** by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

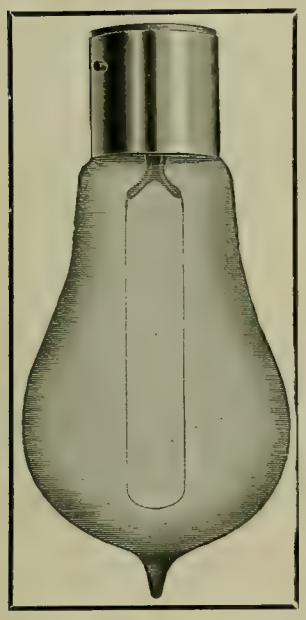
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

—THE—

Perkins Electric Lamp Co.

ALL CANDLE POWERS.

TO FIT ANY SOCKET. ANY VOLTAGE,

ANY EFFICIENCY.

GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

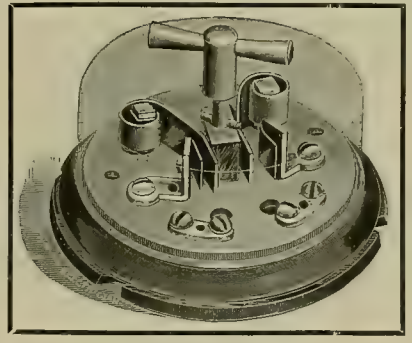
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

—WE CALL SPECIAL ATTENTION TO—

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

—FOR—

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

WESTERN AGENTS.

HABIRSHAW WIRES, CABLES AND CORES.

A HIGH GRADE OF RUBBER INSULATION.

[CONTINUED FROM LAST WEEK.]

In our advertisement of August 30, we referred to the quality of Habirshaw Insulation, giving some letters from both experts and users. The week following we gave a list showing a few places where it had been used. The next week we illustrated some of the cores in the installations referred to. Last week we made some general statements in reference to superiority of insulated wires.

This week we wish to call attention to a simple test we have had made of all of the different rubber insulations.

1. 2. 3. 4.

The accompanying cuts represent the characteristic results of a qualitative test on the composition of 13 samples of so-called rubber wires. This test was made by removing the outer covering of each sample—all braid, paint, etc.—and then paring off the insulating material and putting in a bottle with naphtha. The action of naphtha on "rubber" wire covering is briefly as follows:

1.—To swell the rubber without dissolving.
2.—By this action to loosen and precipitate mineral impurities and adulterations to some extent.
3.—To dissolve waxes, ozokerites, oil compounds, etc.

This test, while by no means exhaustive, is more instructive and valuable than any single test that can be applied in the laboratory—far more valuable than insulation tests—and when the final rub, the test of time, cannot be awaited it will serve to show the ridiculous pretensions of the makers of many "Best Rubber Wires."

Our samples, in the test here illustrated at the end of three months, included all the well-known gum insulations in the market (we dislike to say "Rubber") and some not so well known, which are none the worse for that.

Number of samples represented by Fig. 1..... 1
Character, clear liquor, very heavy white mineral deposit. Showing the compound to be heavily adulterated with white lead.

Number of samples represented by Fig. 2..... 8
Character, inky black liquor from dissolved gums, oils or resins, other than rubber.

Number of samples represented by Fig. 3..... 3
Character, black or dirty liquor. Abundant chalky or dirty mineral deposit.

Number of samples represented by Fig. 4..... 1
Contents, all kinds of **HABIRSHAW.**
Character, clear liquor showing absence of gums, oils or resins, other than rubber No deposit, showing absence of dirt or mineral impurity.

Number of samples tested..... 13

Pure Para Rubber is the only Organic Substance used in the Habirshaw Insulation.

The Habirshaw insulation fulfills all requirements in places demanding the "BEST," and in that field finds no successful competitors.

THE BRUSH ELECTRIC COMPANY

STILL CLAIMS THE EXCLUSIVE RIGHT TO MANUFACTURE, SELL OR USE

DOUBLE CARBON ARC LAMPS.

AGAIN SUCCESSFUL

THE BRUSH ELECTRIC COMPANY
vs.
THE WESTERN ELECTRIC LIGHT & POWER COMPANY, et al.
(Western Electric System.)

Opinion by Judges Brown and Ricks in the United States Circuit Court for the Northern District of Ohio, filed August 15, 1890:

"Any dissimultaneous arc forming separation by mechanism resulting in the suc-"cessive burning of the carbons, is an infringement of the Brush patent."

So called double fixed carbon, three carbon or flat carbon lamps are crude and unsatisfactorv.

The Court says:

"Defendants experts are constrained to admit, not only that Brush was the first to "invent the principle of substitution in his double carbon lamp, but that the Western "Electric Company could not successfully compete with the companies using his patent, "in furnishing all night electric lighting plants unless it could provide double carbon "lamps to its customers."

"We should have felt fully justified in disposing of this case by a simple reference to "the opinion of Judge Gresham in the Brush Electric Company vs. The Ft. Wayne Electric "Light Company, in which the same construction was placed upon the Brush patent, but "in view of the importance of the questions involved, and of the elaborate preparation of "counsel, we have deemed it proper to give it an independent consideration."

"We are clearly of opinion that complainant is entitled to relief in this case, and a "decree will, therefore, be entered for an injunction, and the usual reference to a Master "to assess and report its damages."

BRUSH APPARATUS ALWAYS RELIABLE.

ARC AND INCANDESCENT LIGHTING SYSTEMS,

ELECTRIC MOTORS, GENERATORS, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

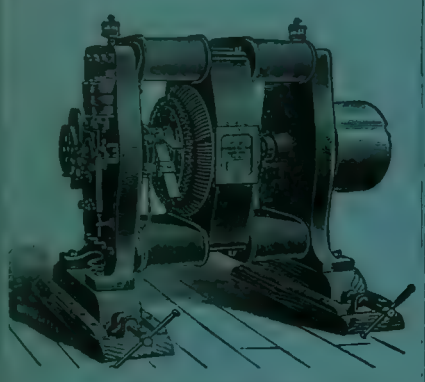
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



WOOD ARC DYNAMO.

MAIN OFFICE:

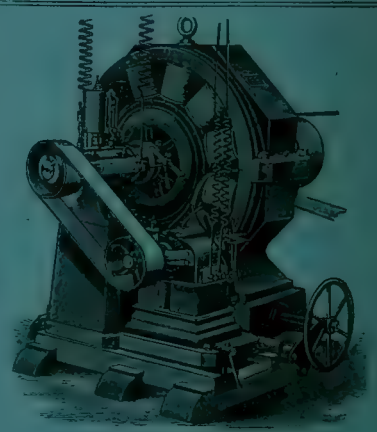
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from. 1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

Every Motor is Guaranteed.

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

THE MITCHELL VANCE CO.,

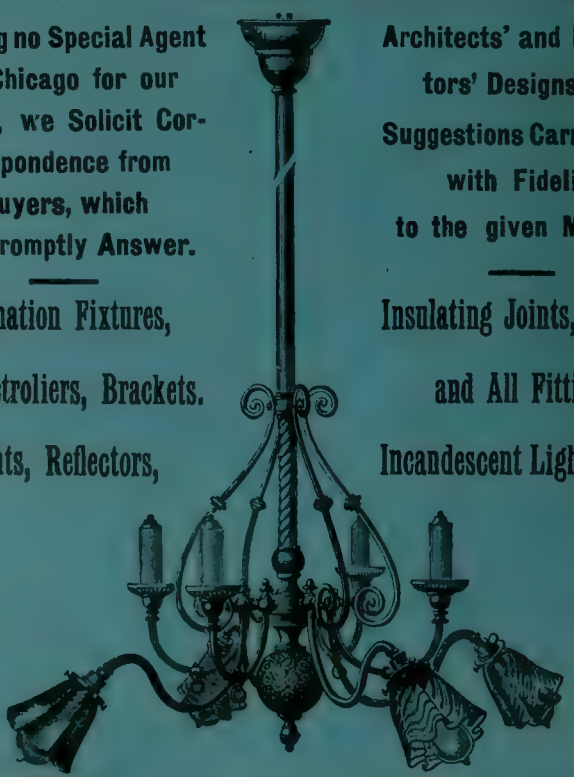
(Successors to MITCHELL, VANCE & CO.)

DESIGNERS AND MAKERS OF

ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.



Combination Fixtures,
Electroliers, Brackets.
Pendants, Reflectors,

Insulating Joints,
and All Fittings for
Incandescent Lighting.

MANUFACTORY, 24 and 25th St. and 10th Ave.,

SALESROOM, 836-38 Broadway and 13th St.,

NEW YORK CITY.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, OCTOBER 4, 1890. No. 14

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

CABLES AND WIRES FOR Electric Railroads, Telephone and Telegraph, Electric Lights.

STANDARD UNDERGROUND CABLE CO.,

NEW YORK. PITTSBURGH. CHICAGO.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4¾-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York. / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

INSULATING TAPE: "THE ACME."

CENTRAL DISTRICT OFFICE, RIALTO BUILDING, CHICAGO.

For Addresses of other District Offices, SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	285
Waterhouse	222	.....	222
Heisler	.....	500	500
Remington	159	300	459
Sperry	130	.....	130
Excelsior	90	.....	90
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System	Arc	Inc
Thomson-Houston	16,927	[illegible]
Brush	6,090	4,259
Westinghouse	821	49,467
Edison	..	[illegible]
American	1,537	[illegible]
United States	632	6 141
Schuyler	1, 66	....
Ball	962	6
Western Elec ric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	387	.....
Heisler	.....	5,815
Remington	129	.....
Sperry	180	.....
Excelsior	205	30
Hochhausen	[illegible]	..
Weston	138	..
Fuller	10	.....
Reliance	30	.....
National	..	1,000
Bernstein	..	215
Total	91,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	91,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 I candescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16.927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16.927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.. xxv
Alexander, Barney & Chapin.. xii
Allis, E. P. & Co..... xxiv
American Electrical Works.. xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co..... vii
Baggot, E..... xvi
Bain, Foree..... xxii, xvi
Ball Engine Co..... xvi
Barnes, W. F. & Jno..... xxi
Barton, Geo. P..... xxv
Baxter Electric Motor Co..... xxiii
Bernstein Electric Co..... vii
Bleckert & Nelson..... xvii
Brown, Frank T..... xvi
Brooks Underground Tel. Co.. xiv
Brush Electric Co..... xxix
Bunnell & Co., J. H..... xiv
Butler Hard Rubber Co..... xx
C. B. & Q. R. R..... xxv
C. & C. Electric Motor Co... xxii
Central Electric Co..... xi
Cleverly Electrical Works... xvi
Colburn & Co., I. W..... xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... xix
Consolidated Electric Storage Co..... xxx
Continental Dynamo Co..... xv
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... xxv
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xviii
Easton Electric Co..... iv
Eastern Electric Cable Co. xv
Eddy Electric Mfg. Co..... xv
Eddy, Henry C..... xiv
Edison Mfg. Co..... xxii
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co..... xix
Electric Construction & Sup. Co iv
Electric Merchandise Co..... xvi
Electrician Publishing Comp'y, xxv, xxiii, xxiv
Electrical Supply Co..... xxviii
Elektron Mfg. Co..... xvi
Empire City Electric Co..... xviii
Empire China Works..... xvi
English, Morse & Co..... xvii
Eureka Tempered Copper Co.. xvii
Evans Friction Cone Co..... xix
Excelsior Electric Co..... xxi
Fibrone Mfg. Co..... xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works.... Fort Wayne Electric Co..... xxx
Gibson Gas Fixture Co..... xviii
Giles Bros,..... vii
Globe Carbon Co..... xviii
Great Western Electric Sup. Co. v
Greeley & Co., E. S..... Harmount, G. A..... xvi
Hawkeye Electric Mfg. Co.... iv
Hazazer & Stanley..... xiv
Hazelton Tripod Boiler Co.... xxv
Heisler Electric Light Co..... xxii
Hill Clutch Works..... xxiii
Holmes, Booth & Haydens..... xvii
Holmes & Co., C. H..... xvii
Holtzer-Cabot Electric Co..... i
Humphrey, H. H..... xvi
Illinois Electric Material Co.... xiv
India Rubber & Gutta Percha Co. i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L.. i
Jewell Belting Co..... xv
Jones Bros. Electric Co..... vii
Knapp Electrical Works..... xxvii
Laminar Fibre Goods Co..... xvii
Law Telephone Co..... xv
Leclanche Battery Co..... vii
Magnolia Anti-Friction Metal Co i
Mason, Jas. H..... xxi
Mitchell Vance Co..... xxx
Monitor Electric Co..... xvi
Munsell & Co., Eug..... xv
Munson Belting Co., Chas..... xiv
National Carbon Co..... iv
National Electric Mfg. Co..... x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T..... xvi
N. Y. Belting & Packing Co... xiv
Okonite Co..... xv
Ostrander & Co., W. R. xviii
Page Belting Co..... xxv
Paiste, H. T..... xiv
Partrick & Carter..... xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co..... xxiii
Pond Engineering Co..... xxiv
Powell Co., Wm..... Pumpelly Storage Battery Co. vii
Queen & Co..... xvi
River & Rail Elec. Light Co.. ix
Roeblings' Sons Co., Jno. A... xix
Sawyer-Man Electric Co..... xii
Schoverling, A..... —
Schuyler Electric Co..... xx
Shultz Belting Co..... .....
Southern Electrical Supply Co. xxi
Sperry Electric Co..... xviii
Standard Electrical Works.... xvi
Standard Paint Co..... xiv
Standard Underground Cable Co. i
Standard Carbon Co..... xx
Stephenson & Co., Jno xxiv
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co..xxi
Sunbeam Incandescent Lamp Co.xv
Taussig, S..... xvi
Taylor Mfg. Co..... xxv
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxvi
Triumph Compound Engine Co..... xxv
Turner Brass Works..... xv
Union Hardware Co..... xiv
United Electric Traction Co.... vii
United States Electric Lighting Co..... —
Van Nuis C. S.....
Wanted..... xiv
Western Electric Co.....xviii
Western Power Construction Co. xxiv
Westinghouse Electric Co..... xiii
Weston Electrical Instrument Co..... xiv
Wollensak, Jno. S..... xxi
Woodbridge & Turner..... xvii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Hazazer & Stanley.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Hazazer & Stanley.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Hazazer & Stanley.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Hazazer & Stanley
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Hazazer & Stanley.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Brooks Underground Telegraph Co.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brooks Underground Telegraph Co.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Const
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Fairbanks, Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.

Friction Cone.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Contd.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Easton Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Western Electric Co.
Okonite Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

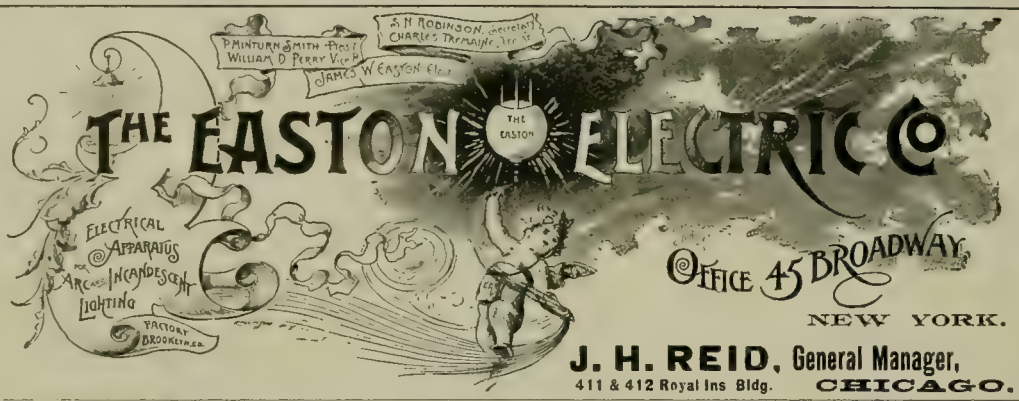
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



J. H. REID, General Manager,
411 & 412 Royal Ins Bldg. CHICAGO.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

THE HAWKEYE ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station AND ISOLATED PLANTS, ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps***, Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

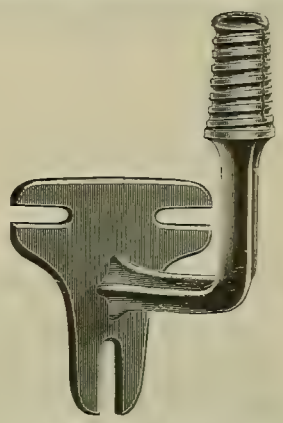
GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192
FIFTH AVE.,
CHICAGO.

Makers of the Choicest Electrical Supplies.

CHUBBUCK BREAK ARM.
Malleable Iron. PATENTED.

SOLE MANUFACTURERS OF
THE CHUBBUCK BRACKET,
THE CHUBBUCK BREAK ARM.
PATENTED SEPT. 9, 1890.
Made of Malleable Iron, with Split Insulator Screw, allowing free expansion of the metal. Will not crack or break the insulators.

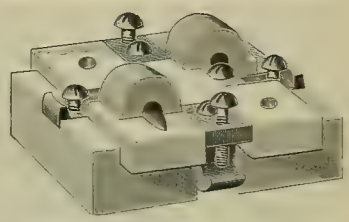


CHUBBUCK BRACKET.
PATENTED Sept. 9, 1890.

THE WIRE THAT GIVES THE HIGHEST LINE INSULATION.
SIMPLEX
THE WIRE THAT PAYS BEST IN THE LONG RUN.

GENERAL WESTERN AGENCY
The Samson Battery.
PATENT PENDING.

TREBLE CURVE INSULATOR.
Greatest Strength and Highest Insulation.
POLE TOPS, RAIL BONDS, ARMATURE PINIONS, and other novelties of merit, with a full line of all the standard
Electric Railway Supplies



CUTTER'S PORCELAIN BRANCH CUT-OUT.
Fuse Covers and Base made out of one solid piece.

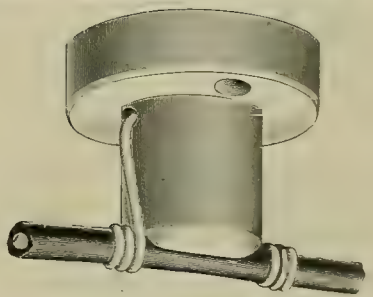
The Most Powerful and Enduring Open Circuit Battery Made.

For specially hard work, use
For all bell circuits, always use
For Annunciators and Alarms, use
THE SAMSON.

THE SAMSON Is unequaled for Gas Lighting. Recovers from Short Circuits quickly. Is popular with the best contractors.

Architects should always specify the SAMSON.

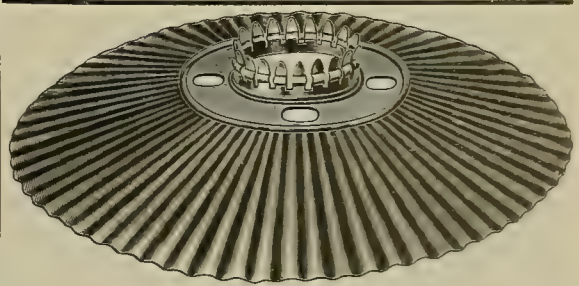
ELECTRIC FIXTURES, Many New Designs.
ELECTRIC SHADES, Large and Complete Stock.
ARC GLOBES, Good Figures in Quantities.
TELEGRAPH APPARATUS, A Fine Line.
ANNUNCIATORS and BELLS, All Sizes.
LINEMAN'S TOOLS, Choice Assortment.



CUTTER'S E. L. INSULATOR.
Gives High Insulation even on Damp Ceilings, and Prevents the Unsightly Blackening.

COMBINATION CONE SHADE.
PATENTED.

CUTTER'S COMBINATION SHADES.
Fit T-H., Westinghouse or Sawyer-Man Sockets.
ALSO MADE FOR EDISON SOCKETS.
No Tools, No Trembling, No Holder.
THE MOST ECONOMICAL SHADES MADE.



COMBINATION TIN SHADE.
PATENTED.

Send for Special Circular describing any of the above, or write us of your needs, and we will cheerfully give our advice.

IF YOU HAVE NOT YET GOT A COPY OF OUR
Sketch Catalogue,
BE SURE TO SEND YOUR BUSINESS CARD FOR ONE.

WHAT'S THE MATTER

WITH YOUR DYNAMO?

IS THE ARMATURE BURNED OUT?

SEND IT TO THE REPAIR DEPARTMENT OF THE

NORTHWEST THOMSON-HOUSTON ELECTRIC COMPANY,

401 FIRST ST., SOUTH, MINNEAPOLIS, MINN.

REMEMBER, We Repair Everything ELECTRICAL,

It Matters Not What System You Use.

If anything is out of order, send it to us and we will repair and return quicker and in better order than any one else in the Northwest.

GIVE US A CALL.

We Always Please Our Customers.

Pumpelly Storage Batteries

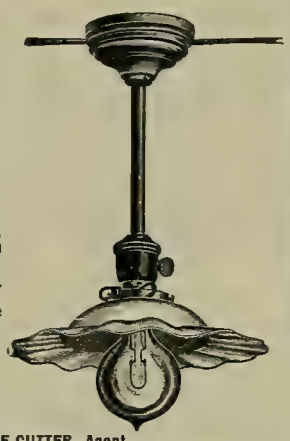
For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

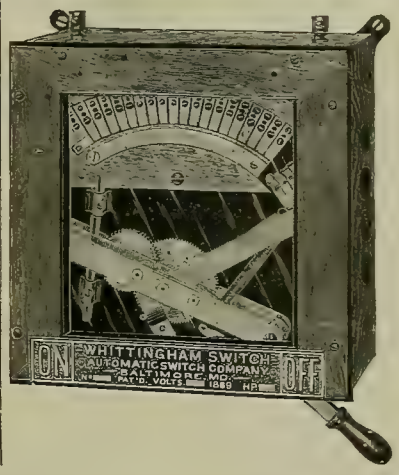
SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

AUTOMATIC SWITCH Co.,



No. 8 KEYSER BUILDING.
BALTIMORE, MD., U. S. A.
Sole Manufacturers of the
WHITTINGHAM
AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.
Applicable to Constant Potential Motors of all sizes and patterns.
SEND FOR CATALOGUE.

W-A-T-C-H-E-S.

The World's Exposition in Paris, 1889, awarded a prize medal to The Giles Anti-Magnetic Shield for watches. It has been proven to be the best practical and permanent solution to the trouble electricians have with their watches.
The shield can be applied to any watch, or is furnished in new watches by

GILES BROS., - CHICAGO.

TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,

149 West 18th Street, - - NEW YORK.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.
ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

ARMATURES REPAIRED and REWOUND
COMMUTATORS TRUED, OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

THE EDISON SYSTEM

OF

OVERHEAD WIRE ELECTRIC RAILWAYS

HAS BEEN

ADOPTED BY 113 DIFFERENT COMPANIES

Which have made 113 Original Contracts and 85 Extension Contracts, covering

75,000 HORSE POWER IN APPARATUS.

CHARACTERISTIC FEATURES:

Economy in Power Generation,
Minimum Coal per Passenger Carried,
Minimum Depreciation per Car Mile,
Street Construction of Great Strength,
The Feeder System of Distribution,
Mechanical Perfection in Detail Appliances.

The Largest Electric Railway Contract ever Placed.

OVER 7,000 HORSE POWER IN APPARATUS.

Was Awarded by the St. Paul & Minneapolis Railway Systems to the

EDISON GENERAL ELECTRIC COMPANY,

Edison Building, Broad St., NEW YORK CITY.

DISTRICT OFFICES:

NEW YORK, Edison Building.
CHICAGO, Rialto Building.
DENVER, COLO., Masonic Building.
NEW ORLEANS, LA., Cotton Exchange.
BOSTON, MASS., 38 Pearl Street.
SAN FRANCISCO, CAL., 112 Bush St.
PORTLAND, ORE., Fleischner Building.
TORONTO, CAN., Bank of Commerce Building.

☞ Please address all communications to nearest District Office. ☜

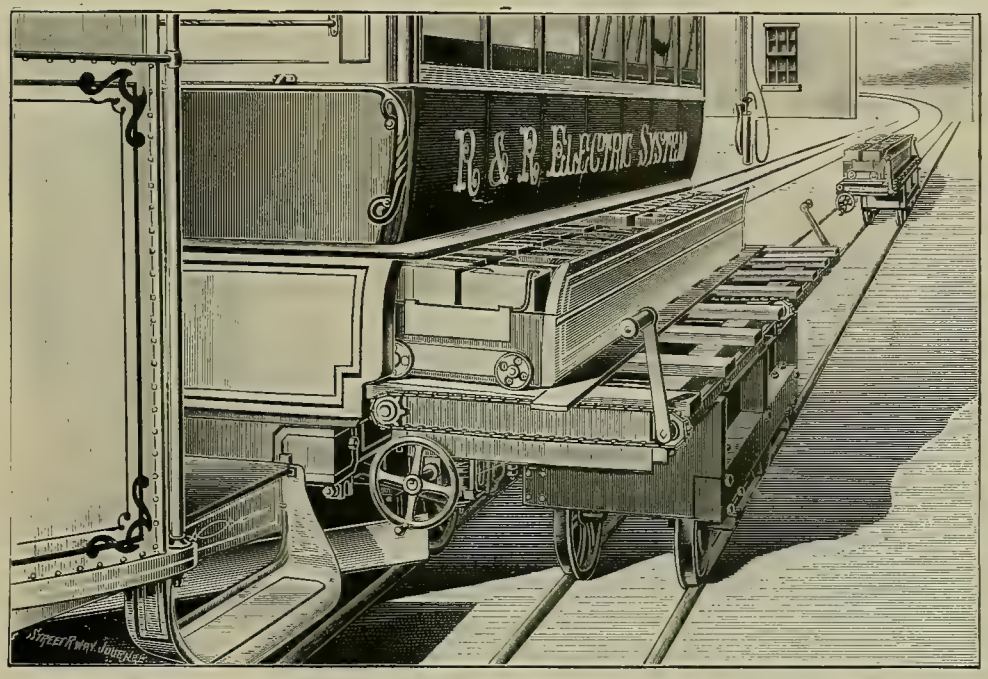
FACTORIES:—New York City. Schenectady, N. Y. Harrison, N. J. Hamilton, Ontario. Sherbrooke, Quebec.

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



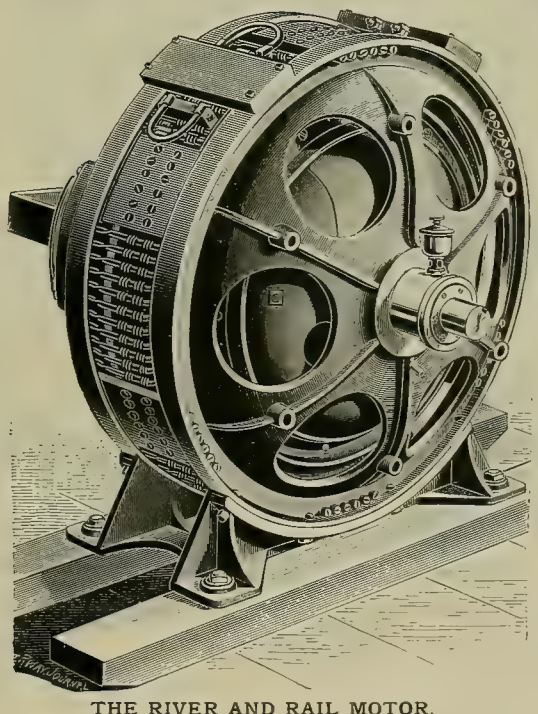
Cars are Lighted by Batteries That Propel The Motor.

METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

THE MAIN Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

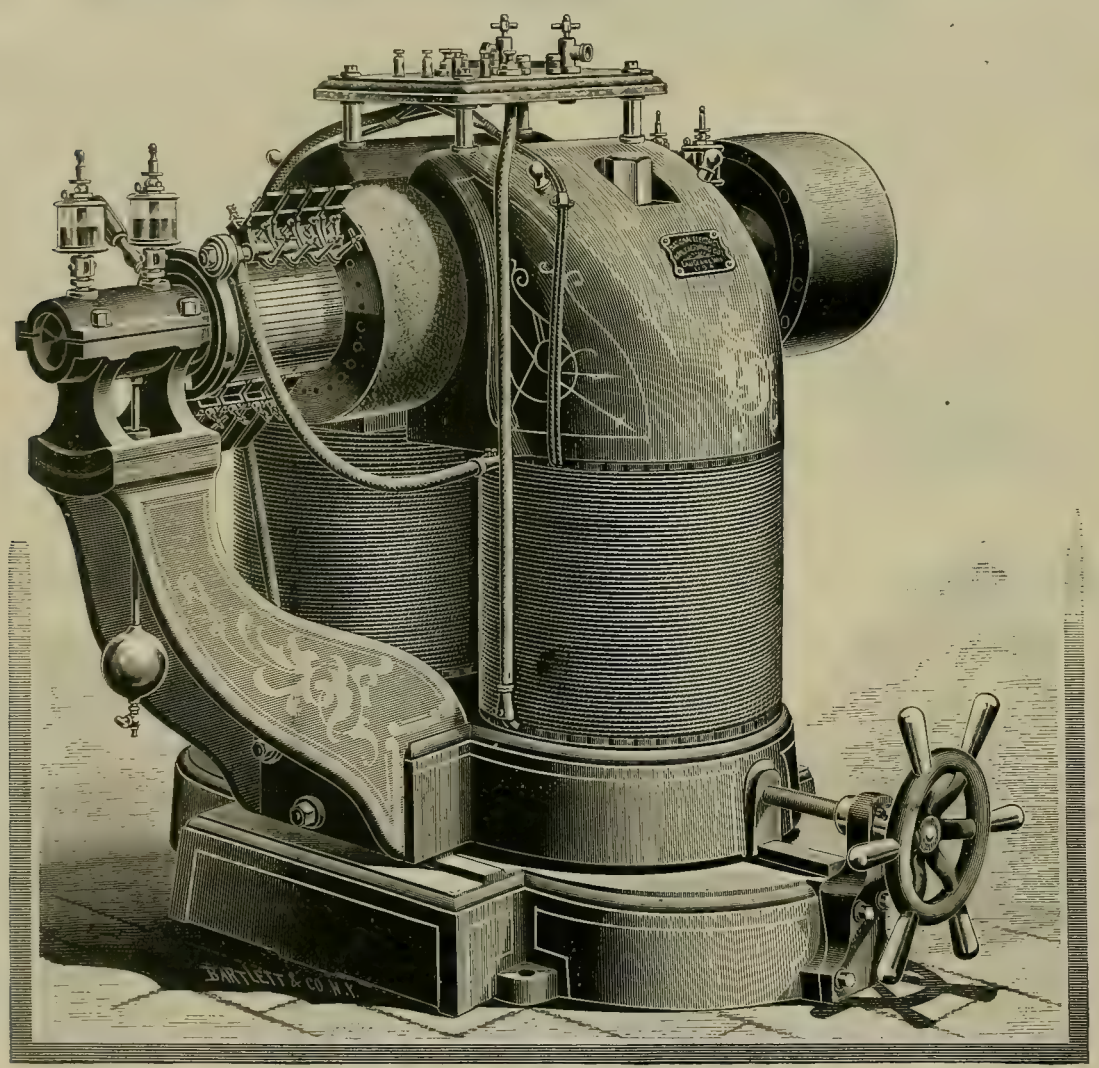
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMOS, CAPACITY 500 16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

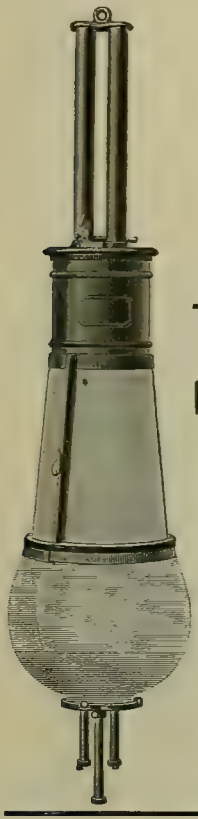
BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Ag'ts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building. St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC Co.,

116 & 118 FRANKLIN STREET, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Co.



OKONITE TRADE MARK.

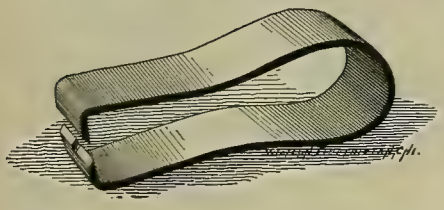
GENERAL WESTERN AGENTS FOR

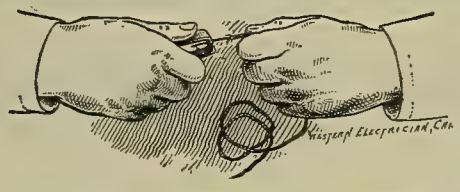
OKONITE AND CANDEE WIRES.

The Central Spark Arrester

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting to the globe.

THE PERRY WIRE PEELER.





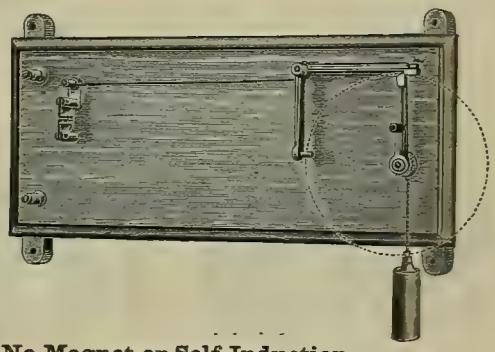
This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs.
Cleveland Switches, Paiste Switches, Branch Blocks,
And all kinds of Electrical Supplies.

THE HOT WIRE

Lightning Arrester.



No Magnet or Self-Induction.
Furnishes Absolute Protection,
And is Automatic in its Action.

OUR PRICE ON THESE INSTRUMENTS IS VERY LOW.

ANTI-MAGNETIC WATCHES.

We have completed arrangements with the Electricians' Time Company by which we are enabled to offer to Electrical men a thoroughly first-class watch, absolutely protected from magnetic influence, and at a very low price. Each watch is accompanied by a guarantee, stating first what it is, and in cases where desired, payments are made easy. Send for a descriptive circular.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

A
B
C
And Everything
Up To
Z

OCTOBER 6th, 1890.

IN

ELECTRICAL SUPPLIES

WILL BE FOUND AT

Alexander, Barney & Chapin,

20 CORTLANDT STREET,

TELEPHONE, 1139 CORTLANDT.

NEW YORK.

SAWYER-MAN LAMPS,

Any Candle Power,

To Fit Any Socket.

NEW SERIES LAMP AND SOCKET FOR

ARC CIRCUITS.

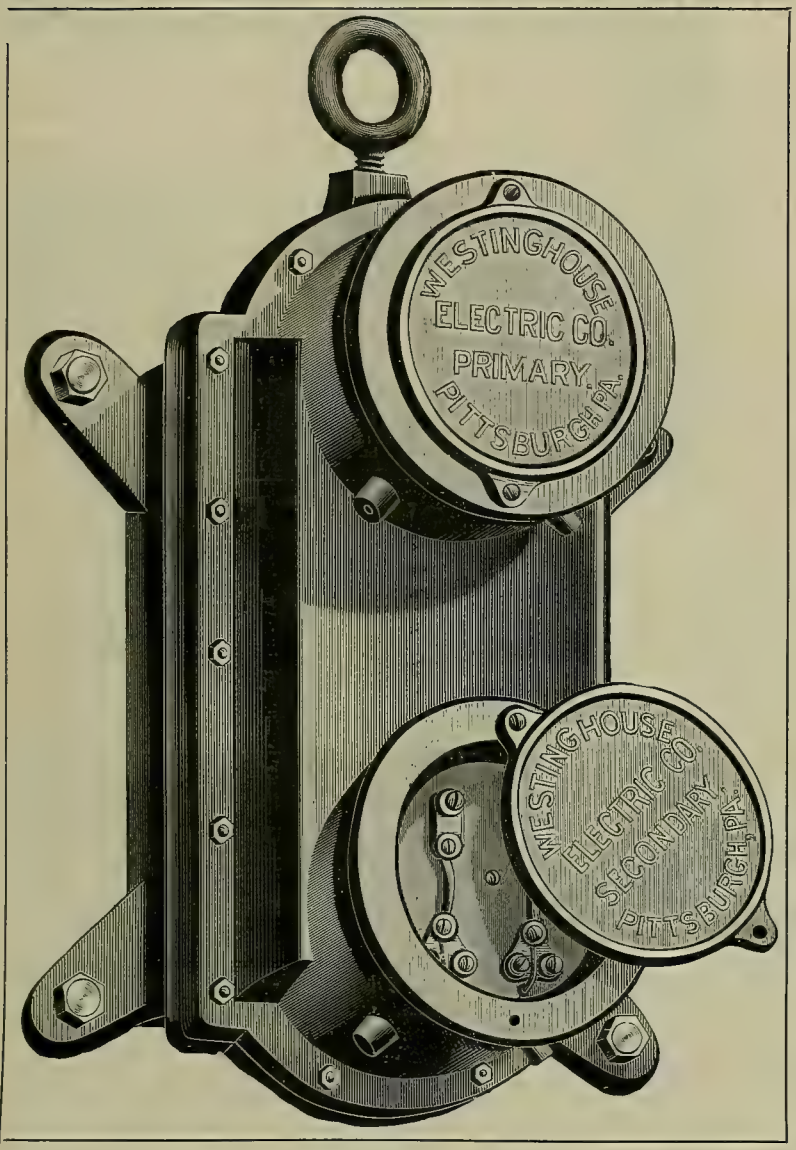
SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.

CONVERTER EFFICIENCIES.

It Will Pay You to Throw Out Your Present Converters and Substitute Our Make.



COMPARISON OF CONVERTERS.

	Total Efficiency.	Converter Capacity Tested.
Thomson-Houston,	87.50 Per cent.	25.
Ft. Wayne Jenney,	87.	25.
National,	88.	20.
WESTINGHOUSE.	95.	20.

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

Incandescent Alternating Current Dynamos, Converters, Meters, Motors.

325 Central Stations and 600,000 Lamps.

Alternating Current Arc Lighting Apparatus.

Lamps burn 40 hours without renewal of carbon.

Arc Lighting revolutionized.

Send for Special Circular.

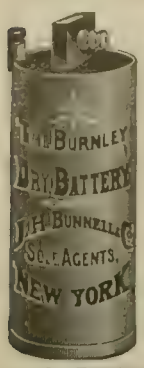
55 PLANTS, AND 5000 LAMPS SOLD WITHIN A FEW MONTHS

CORRESPONDENCE SOLICITED.

WESTINGHOUSE ELECTRIC & MFG. COMPANY,

PITTSBURGH, PA., U. S. A.

BOSTON, NEW YORK, CHICAGO, CINCINNATI
ST. LOUIS, SAN FRANCISCO, PORTLAND.



BURNLEY DRY BATTERY

PATENTED January, 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:—Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. **76 Cortlandt St., N.Y.**

Cheaper than Overhead Wires,

MORE THAN TEN TIMES AS DURABLE.

Guaranteed to stand a pressure of 100,000 volts when used for Electric Light Mains. Write for Estimates to the

Brooks Underground Telegraph Co., 207 Walnut Place, Room 5, Philadelphia.

FOR SALE.

At a bargain, a quantity of tools, etc., used in constructing electric roads.

Sprague Electric Equipment Co.,
106 Pullman Bldg., Chicago.

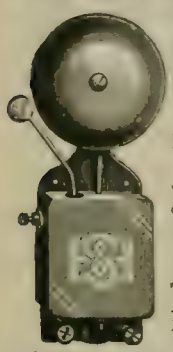
HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St., CHICAGO.

HAZAZER & STANLEY,



ELECTRICAL HOUSE FURNISHINGS,

32 and 34 Frankfort St., - - NEW YORK.

NEW YORK, July 25, 1890.

Messrs. Hazazer & Stanley.

GENTLEMEN:—Please ship immediately the 100 bells ordered last week. I have used your bells for the last five years and have found no others equal to them. They are the Best Electric Bells on EARTH.

Yours truly, *CHAS. E. GOODRICH, Electrician,*
503 Eighth Avenue.

T. W. NESS, Montreal, Agent for Canada.
A. SECHRIST & CO., Denver, Agents for Colorado.
LOUIS B. HETTY, 126 Eddy St., San Francisco, Cal., Agent for the Pacific Coast.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:

PHILADELPHIA, 306 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:

ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
ST. LOUIS, 616 Locust St.

"CANVAS JACKET"

LINE WIRE

MOISTURE & FIREPROOF.

ILLINOIS ELECTRIC MATERIAL CO.,

POLES

"BISHOP" RUBBER

CABLES.

COVERED WIRES AND

"The Rookery," CHICAGO. ILL.

INTERIOR CONDUIT & INSULATION CO.

A NEW DEPARTURE IN INSULATION.

INTERIOR CONDUITS { Endorsed by the leading Architects, Builders, Electric Light Companies, Wiring Contractors and Boards of Fire Underwriters. Personally endorsed by Thos. A. Edison, Prof. Elihu Thomson and other Electrical authorities.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Price lists, Samples and General Information, address

INTERIOR CONDUIT & INSULATION CO. 16 & 18 BROAD STREET, NEW YORK.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

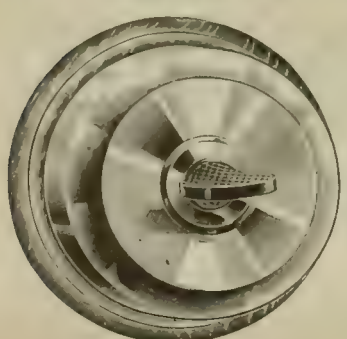
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

THE PAISTE SNAP SWITCH



FOR INCANDESCENT WORK

Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,

12th and Market Sts.,

Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co.

MANUFACTURERS OF

EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

GET THE BEST!

P. and B.

INSULATING COMPOUNDS,
ARMATURE VARNISH,
INSULATING TAPE.
INSULATING PAPERS,
MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N.Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, OCTOBER 4, 1890. No. 14

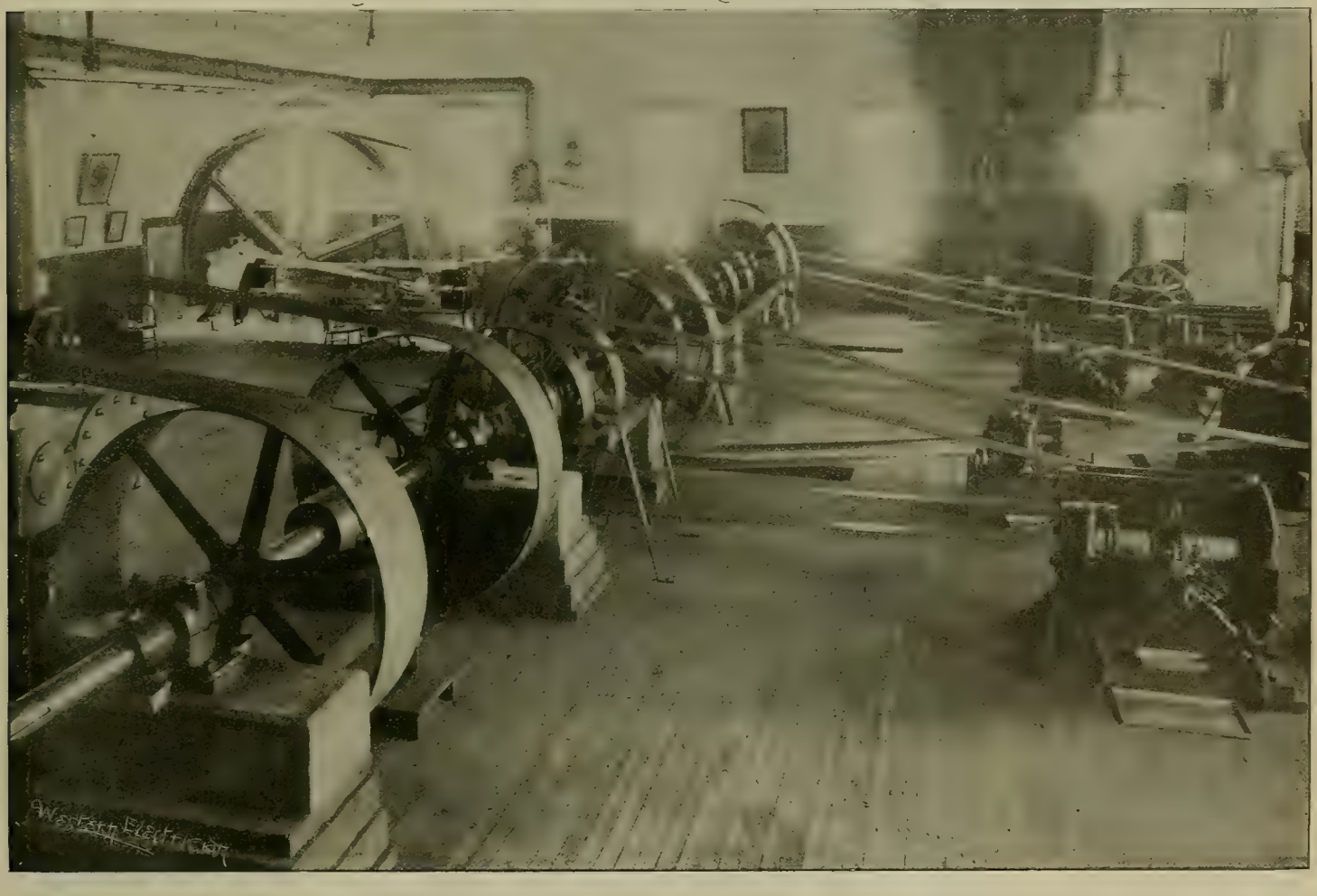
Dynamo Room of the Sioux City Electric Company.

The cut presented herewith illustrates the dynamo and engine room in the station of the Sioux City Electric company. This plant was built in 1889, and is located at the corner of First and Court streets. The building is of brick, and is one-story high with a slate roof.

The dynamo and engine room is 50 feet wide by 73 feet long, and is separated from the boiler room by a fire wall. The boiler room is 52 feet long by 47½ feet wide, and contains four 80-horse power tubular boilers. The station is provided with an 80 foot stack of 60 inches diameter. The engines, of which there are two, belt as shown to the one 5 inch countershaft, which in turn drives the dynamos. One of the engines is a 200-horse power, Reynolds-Corliss, and the other is a 250-horse power Armington & Sims. Hill clutches are used on the main shaft. The dynamos consist of two 750 light Westinghouse incandescent machines, two 35-light and two 50-light Thomson-Houston arc machines. Another arc-machine is to be added in the near future.

The water supply for the Sioux City station is taken from a system of tube wells, and there is also a connection with city mains for use in the event of an accident. Iowa nut, a slack coal, is burned. A side track runs alongside the station, so that the fuel is shoveled from the cars to boiler room. The station is in charge of C. E. Woodrow, chief engineer. L. L. Kellogg is manager of the company.

The Sioux City Corn Palace which was opened to the public last week is brilliantly illuminated by arc and incandescent lights supplied with current from this station. The lighting effects in this palace are original and striking, and they form one of the most attractive features of the exhibit.



DYNAMO ROOM OF THE SIOUX CITY ELECTRIC COMPANY.

Chicago's Telephone Service.

The Subscribers' telephone ordinance was presented to the Chicago city council last week, and action was postponed. The company which petitioned the council for a franchise had announced its intention of establishing an exchange immediately and cutting the price of service to $75 per year. This announcement was received with satisfaction by the druggists who have been actively engaged in the agitation against the telephone company heretofore. Before the council passed the ordinance, however, some of the aldermen desired an explanation of several important points. In the first place it was desired to know what telephone the company proposed to adopt, and again, when the exchange would be ready. The question of terms was also considered.

Up to that time the new company had been very reticent but when pressed for an explanation it was announced that as yet no telephone had been adopted. The new company had not yet determined whether to open an exchange immediately or await the expiration of the Bell patents. If it was thought best to establish an exchange at once the Cushman or the D'Unger telephone would be adopted. In view of the fact that a company secured a franchise a few years ago from the Chicago city council to establish a Cushman telephone exchange and was immediately enjoined by the Bell company, this proposition to adopt the Cushman telephone was not considered worthy of attention. It is hardly possible that Dr. D'Unger's telephone will be adopted. In fact, it seems to have been the plan of the projectors to secure a franchise, organize a company if necessary, issue stock and then await the expiration of the Bell patents.

Another obstacle was encountered. The company agreed to give service for $75 per year, but it was learned that a three year contract would be required before an instrument would be put in.

When these facts were announced many of the warmest advocates of the new company withdrew their support. They could see no reasonable hope for a change, in fact, the prospect for the new enterprise was anything but

inviting. The opponents of the bill said the Bell company would improve its service before the new company could get into shape, and the inventions controlled by the telephone company and now under trial would be perfected and would undoubtedly add much to the efficiency of the present service.

The Westinghouse Exhibit at the Pittsburg Exposition.

The Pittsburg Exposition, an annual display at which the industries of that city exhibit their productions, has again opened. It was expected that the electrical industry, which has assumed a leading position in that city, would find a prominent place at the exposition, and this has been fully realized. Pittsburg as the home of the Westinghouse Electric & Manufacturing company was looked upon as the proper place for a display of the alternating current system of central station electric lighting.

FIG. 1. WESTINGHOUSE EXHIBIT AT THE PITTSBURG EXPOSITION.

The Westinghouse company occupies the largest space of any exhibitor in Mechanical Hall, the building which is especially set apart for the electrical display. To get an adequate idea of all the wonders revealed here would require a personal inspection of the display.

The Westinghouse company has confined its exhibits to apparatus characteristic of the alternating current system. For this reason the electrical exhibit at this exposition is not only unique in this country, but in the world. The accompanying cuts illustrate the apparatus displayed.

Entering the middle gate of the hall, the Westinghouse exhibit is at once noticed on the right, where an apparently interminable row of engines and dynamos attract the visitor's attention. The first object noticed is the four hundred horse-power triple expansion rotary engine, one of the latest inventions of George Westinghouse, Jr. The peculiar appearance of this rotary engine causes a great deal of admiration. This engine is belted to a 3,000-light alternating current machine and to a direct current dynamo, used as an exciter for the field of the alternator. Following in line with the above is a 1,500-light alternating machine belted to a Westinghouse compound engine; then a 750-light machine belted to a Westinghouse standard engine; a 500-light alternator of 2,000-volt pressure, attached to another Westinghouse standard engine. This alternator is self-exciting and self-regulating. Now follows a 25-light Westinghouse alternating current arc machine, belted to a Westinghouse, Jr., engine. This arc machine generates the current for the flat carbon arc lamps, which light up the display. Beyond this is the Tesla motor generator of 30 horse power and an exciter belted to a standard engine. This ends the details of the row of machines, all especially made to be first used at this exposition, and that they constitute the chief attraction in the hall is not be wondered at.

The Tesla motor is given a conspicuous position in the exhibit, and much is expected of it by the company. It has attracted considerable attention. In this exhibition the motor illustrates its usefulness by operating at one end a printing press; at another place the Hercules mining machine; at a third a carpet loom; and in addition to these it drives a soap wrapping and a caramel wrapping machine, and operates enough fans throughout the building to maintain a cool breeze everywhere. A view of this exhibit is presented in Fig. 1.

The switch-boards for all the alternating machines are secured on the pillars, which serve as supporters to the building. In the evening all of the machines are in operation, the 3,000-light alternator serving for the following purpose: Outside the hall on the lawn stands an enormous arch 40 feet wide and 50 feet high. This arch is an illuminated sign, entirely composed of 16 candle power incandescent lamps. The sign consists of the words: "Westinghouse —Pioneers of the Alternating System." There are about 2,500 lamps used in this sign. The letters are nearly three feet long, and in the evening when the sign is lit up the effect is really very wonderful. The sign can be read at a distance of one mile very distinctly.

It must not be forgotten that the entire site occupied by the Westinghouse display is handsomely draped and decorated. Adjoining the motor generator a beautiful pavilion has been erected. It is furnished in antique oak and affords a welcome resting place after a fatiguing walk through the building. In every corner of the pavilion stands a fan on an ornamental bracket. The fans are attached to a new alternating current motor brought out by the company not long ago. The same motor is also attached to a sewing machine, which is operated by this means. This little motor can be run on the same circuit as the lamps, and by a peculiar regulating device the speed of the sewing machine is controlled by the treadle of the machine. The sewing machine and motor make the pavilion an especially attractive place for ladies.

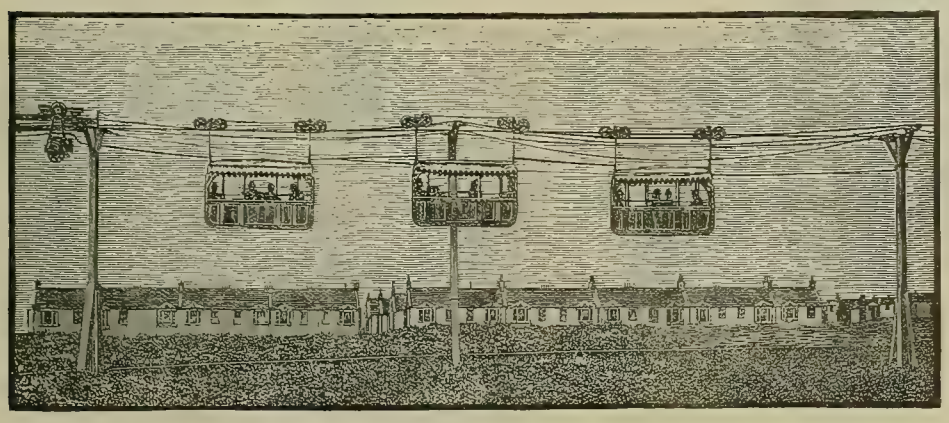
However, in the front of the pavilion the largest number of interested spectators are always to be found to watch the proceedings at the experimenting table, which has been put up here. This table, a view of which is presented in Fig. 2, is in charge of an electrician who explains to the wondering people the marvels of electricity. He shows them the operation of the Shallenberger alternating current meter, how it acts when only one lamp is burning in the circuit and when 50 lamps are burning. He explains the operation of the Bell stage regulator; the action of the converter system is illustrated; the operation of the Tesla motor is explained; an electric cigar lighter is offered to the dude to ignite his cigarette, and on a porcelain plate a copper-coated egg is by means of the electric current made to stand on end and revolve like a top. All these things help to entertain and interest the people, and illustrate in a most thorough manner the development of the alternating current. A better opportunity to examine the system cannot be secured than is afforded by the electrical display of the Westinghouse Electrical & Manufacturing company at the Pittsburg Exposition.

FIG. 2. WESTINGHOUSE EXHIBIT AT THE PITTSBURG EXPOSITION.

Telpher Line at Edinburgh.

The telpher line recently constructed at Edinburgh is illustrated in the accompanying cut. In this line it is claimed all the recent improvements in the telpher system have been embodied by the Electrical Engineering company of London, which controls the system.

The line consists of over a quarter of a mile of track, the flexible portion of it being constructed in spans of 50 feet, and the rigid ends in spans of 15 feet. The stand ropes on which the locomotive and carriages travel are of crucible steel and 1⅓ inches in diameter. These are tightened, so that with a full load on the line there is a sag of about 2 feet 4½ inches on the spans covered by the train. The arms supporting the stand rope are arranged so that they move in either direction, allowing the sag in the rope to follow the train as it moves along, thus avoiding undue strain upon the posts themselves. The stand rope at its junction with the rigid rail passes from a special descent junction saddle so arranged that the train arises from the rope to the rigid rail without any jerk or other unsatisfactory movement. From the junction saddle the stand rope passes direct to a structure termed the abutment post; this is fastened to the substantial anchorages in the ground by flexible steel ropes. The strain upon the ends of the stand rope with a fully loaded train is about five tons, and the strain upon the anchorage about eight tons. The current is carried along a conductor which is not attached to the insulators on which it rests at any point, but merely rests upon them. From the locomotive a rigid arm projects underneath the conductor, but above the insulators, and slides along under the conductor, lifting it off the insulators as the arm passes them, allowing it to rest on them again after it has passed.



TELPHER LINE AT EDINBURGH, SCOTLAND.

It will be observed that the cars on this system are constructed after the regulation English style, each having two compartments holding four persons. The car is suspended by iron hangers from two bogie trucks, the bodies of which consist of mitis iron castings resting on the axles of the wheels at each end. The hanger does not depend directly from the body of the bogie truck, but rests upon two vertical springs contained in boxes on each side of the body. The locomotive consists of a swinging tub, and the motor drives a small countershaft, to one end of which is attached an electrical governor to maintain a set speed; the other end of the countershaft has upon it a chain wheel, which drives directly upon a larger chain wheel contained on the upper frame. The motor is suspended from the upper frame by a hanger, so arranged as to allow the whole to swing. The upper frame contains, in addition to the large chain-wheel, two driving wheels with malleable iron tyres to grip the rope, each attached to a chain-wheel driven from the shaft supporting the large central chain-wheel. The illustration is taken from the London *Electrician*.

Western Union Poles Chopped Down.

The city officials of Grand Rapids, Mich., consider that municipality on a level with New York and Chicago, or at least destined to become their equal at some time. They are afraid that the progress of their little settlement may be affected by the presence of poles in the streets, and have accordingly begun a warfare against the Western Union company. The city has the advantage thus far, but the fight has only begun. The details are presented in the following special dispatch of Sept. 27th from the seat of war: Some time since the common council ordered the removal of the electric wires from Canal street, the principal business street of the city. The Western Union Telegraph company declined to obey the order, basing its refusal on the ground that the United States had declared all public roads postal roads. In order to prevent any overt action on the part of city officials the company applied to the United States court for a restraining order. Today Judge Severs denied the injunction. Mayor Uhl immediately ordered the city marshal to chop the offending poles down. This was done, and thirty poles bit the dust. The wires were hacked from the poles, coiled up and stowed away and the poles carted off. The council had previously offered the Western Union the compromise of allowing its wires in Canal street providing the company would string them on handsome iron poles to be erected by the council, the company to pay a reasonable rental therefor. This offer was declined. The local manager of the Western Union declines to say what his company will do. One of the company's grounds for fighting the matter was the fear of establishing a precedent to be followed by other towns.

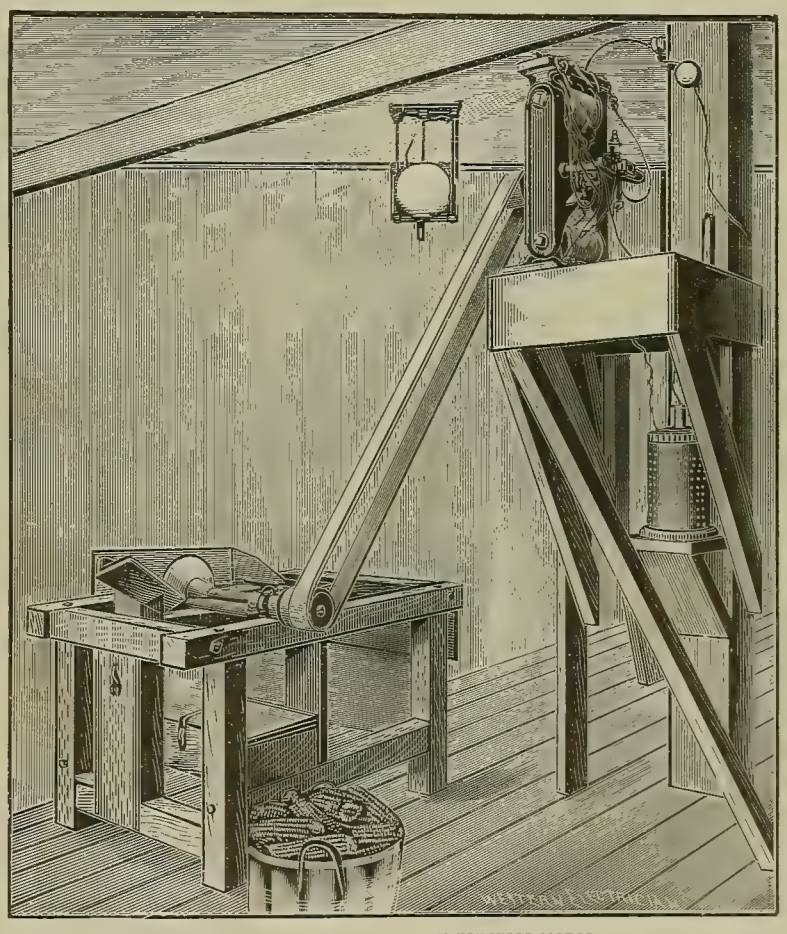
Northwest Chicago Electric Street Railway Company.

The Northwest Chicago Electric Street Railway company was incorporated last week. The plans of the company have not yet been made public further than the fact that the cars will be operated by storage batteries. It is proposed to start at the corner of Milwaukee and Western avenues and run north on Elston avenue to Montrose. A branch will run from Elston avenue along Kedzie avenue to Logan square, then down Milwaukee avenue, and another branch will run from Elston avenue along Crawford avenue. The company says it can be ready for business in ninety days from the time it gets its franchise.

The projectors of the enterprise announce that they have already decided upon the system to be employed but they have thus far refused to announce the features of the system, nor is it known what storage batteries will be employed.

Corn Cutter Operated by an Electric Motor.

In the construction of the Sioux City Corn Palace this year an excellent opportunity to display the advantages of the electric motor was presented. In former years the corn used to cover the palace was cut by saws operated by four horses, but this year a 3-horse power Hawkeye motor is employed with much more satisfactory results. The capacity of the cutting machine is 60 bushels an hour and it is estimated that 15,000 bushels were required to complete the work. The decoration of the building required the employment of 260 men and nearly as many women. The accompanying cut represents the motor in position operating the cutting machine. The motor was installed by the Hawkeye Electric Manufacturing company.



CORN CUTTER OPERATED BY AN ELECTRIC MOTOR.

An electric light and motor company has been organized at Clinton, Ia., with a capital of $100,000, and will at once proceed to erect a plant.

United Electric Traction Company's Street Car Motor.

The general arrangement and a few of the details of the standard 30-horse power motor of the United Electric Traction company, New York, are shown in the illustrations.

Fig. 1 represents the motor hung to the rear axle and shows the gearing and the forward end of the motor with the ring for the attachment to the forward axle. The bearing on the forward axle allows a play of about six inches, and by means of rubber car springs a flexible suspension is secured. Fig. 2 shows the motor and gearing tilted up so that the top of the former may be seen. This machine is of the consequent pole type with a large and very substantial Gramme armature wound in a large number of sections. The field magnets are of laminated wrought iron. Square iron bars bent into shape and assembled in the manner shown in the cut, are used to form the magnets. The castings which support the journals are of bronze. The gears are of cast steel, and are carefully cut. The pinions are of forged steel. The back frame of the motor illustrated in Figs. 3 and 4, Fig. 3 being a view from underneath, is a casting of steel. The bent I beam which supports the front of the motor, is of forged steel. Oil reservoirs and automatic oil pumps are used in connection with the bearings. The electrical features claimed for the motor are its flat field, an absence of sparking under load and a powerful torque on starting, due to the large diameter of its armature. Regulation is effected by cumulative windings in the field of the motor. The field coils and spools are thoroughly waterproof. The armature can be removed by simply unkeying its pinion and removing the four screws of the supporting spider at the other end of the shaft. Carbon brushes are used, and no change in their position is required on reversal of the motor. One switch-board is set up on each car and is controlled from either platform by means of a simple mechanical connection. This device on the platform occupies a space only about two inches square. A rheostat of two sections is used in starting.

The United Electric Traction company claim that it has been found from practical experience that suspending the motor directly from the axle and not attaching it to the frame of the truck or car body reduces the noise to a minimum.

The forged steel pinions and cast steel gear, they state, work together with almost an entire absence of the usual growl. These motors are wound for either overhead or storage battery work.

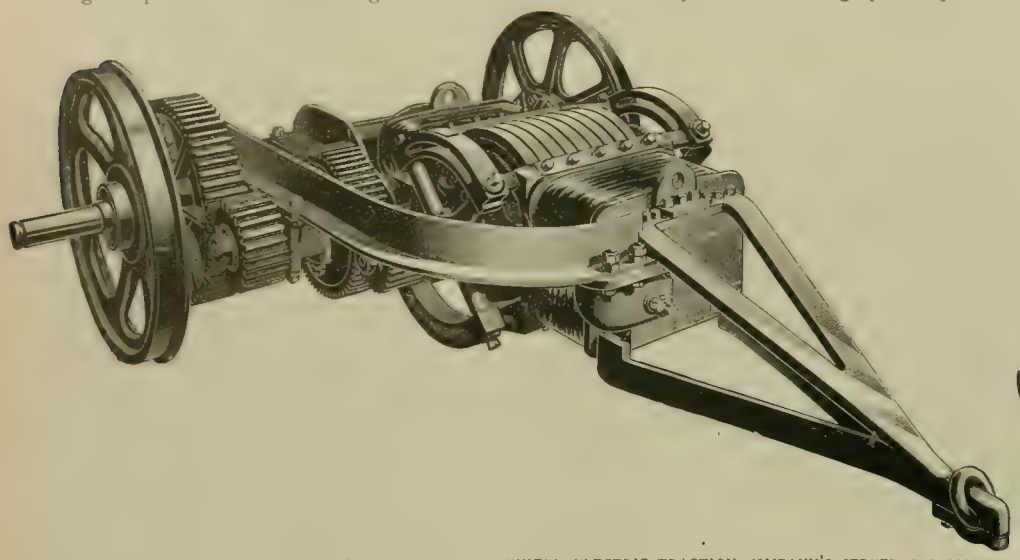
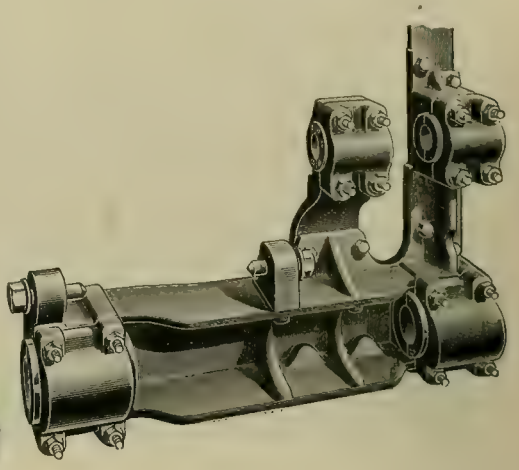


FIG. 1. UNITED ELECTRIC TRACTION COMPANY'S STREET CAR MOTORS. FIG. 3.



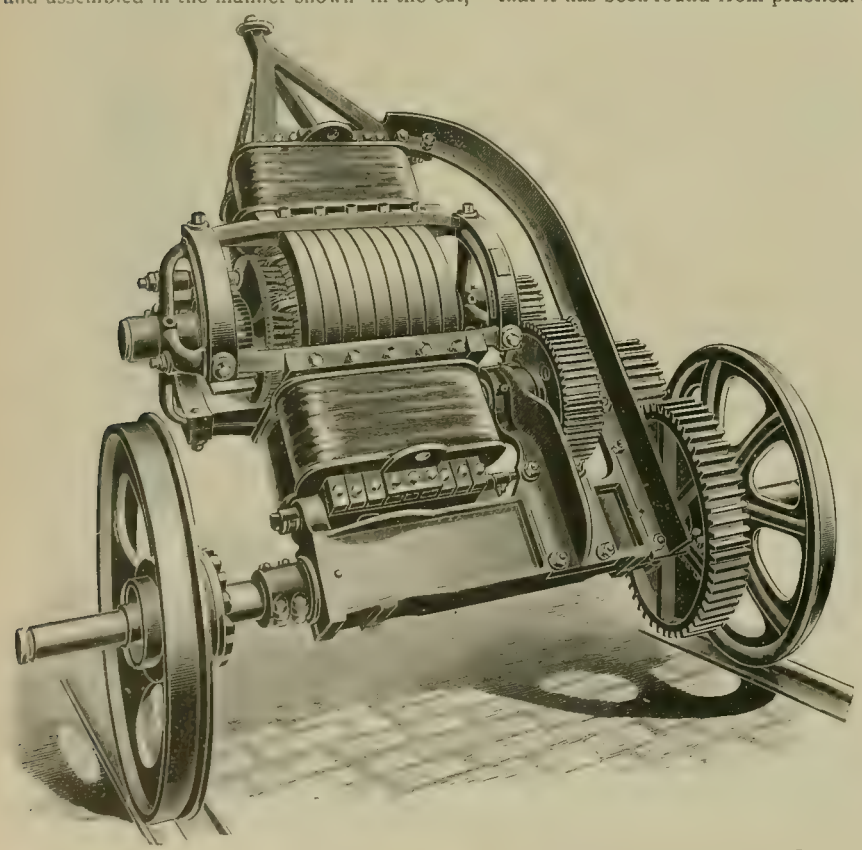
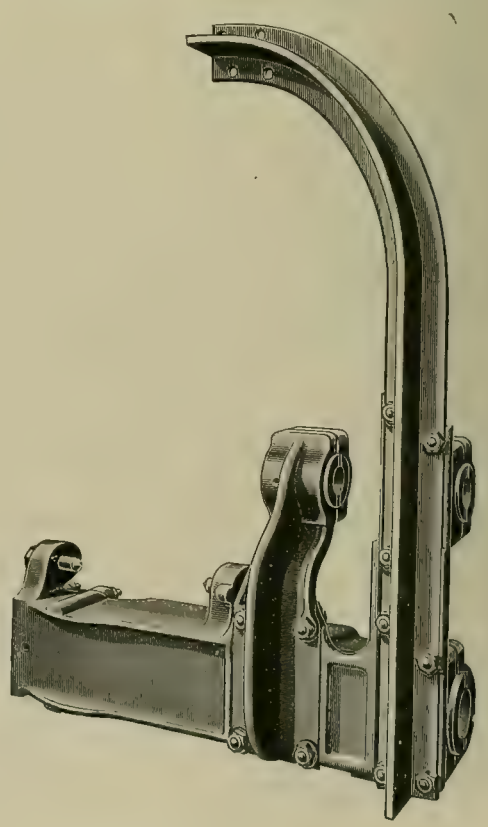


FIG. 2 UNITED ELECTRIC TRACTION COMPANY'S STREET CAR MOTORS. FIG. 4.

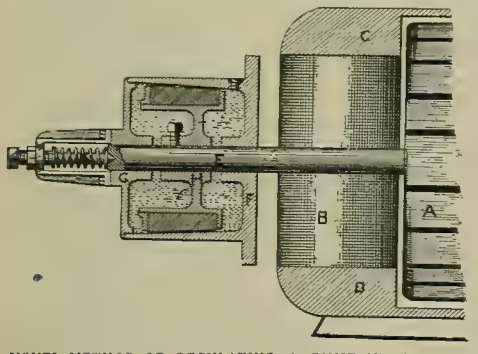


Novel Method of Rgulating a Constant Current Dynamo.

It is well known in the operation of constant current dynamos that the current increases or diminishes with the speed of the armature where the resistance of the circuit remains the same, and that where the resistance varies the strength of the current is constant if the speed of the armature be correspondingly varied. If, therefore, the speed of the armature can be made to change to correspond to variations in the resistance of the circuit the strength of the current generated will be unaffected and remain constant. In the method of regulation here described the inventor, S. E. Nutting of Chicago, varies the speed of the armature to correspond to variations in the resistance of the circuit independently of the speed of the engine.

A diagrammatic representation of the device employed to carry out this idea is given in the figure. An ordinary constant current dynamo in which regulation is obtained by the changing of the strength of the field magnets, is here shown equipped with the regulator. The parts may be described as follows: *A* represents the armature; *B* one of the field coils; *C* one of the poles; *D* the other; and *E* the shaft, to which power is applied for the rotation of the armature. On the end of the shaft which extends

beyond the machine, a pulley *F* is arranged and adapted to receive the belt from the engine. This pulley, however, is mounted loosely on the shaft so as to be rotatable independently. It is made hollow, as shown, and the end next to the machine is provided with a flange to increase the mass of magnetic material capable of being operated on by the magnet field. The other end



NOVEL METHOD OF REGULATING A CONSTANT CURRENT DYNAMO.

of the pulley is provided with a cap *G*, capable of being screwed tightly into place. Within the hollow pulley is arranged a hub *H*, connected to the shaft by a screw-bolt so that the hub and shaft will rotate together. The outer edge of this hub is composed of some material adapted to present a smooth frictional surface. The hollow of the pulley diminishes in size or diameter toward one end, and the exterior of the hub tapers at a corresponding angle. On the end of the cap *G* is arranged a spring *K*, made adjustable by means of a set screw. This spring opposes the attraction of the field magnet for the pulley-shell, and puts it back when sufficiently released from such attraction. In other words, the magnetism of the field tends to move the pulley against the tension of the spring. Now, when the power from the engine is applied to the pulley, causing it to rotate at a constant speed, the hub, together with the shaft and armature, will rotate at the same speed if the frictional contact between the hub and the pulley-shell be sufficiently great. When the dynamo is set in operation the speed of the armature and that of the engine will therefore correspond with each other unless something intervenes to prevent. The magnetism of the field magnet, however, is constantly exerted on the end of the pulley-shell, tending to draw it toward the machine. As this magnetism increases with any increase of the current resulting from a decrease of resistance in the circuit, the pulley-shell will be drawn toward the machine, and to that extent loosen the frictional contact between its interior surface and the frictional surface of the hub. This will cause a "slipping," so to speak, to occur between the pulley-shell and the hub, and thus diminish the speed of the armature. If the resistance of the circuit be increased, however, as by bringing one or more lights into the circuit, the diminished strength of the current

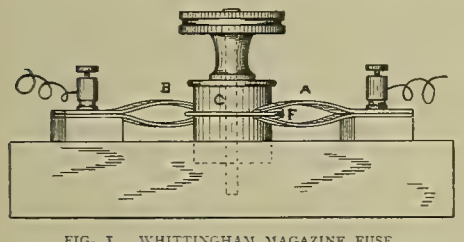


FIG. 1. WHITTINGHAM MAGAZINE FUSE.

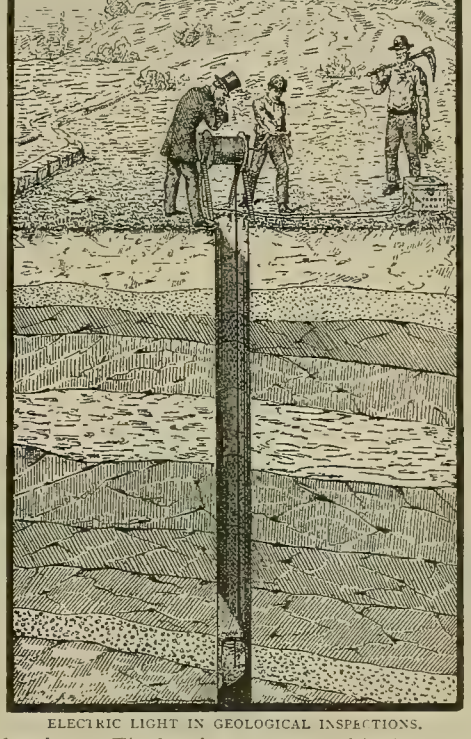
will decrease the strength of the magnetism and allow the spring to move the pulley-shell in the other direction and against the attraction of the magnetic field. This increases the frictional contact and increases the speed of the hub and the armature to correspond to the variation that has been produced in the resistance of the circuit. In this way a constant and practically imperceptible movement of the pulley-shell toward and from the magnetic field will be produced, corresponding to every variation in the resistance of the circuit, and as it moves in the one direction or the other the speed, and consequently the electromotive force, of the armature will be increased or diminished.

The Electric Light in Geological Inspections.

The accompanying cut illustrates a novel and ingenious application of the incandescent electric light in geological work. The device employed is described in *Revue International de L'Electricite* by the inventor, M. G. Trouvé, substantially as follows:

The apparatus, which is called an electric orygmatoscope, is designed for the inspection of geological strata which have been traversed by a boring tool.

The orygmatoscope comprises a powerful incandescent lamp inclosed in a cylinder as shown. One-half of the cylinder forms a reflector and the other, which is made of thick glass, allows the passage of the rays of light. These rays brilliantly illuminate the various strata as the instrument passes them. The bottom of the device is inclined at an angle of 45 degrees, and is an elliptical mirror. The right-hand portion of the top is opened to permit an observer placed at the entrance of the shaft and provided with a strong telescope, to examine in the mirror the image of the layer of rock. The lamp is mounted in such a manner that the rays which it emits toward the top are intercepted. The apparatus is suspended by a long cable made up of two cotton-covered conductors. These conductors are wound on a windlass or drum with insulated



ELECTRIC LIGHT IN GEOLOGICAL INSPECTIONS.

bearings. The bearings connect with the conductor on one side by means of two rubbing springs and on the other with the poles of a Trouve portable battery. This arrangement permits the lowering and raising of the orygmatoscope as desired without trouble and without cutting off the lights and stopping the inspection.

This apparatus at depths of 200 to 300 meters, it is said, gives very good results and it is with the greatest distinctness that the strata of rock are seen and recognized by observers. It must be understood, however, that where the electric light is used nothing hinders the pursuit of an investigation at greater depths, as the scope of the apparatus is limited only by the power of the telescope.

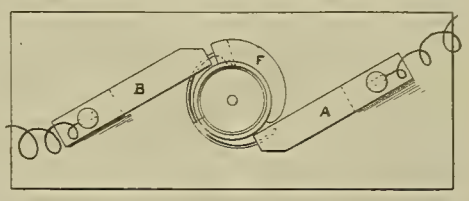
It may be mentioned that an expedition dispatched by the Portuguese government to examine the soil on the shores at Mozambique and to make a report of its richness in useful minerals and especially in coal, is provided with this apparatus. In this work it is understood that this instrument has already given very satisfactory results.

A company has been formed at Puyallup, Wash., with a capital of $35,000 to operate an electric light plant.

The Whittingham Magazine Fuse.

With the ordinary forms of thermal cut-outs in which a fuse is employed, it is necessary as a rule when it is desired to replace a burnt out fuse, to first unscrew a set of clamps, insert a fresh strip and then tighten the clamps again. This operation entails considerable trouble, especially to persons unaccustomed to manipulating electrical apparatus. In the accompanying cuts a thermal cut-out is illustrated, in which the burnt out fuse is replaced by simply turning a knob. The construction will be understood by reference to the lettered parts.

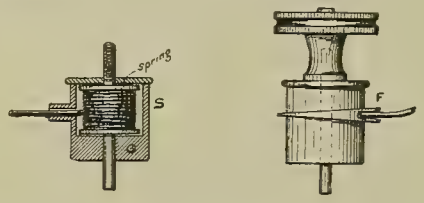
A small non-conducting cylinder *C* carrying



WHITTINGHAM MAGAZINE FUSE.

on its spindle a spool *S* wound with fuse wire and provided on the side with a wedge shaped flange or nib *F*, is pivoted so that the flange may be, by a turn of the thumb screw, forced through first the clip *A* and then the clip *B*.

The operation of the device will now be understood. When it is desired to establish the circuit between the clips the parts being in the position shown in Fig. 1, except that there is no fuse between the clips, the knob is given a half turn. In doing this the sharp end of the wedge shaped flange will enter the first clip, spread its jaws apart, and pass through it. As the thick end of the flange leaves this clip, the spring-jaws come together and catch the end of the fuse, which protrudes from the flange as shown. The clip will thus hold the end of fuse between its jaws. Another half turn of the knob causes the sharp end of the flange to enter between the jaws of the other clip and spread them apart as it passes. The end of the fuse being now held



WHITTINGHAM MAGAZINE FUSE.

by the first clip, is drawn out from the spool as the cylinder is turned. When the second half-revolution of the knob and cylinder are completed, the thick end of the wedge-shaped flange will pass through the jaws of the last mentioned clip, and these will shut upon and clamp the fuse, which protrudes from the thick end of the flange. It is in this way that the fuse connection is established.

The advantage of the device is apparent. When the fuse between the clips is burned, it is only necessary to turn the knob through one-half revolution and a fresh portion of fuse will be supplied between the clips and complete the circuit. This may be continued until all the fuse wire is destroyed. This novel little device is manufactured by the Automatic Switch Company, Baltimore, Md.

Electrical Committee for the World's Fair.

The president of the national commissioners of the World's Fair has announced his committees including that on electricity and electrical appliances, which is composed of the following named commissioners: G. C. Sims, Rhode Island, chairman; C. R. Hopkins, Washington; M. Ryan, North Dakota; G. W. Allen, commissioner-at-large; W. G. Davis, Maine; F. W. Breed, Massachusetts; O. R. Hundley, Alabama; R. R. Price, Kansas.

The Edison company is doing a large amount of foreign business, one of its recent contracts being for the equipment of the St. Johns City Railway company of St. Johns, New Brunswick, which is one of the strongest roads in the Dominion. The contract was closed through John F. Zebley of New York, the president of the road, and the Edison system was determined upon by Mr. Zebley after a most thorough and careful investigation.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Dynamo Room of the Sioux City Electric Company. Illustrated	179
Chicago Telephone Service	179, 180
The Westinghouse Exhibit at the Pittsburgh Exposition. Illustrated	180
Telpher Line at Edinburgh. Illustrated	181
Western Union Poles Chopped Down	181
Northwest Chicago Electric Street Railway Company	181
Corn Cutter Operated by an Electric Motor. Illustrated	181
United Electric Traction Co.'s Street Car Motors. Illustrated	182
Novel Method of Regulating a Constant Current Dynamo. Illustrated	182, 183
The Electric Light in Geological Inspections. Illustrated	183
The Whittingham Magazine Fuse. Illustrated	183
Electric Committee of the World's Fair	183
Editorial	184
New Thomson-Houston Snowplow and Snowsweeper. Illustrated	185
Novel Use of the Telephone	185
Electric Railways at Indianapolis and Joliet. Illustrated	186
Electrical Display at the Pittsburg Exposition	186
The Crocker-Wheeler Motors at Cape May. Illustrated	187
New Edison-Eickemeyer Street Railway Armature	187
Telegraph Operators on the Mackey System Quit Work	187, 188
Telephone Rates in Chicago	188
The British Association	188
Quick Electric Railway Construction	188
DEPARTMENTS.	
Correspondence	188, 189
The Electric Light	189
The Electric Motor	189, 190
The Telephone	190
Electrical Patents	190

"THE demand for electric lighting has increased to such an extent here," says our Pittsburg correspondent, "that now instead of putting gas pipes into newly built houses they are wired for electric lights." This speaks well for the service of the electric lighting companies of Pittsburgh and also for the enterprise of the residents of that city.

THE street railway convention at Buffalo, October 15, 16 and 17, will be largely attended and will be one of the most important conventions of the year to electrical companies. There will be a number of interesting papers presented on electrical railway work. The headquarters of the WESTERN ELECTRICIAN during the convention will be at Parlor F, Iroquois hotel. We will issue two special numbers covering the proceedings of the convention.

AN enterprising hotel keeper at Woodstock, Ont., utilized the telephone during the trial of Birchall, the murderer of Benwell, to satisfy the curiosity of those who were unable to gain admission to the court room. The testimony was transmitted over the wire and a fee of twenty-five cents per hour, charged. The ladies were not overlooked and a private room in the hotel containing four receivers was placed at their disposal for a consideration.

THE Edison company has decided to adopt the Eickemeyer armature as a standard type for railway motors. By the employment of an armature of this design the company claims to overcome the evils which resulted from the necessary bunching of the wires at the end in the old style Siemens' armature. It may be stated, however, that it is not the intention of the company to adopt the Eickemeyer winding in any of the machines except the railway motor. The Siemans' winding has given satisfaction in the lighting dynamos, and this style will still be a standard for such machines. A description of the new railway motor armature is given in this issue.

A NOVEL yet extremely simple application of the electric light for geological inspections is described in another column. A Frenchman has devised a combination of incandescent lamp and mirror which he lowers into a shaft bored down into the earth. The cable supporting the mirror and lamp contains two conductors which connect the lamp with a small portable battery located at the entrance of the shaft. When an inspection is to be made the orygmatoscope, as it is called, is lowered to the required depth, and by the aid of a strong telescope an observer can recognize with great distinctness, the character of the stratum of rock or earth at that point. This application of the electric light in combination with a telescope is suggestive as well as ingenious.

THE street railway war in Milwaukee has attracted considerable attention, the Villard syndicate and a company of local capitalists doing everything in their power to secure control of the streets. The controversy will undoubtedly prove costly to both corporations, as every step is contested in court. No matter how the pending actions result the city of Milwaukee will gain. It will secure a complete system of street railways, all operated by electricity, and each representing the best equipment of the system adopted. All the old lines are being equipped with electrical apparatus and new lines are in course of construction. By May 1st the Cream city will be covered with a network of street railways, all operated by electricity, forming it is claimed, the most complete electric system in the country.

IN this issue a description is given of a passenger telpher line at Edinburgh, Scotland. The line is said to be over a quarter of a mile in length and the cars are constructed after the regulation English style, each having two compartments holding four persons. Whether the electrical engineering company of London, which controls this system, intends to exploit it in the field in competition with the various surface passenger systems, is not stated. In this connection, however, it will be interesting to many to know that in the Weems system in this country, which for a year or two has been experimented with as an electrical system of car propulsion on an elevated structure, it has been decided that where the cars were to be run at a high rate of speed the solid earth was the place for a track. Those who wish to realize something of the nature of the strain on an elevated structure built with curves and carrying cars traveling, comparatively speaking, even at a moderate rate of speed, will find a striking illustration in the ordinary roller coaster. A ride in one of these solid little roller cars as it passes at high speed from the straight length of track into a sharp curve causes a thoughtful passenger to wonder what might happen if the car weighed tons instead of pounds.

THE death of Lineman Kopp in New York and the result of the subsequent investigation proves the necessity of constant vigilance on the part of employes of electric lighting companies. Kopp was considered a first class workman and he understood the dangers attending reckless handling of high tension currents, yet he deliberately neglected to take the first precaution required and he paid the penalty of his carelessness with his life. This is not the first instance, and there is little probability that it will be the last, in which linemen disregarding the terrible warnings of this character have fallen victims to their own recklessness. There was a hue and cry raised in New York when the announcement was made that another lineman had been killed aud even after the facts were presented in the report to the Board of Electrical Control an attempt was made to create a sentiment against the electric lighting companies. Mayor Grant instructed Expert Wheeler to prepare recommendations for safeguards for linemen. This question of protection to employes has occupied considerable attention on the part of electrical companies and has been thoroughly discussed in electrical conventions. Many companies have adopted rules to govern the action of their employes, but it would appear as if it were impossible to impress the necessity of observance on those most directly interested, as the accidents to linemen prove.

THE provisions of the McKinley tariff bill have occupied the attention of manufacturers throughout the country, but it can safely be said that no class has given more attention to the subject than the electrical companies. The representative electrical organizations of the country petitioned congress to remove the tax on copper and in support of this demand presented the names of nearly every one interested in electrical industries. This petition was made without regard to political opinions or parties—protectionists joining with free traders and revenue tariff advocates in opposing the extortion proposed in this McKinley bill. It was recognized by all that the tax imposed upon copper was without justification, and it was accordingly demanded that it be placed on the free list. This was not granted but a material reduction was secured. The duty on copper ores is reduced one cent, old copper for remanufacture 2 cents, copper in plates, bars or ingots not manufactured 2¾ cents. No change was made in the schedule of lead but in zinc the duty on blocks or pigs is raised from 1½ to 1¾ cents, while a reduction of ¼ cent is made on old zinc for manufacture.

The electrical manufacturers of the country will not cease their efforts to secure the removal of the duty on copper and other raw materials employed in the manufacture of electrical devices. The agitation will be continued until recognition of their claims is conceded.

THE telephone fight promised by the Subscribers' company recently formed at Chicago bids fair to dwindle into insignificance as have many former attempts to compete with the Chicago Telephone company. It transpires that the company has not secured control of any telephone system and would undoubtedly be obliged to wait until the expiration of the Bell patents before establishing its exchange. If this new enterprise should commence operations before the expiration of the Bell patent, it was proposed to introduce either the Cushman or D'Unger instrument. An injunction procured by the Bell company prohibits the use of the Cushman telephone in Chicago. Should the D'Unger system be favored by the new company we suggest that each stockholder purchase a copy of the specifications and the drawings of Dr. D'Unger's telephone patent and compare them with the Bell papers before making their investment. We think that it will not require an expert at patent law to discover that the D'Unger receiver is practically a modification of the Bell telephone. In addition to this and granting the new project the use of such instruments and devices as will be public property in 1893 how can it hope to compete with the improved system of the Bell company? The new enterprise would be in the same position the Bell company was when it started, and could not hope to compete with the old company when it had nothing but discarded apparatus. The Bell company is of course preparing for the opposition it will encounter when its fundamental patent expires, and is perfecting its system and adding all the little refinements which its experience has produced. It possesses the experience and controls the ablest engineering skill in its particular department. These are great advantages, as any new company will find.

New Thomson-Houston Snow Plow and Snow Sweeper.

Experience in operating electric railways in winter has demonstrated the fact that some appliance is needed for keeping the tracks as free from snow as possible. That the Thomson-Houston Electric company fully realized this is shown by its action in devising the snow plow and snow sweeper shown in the accompanying illustrations. Last winter's experience showed just what was needed in this direction, and in the new appliances will be found many improvements over the old types. The dimensions of the snow plow are: Length over all, 20 feet; width, 7 feet; height from rail to floor of car, 3 feet 6 inches. The truck has four 36-inch wheels, in front of which is placed a digger which scrapes the snow from the track, thereby securing a good contact for the wheels. These diggers or scrapers, are controlled by levers placed at each end of the car, and may be raised and lowered at will. One of the main plows is placed diagonally across the car, one end being in front of the forward wheel on one side, the other end coming out between the front and rear wheels on the opposite side, at an angle of about 60 degrees. By placing the plow in this manner a position is secured where the least oscillation occurs. Although the plows extend two feet beyond the wheels, each is provided with an extension, by means of which a path of any desired width, depending upon local conditions, can be made. The second main plow is hung parallel to, and in the same manner as the first, each, however, being independent and controlled by levers placed upon the car platform. One or both can be used as the circumstances require. The plows are kept at a proper angle by means of chains and iron rods, so arranged as to permit great freedom of movement in a vertical direction.

THE THOMSON-HOUSTON SNOWPLOW.

The car is propelled by two 20-horse power motors, of the consequent pole type, one being geared to each axle by means of sprocket chains and chain gear wheels, and are capable of propelling a car at a speed of ten miles an hour. The sprocket chains run as slow as possible since the total reduction in speed is made by gears on the motor frames. They are inclosed in iron boxes. In circuit with the motors is placed a reversing switch and rheostat, also placed in a closed iron box. The trolley arm is supported by a post placed in the center of the car platform, and which is also used as a support for a number of incandescent lamps. The car can be operated in either direction.

The car for the snow sweeper is of the same dimensions as that used for the plow, the wheels being 36 inches in diameter, and mounted on a 3½ inch axle. The motors for driving the car are of 15-horse power each, and are entirely independent of the motors used for driving the brushes, being provided with separate reversing switch and rheostat, inclosed in an iron box, and placed on the platform within easy reach of the operator. The motors for operating the brushes are placed on the car platform, with a shaft parallel to that of the broom, and connected to it by means of sprocket chains so as to run at a speed of 200 revolutions per minute. The brushes, which are placed in advance of the truck are two in number, and are made in sections to facilitate removal or changes of any kind.

On the platform of the car on both sides are handles operating clutches by means of which the broom can be thrown in or out of operation. Levers are also provided for raising and lowering the brooms, thereby rendering it possible to operate them at any desired height. To insure the snow being thrown off the track the brooms are set at an angle of 60 degrees to the rail. The electrical connections are the same as found on the passenger cars, the motors for propulsion being connected in multiple, but independently of the motors used for driving the brushes. The current is taken from the overhead conductor by means of a trolley, supported on a post eight feet high placed in the center of the car. Around this post are grouped incandescent lamps which are employed when the car is required for night service. Both the snow plow and sweeper are made for severe work and tests to which they have been submitted indicated that they will meet the requirements for which they were devised.

THE THOMSON-HOUSTON SNOWSWEEPER.

Novel Use of the Telephone.

The most unique use to which the telephone has been adapted is reported from Woodstock, Ont., where the sensational murder trial of Reginald Birchall is in progress. It appears that the courtroom in which the trial is being held is very small and can scarcely accommodate the court attendants, attorneys, reporters and witnesses. The trial naturally excited much interest, and the people from every town in the section gathered to listen to the testimony. They found it impossible to secure admission to the courtroom, but they were afforded an opportunity of listening to the testimony communicated by telephone to "the public house," where twenty receivers were in use throughout the session. A dispatch says: "For several days preparations have been made for this great trial and to-day the scene resembled in a way a great political convention. Several wires of the Great Northwestern Telegraph company had been run into the building and a number of operators were seated in front of their instruments at a table in the rear of the court. At the reporters' table were representatives of several London newspapers and correspondents of leading journals in the Dominion and the United States. On the wall over the judge's head was the large receiver of a telephone. It had been placed there by an enterprising public house keeper and was connected with twenty instruments at his place of business. He knew the court-room could accommodate only a few of those who were anxious to listen to the testimony, and so his house caught the overflow, and all day long men took turns listening to what came over the wires."

The intetest in the trial increased as it progressed. A telegram from Woodstock on the third day of the trial announced that the telephone transmitters that hang over the heads of the counsel and his lordship worked all day yesterday. The wires run to a hotel, where the tubes are rented at twenty-five cents an hour. There are also four tubes in a private room for ladies. All of them were busy all day yesterday, and every word that was said in court leaked into the ears of the listeners in the hotel.

Electric Railways at Indianapolis and Joliet.

The accompanying cuts illustrate the Thomson-Houston Electric Railway systems at Indianapolis and Joliet.

Fig. 1 is a view of the Citizens Street Railway, Indianapolis, which has been in operation since June 8th. It is one of the finest constructed electric railways in the country. The center pole double bracket construction has been used throughout. The poles are made of heavy iron pipe with fancy bracket and arm attached to each side of the pole, extending over the center of each track to support the trolley wire. This construction runs through the business portion of the city, and is considered one of the finest overhead lines for railway work that has been built. On this line are a number of difficult curves which required considerable engineering skill to conform the overhead wire to the line of track. The company at present operates ten motor cars, equipped with the fifteen horse power motors, and each motor car at all times hauling a trail car. The traffic on the road since starting has been larger than the most sanguine had anticipated, and has been in operation without the slightest delay or trouble. The cars were manufactured by the St. Louis Car company, of St. Louis, Mo. The power station is equipped with one 250 horse power Wheelock engine, Corliss type, and one 500 horse power Hazelton boiler. Natural gas is used instead of coal. Two thirty horse power Thomson-Houston generators are installed in this station, together with an elaborate marble switch-board which has upon it circuit breakers, ampere meters, voltmeters, switches, rheostats and potential boards taken altogether it is one of the most complete stations which has been equipped in this country. The Thomson-Houston Electric company is at present building one large electric snowsweeper for this railway, which will be used to remove the snow from their tracks during the winter months.

The Joliet Electric Street Railway company, which has adopted the Thomson-Houston electric railway system, completed the electrical equipment of its road and put it in operation on February 3d. It is four miles in length, and part of it is built with bracket suspension, and the remainder with the cross suspension method. The overhead line is built upon thirty feet cedar poles, tastefully painted. It has a number of difficult curves, crossings and switches, for which the overhead line is arranged, and since starting it has had an exceedingly heavy traffic, but has been in constant operation without the slightest delay or trouble. The company is at present operating nine motor cars, each equipped with two 10 horse power railway motors. The power station is equipped with two 80 horse power Thomson-Houston generators, with switch-board fitted with all the necessary appliances. The management of this road is so well pleased with its operation that it has placed orders with the Thomson-Houston electric company for additional equipment. It is remarked by the citizens of Joliet, that the Joliet Electric Railway company's cars are "always on time," and the patrons of the road are pleased with the efficient service.

FIG. 1. ELECTRIC STREET RAILWAY AT INDIANAPOLIS.

Electrical Display at the Pittsburg Exhibition.

Apart from the unique position occupied by the Westinghouse Electric Manufacturing company's exhibit in the Pittsburg Exhibition building, electricity generally has done a great deal to enhance the attractiveness of all other displays. In fact, were it not for the illumination of the buildings by arc and incandescent lamps the show would lose a great deal of its regal splendor. Except the lights used by the exhibiting electric companies in their displays, all the lighting is done by the Allegheny County Light company, the largest electric lighting corporation in Western Pennsylvania. This company has now a capacity of 35,000 incandescent lamps and 1,000 arc lamps, and is even now increasing its capacity at the rate of 1,000 lights per month.

The exposition buildings—there are two of them, Mechanical Hall and Main Hall—are lighted by 1,700 incandescent and sixty three arc lamps. The buildings are about one mile away from the Central Station plant and the current is carried over an o-wire. The company operates the Westinghouse alternating current system. The wiring of the buildings was done by the North American Construction company. Since the opening day of the exposition there has never been the least trouble with the lights.

Opposite the Westinghouse exhibit on the other side of the entrance to Mechanical Hall the Thomson-Houston company of Lynn, Mass., has also an extensive display. This has been arranged by the local agents of that company, Messrs. Hughes and Hawthrop, and these gentlemen have certainly endeavored to make the best show of the apparatus their company manufactures. They have several direct current dynamos, one of 450 light capacity. In the exhibit is also a 650 light alternating dynamo and a 35 light arc dynamo. The space occupied by the company's display is decorated with a peculiar assortment of flags, which renders the entire exhibit very conspicuous. There is also a large variety of motors in the exhiblt, all operated by a 30-horse power motor generator. A number of the motors are attached to fans, others to ventilators, another again to an ice cream machine. and one to a cider press.

The company expects to have a number of electric welding maehines on exhibition very shortly, and the process of welding by electricity will then be explained to the visitors by one of the electricians of the company.

The Westinghouse Electric & Manufacturing company is now adding to its handsome exhibit one of its street car motors. It is one of the latest pattern, known in Pittsburg as the "Noiseless" motor.

The R. D. Nuttall Manufacturing company is exhibiting W. H. Emmet's street car trolley.

The Standard Underground Cable company of Pittsburg has a full display of all the different wires and cables manufactured by the company.

FIG. 2. ELECTRIC STREET RAILWAY AT JOLIET.

The Crocker-Wheeler Motors at Cape May.

The Crocker-Wheeler company had a large exhibit of motors of their "Perfected" type at Cape May during the electric light convention. The machines were arranged upon a large table under a canopy bearing their trademark, "Perfected Motors." The accompanying cut illustrates the exhibit.

At the right of the table was a ½-horse power arc motor connected by compound gearing to a triplex pressure pump, capable of forcing water to a height of 200 feet, with power suitable to a 6-½ or "½-arc" circuit. The pinion on the motor was keyed on, and yet was carefully insulated from the shaft and was provided with flanges on one side faced with insulating material so that no electrical connection could be formed between the pump and the motor. The motor was bolted to a wooden base which was fastened to the base casting of the pump.

Next to this were samples of the ½ and 1-horse power arc machines, 10 amperes, with their new automatic speed governor, by means of which the speed is controlled within twenty-five revolutions, without the use of any switch or connections of any kind with the field energizing coil. Samples of the governor taken apart were also shown. This governor is contained entirely within the driving pulley, where it is concealed from view, and protected from dust aud all injury. By means of the Crocker-Wheeler governor the regulation of their motors is attained by purely mechanical means, there being no connection between it and the circuit. This has the advantage of simplicity, and as it is purely mechanical it is easily understood and can be repaired by any machinist or janitor.

CROCKER-WHEELER MOTORS AT CAPE MAY.

A 1-6 horse power pump outfit was also exhibited. This consists of a very small triple cylinder pressure pump with a 1-6 horse power constant speed motor belted to it. This little motor has a sufficient power to run the pump for any height of pumping lift and may be wound for any electric light circuit. It has a capacity of lifting 1,000 gallons of water per day 100 feet, and other quantities at correspondingly greater or less height. These outfits are made by the Crocker-Wheeler company in all sizes. In the larger sizes the motor is usually geared firmly to the pump. The larger sizes, 3 and 5-horse power and upward are used for elevators, large tanks, fire purposes, etc.

In the center of the table was exhibited a number of small motors of 1-6 and ⅛ horse power, one being mounted on a little stand, and carrying a miniature cast iron pulley with crowning face and flanges, being in every respect a perfect miniature of the regulation dynamo. Others were fitted with 12 and 16 inch fans of polished brass or nickel, some with and some without wire guards. These guards are very neat in construction, being carefully designed and held in place by a neat brass casting with slender arms which reach out and grasp the rim of the fan guard bracing it firmly from the top of the motor. The construction of these little motors deserves a little attention. They are all regulated by a switch attached to one pole piece which controls the flow of current to the armature and to the field, and includes a spring coil built in the machine for starting the armature slowly. The brushes are held in miniature brush holders, which have a steel spring tension and are carried upon a rocking arm capable of making a complete revolution about the commutator. This enables the motor to be reversed without a switch, or without rearranging the brushes. The bearings are self-oiling, the oil being contained in a well at the bottom of a pillow block, whence it is carried to the shaft by a ring revolving upon it. The bearings are swung upon ball joints set in babbit metal so that they align themselves perfectly when the shaft is introduced. When the oil has become gritty it is drawn off from an outlet covered by a thumb screw at the base of the pillow block, and fresh oil is poured in at the top. The capacity of the motor, the volts and amperes required, etc., are given on the name plate on the top, and the size of wire and the number of turns to each section of the armature are stamped on the face plate which supports the armature, so that every motor turned out by this company carries the full information as to its capacity, requirements, etc.

New Edison-Eickemeyer Street Railway Armature.

A radical change in railway motor construction which has recently been made is announced this week by the Edison General Electric company which has secured the use for its railway system of the Eickemeyer patents for winding armatures. It will be remembered that the Eickemeyer dynamo for lighting purposes was brought out about two years ago. Since that time it has been actively exploited, and it is claimed that not a single dynamo armature wound on the Eickemeyer plan has burnt out.

The armatures now in general use on Edison railways are wound on what is known as the Siemens system, which has proved entirely suitable for dynamo work, but has some disadvantages in railway motor construction. In Siemens' armatures the wire is so wound that when completed there is an irregular cone-shaped mass of wires at the end with more or less motion among themselves. The experience of the Edison company has been that this motion has a tendency to abrade the insulation of the wires, causing short circuits of adjacent coils which may carry the maximum difference of pressure generated by the armature, and resulting in burn outs. Moreover, as the wire is wound in two complete layers, where burn-outs occur on the under, the expense of repairing usually amounts to nearly as much as that of rewinding the entire armature.

The Eickemeyer system of winding is radically different from the Siemens. Each armature coil is wound upon a form of peculiar construction, and is interchangeable in every respect. In building an armature originally, the laminated iron core is first prepared as in the Siemens armature, and upon this are loosely placed the necessary number of standard coils which are locked in place around the armature by means of the wooden pegs.

The result is a square end, both front and rear, instead of the cone-shaped end of the Siemens armature. The coils are held fiimly in place, and there is no mechanical pressure from coil to coil which would tend to cause short circuit. The armatures are necessarily of standard diameter and interchangeable, and it is claimed that the Eickemeyer armature will never burn out except from dead over-load causing melting of the wire, from accidental mechanical injuries, or from short circuit due to outside causes. If, however, an armature coil should burn out from any of the causes mentioned it could be replaced without difficulty by any ordinary mechanic and without returning to the factory, the whole operation consuming about a day's time, and a small amount of material. Railway companies would be provided with a sufficient number of standard coils held in reserve.

It is the belief of the Edison company that one of the most serious difficulties that has been met with in electric railway work is overcome by the adoption of this armature.

Telegraph Operators in the Mackey System Quit Work.

The announcement was made last week that a strike had been ordered among the telegraph operators on the Mackey system. The origin of the report seems to have been some local trouble between the railway operators at Terre Haute, Ind., and a few other unimportant points. A despatch from Terre Haute says: "Some time ago a federation was formed of a number of operators and clerks employed on the Mackey lines with a view of demanding an increase of pay. It is said that the intention was to demand increased pay, but learning that A. D. Sears, the secretary, had been discharged, the men decided to strike at once. A demand was made on the company for his reinstatement and an increase of pay, about 15 per cent. The company's officials replied that the matter had to be taken under advisement, and last night the men struck. President Hopkins telegraphed to the men on the Evansville and Terre Haute and Evansville and Indianapolis lines to go to work pending a conference to be held with General Manager Saul at Evansville within a week. The company claims that Sears was not discharged because of his membership in the federation, but for other good reasons, and the men assert the contrary. The strike caused some delay in the handling of freight but the passenger service on the road on which the operators were engaged was not impaired."

Another dispatch from Peoria, Ill., says: "The strike on the Mackey system did not affect Peoria. A few men went out at the way stations on the Peoria, Decatur and Evansville road, several at Pekin, and trains for a time were run wild."

St. Louis was one of the points affected by the trouble. A dispatch from that city says: "E. A. Smith, an officer of the Order of Railroad Telegraphers, was asked last evening regarding the strike reported yesterday of the operators on the Mackey system, and replied that the Order of Railway Telegraphers had nothing to do with the strike. All members of the Order of Railroad Telegraphers who are not employed on the Mackey lines," said Mr. Smith, "received messages yesterday morning requesting them to take no part in the strike. The strike was managed entirely by those employed on the Mackey lines, and so far as I am informed, the strike was general.

"At East St. Louis there are three or four operators employed by the Mackey line, and they left their instruments at 7 A. M., when those on the day watch went to work. They resumed work at noon, however, as the company granted their demands in full, which was for increased wages and a promise to employ only competent men.

"Trains are said to have been delayed somewhat by the strike, but, owing to the short time that it was in progress, the train service on the lines was not seriously impaired.

"The wages of the operators," said Mr. Smith, "have been cut down by the action of the telegraph schools. The managers take their pupils to the railroad managers with the request that they may practice on their lines until they become competent operators. They work for nothing until they become expert in the use of the instruments, when they usually offer to do the work at a certain station at $10 a month less than the operator is being paid for it. The wages are not uniform, but are graduated according to the amount of work that is to be done at each place.

"Mr. Smith estimates the number of persons participating in the strike yesterday at over 200.

"The lines affected were the Chicago &

Eastern Illinois, the Evansville & Terre Haute, the Chicago & Indiana Coal Railroad, the Peoria, Decatur & Evansville, and the Louisville, Evansville & St. Louis consolidated."

Telephone Rates in Chicago.

The agitation for a uniform rate of telephone charges in Chicago is at an end. The city council recently instructed the corporation counsel to prepare an opinion on the subject and he has reported in favor of the telephone company. It appears that the complaints came from the recently annexed districts. The telephone company secured its franchises in these districts before they were annexed to Chicago and the provisions of the grant cannot now be altered by the city council. Therefore the present rates in these districts will prevail.

The British Association.

In his address before the British association at Leeds, Sir Frederick A. Bell, the president, said in the course of his remarks:

Among the branches of science in the practical applications of which the greatest strides have been made since the association met at Leeds, in 1858, is electricity. That year witnessed the accomplishment of the first great step toward the establishment of electrical communication between Europe and America, by the laying of a telegraph cable connecting Newfoundland with Valencia. Through this cable a message of thirty-one words was shortly afterward transmitted in thirty-five minutes, an achievement which, though exciting great enthusiasm at the time, scarcely afforded promise of the succession of triumphs of ocean telegraphy which have since surpassed the wildest dreams of the pioneers in the realms of applied electricity. * * * How remarkable the strides have been in the resources and powers of the telegraphist since that time (1837) is demonstrated by a few such facts as these: The first needle instrument of Cooke and Wheatstone transmitted messages at the rate of four words per minute, requiring five wires for that purpose; six messages are now conveyed by one single wire, at ten times that speed, and news is dispatched at the rate of 600 words per minute. Duplex working, which more than doubled the transmitting power of a submarine cable, was soon eclipsed by the application of Edison's quadruplex working, which has in its turn been surpassed by the multiplex system, whereby six messages may be sent independently, in either direction, on one wire. When last the British association met in Leeds, submarine telegraphy had but just started into existence; thirty years later, the accomplished president of the mechanical section informed us, at our meeting at Bath, that 110,000 miles of cable had been laid by British ships, and that a fleet of nearly forty ships was occupied in various oceans in maintaining existing cables and laying new ones.

Touching upon the subject of electric light he said: While the prediction made by Siemens, eight years ago, that electric lighting must take its place with us as a public illuminant, has thus been already, in a measure, fulfilled, important progress is being continuously made by the practical electrician in developing and perfecting the arrangements for the generation of the supply, its efficient distribution from centers, and its delivery to the consumer in a form in which it can be safely and conveniently dealt with and applied at an outlay which, even now, does not preclude a considerable section of the public from enjoying the decided advantages presented by electric lighting over illumination by coal gas. Yet our recent progress in this direction, encouraging though it has been, is insignificant as compared with the strides made in the application of electric lighting in the United States, as may be gauged by the fact that, while in America the number of arc lamps in use, in April of this year, was 235,000, and of glow-lamps about three millions, there are at present about one-tenth the number of the latter, and one-hundredth the number of arc lamps, in operation in England.

The development of telephony is thus described: The operations of the National Telephone company well illustrate our progress in telephonic inter-communication; that company has now 22,743 exchange lines, besides nearly 5,000 private lines, its exchanges numbering 272, and its call offices 526. The number of instruments under rental in England has now reached 99,000; but, important as this figure is, compared to our use of the telephone a very few years ago, it sinks into insignificance by the side of the number of instruments under rental in America, which at the beginning of the present year had reached 222,430, being an increase of 16,675 over the number in 1889. Only thirteen years have elapsed since the telephone was first exhibited as a practically workable apparatus to members of the British association at the Plymouth meeting, and the number of instruments now at work throughout the world may be estimated as considerably exceeding a million.

A large contract for station equipment has been made with the Edison General Electric company by Thomas Lowry, president of the St. Paul and Minneapolis Railway systems. It will be remembered that early in the year Mr. Lowry placed with the Edison company the largest single contract for railway apparatus which has ever been given to a railway company, calling for over 7,000 horse power of electrical apparatus. The contract just closed provides for fifteen Edison dynamos of 150,000 watts (300 h. p.) each, and twenty cars for use between St. Paul and Minneapolis, the latter being required to make a speed of twenty-five miles an hour.

Quick Electric Railway Construction.

A remarkable feat of electrical railway construction at Elmira, N. Y., was recently referred to in these columns. On the 30th of July the Elmira & Horseheads Railway company placed a contract with the Edison General Electric company for the equipment of 7,000 feet of track, six motor cars, and a full station equipment. At the same time a contract was placed with the John Stephenson Car company for six new cars of solid and elegant construction. The contracts were made in both cases with the strong guarantee to the effect that the road should go into operation on the first day of September in order to accommodate the great Inter-state Fair which was to be open on that day. A full history of the efforts made by both companies to fulfill the guarantee would be interesting reading, as it called for the quickest time ever made in electrical railway construction. Both the Edison company and the Stephenson company put their best men upon the work and forwarded supplies with the utmost possible dispatch. On or about the fifteenth day of August the Stephenson company informed the Edison company that its cars were ready for equipment, and at about the same time the motors were shipped from the great Schenectady Works of the Edison company, which have a capacity of from fifteen to twenty street car motors per day. The strike on the New York Central at this time bid fair to cause very serious delays, as the cars were to be equipped in New York. A special consultation of the Edison company and the Stephenson company was held at Schenectady with the result of causing the motors to be shipped via the Delaware & Hudson R. R. and the D. L. & W. R. R. companies, a round-about route which necessitated special cars and unusual expedition. On about the twentieth of August the completed cars began to go out from the Stephenson factory, two being shipped each day. In the meantime a contract had been placed with the Simplex company of Boston for the feed wire, the Edison company had forwarded all line material and supplies, and everything was on the ground but the poles, which were held in Northern New York awaiting arrival of cars which had been delayed on account of the New York Central strike. In this emergency every one turned in to help. Poles were gathered about Elmira and at 12 o'clock on the night of August 23, the street construction work commenced. Provision for the dynamos and appliances had been made by engaging a part of the Westinghouse station at Elmira. On August 31 notice was sent to the railway company that the road would commence operations on the following morning, and promptly at 6 A. M. on the first day of September the road carried its first passengers. For the next few days the tests of the machinery were excessive, the cars frequently having to carry two loaded trailers, and to remain in service from early morning until late at night. The largest number of passengers carried by these electric cars with their complement of trail cars was a little over 25,000. The road was entirely satisfactory in every respect and Col. Robinson and I. B. Newton & Co., the present owners of the road, have every reason to be grateful to both the Stephenson and the Edison companies.

CORRESPONDENCE.

New York Notes.

NEW YORK, Sept. 27.—The Board of Electrical Control adjourned indefinitely without adjusting the subway rental matter. This is a gross injustice to the electric light companies. It is claimed that the rental of $300 a mile will insure a dividend of 10 per cent. to the stockholders of the subway company, but the subway company is not satisfied with this, and demands $1,000 per mile. The failure of the board to adjust the difficulties is seriously commented upon by the daily papers, Mayor Grant coming in for a good share of their attention.

The work of repaving Broadway is in progress, and will be pushed ahead as rapidly as possible. Commissioner Gilroy has served notice upon parties intending to renew or construct works under Broadway, that they must do it now when the repaving of the street is in progress, as under no circumstances will the tearing up of the street be permitted for some years after the new pavement is laid. The subway companies have signified an intention to put down some more conduits.

A committee of three aldermen was appointed by the Jersey City council to wait upon the officials of the Jersey City & Bergen Railway company and protest against the failure of the company in extending its railway system to the ferry. On account of the inconvenience of a change of cars at Monmouth street, the company is urged to complete its new system.

It is claimed that franchises are granted without sufficient consideration in Jersey City, and the mayor has decided to exercise his veto power in two cases, both of which affect the electrical interests. Both companies proposed to erect electric lighting plants, and the council granted the desired authority. The mayor, however, vetoed both measures and astonished the aldermen and people by announcing that the city had already three electric lighting companies, and he considered that number sufficient. This is certainly a remarkable position for a city official to assume.

Michael Fitzpatrick of 214 East Twenty-fifth street, a lineman for the Metropolitan Telephone company, while repairing telephone wires on a pole on Fifth avenue, touched a wire supposed to be dead but which proved to be alive. The shock knocked him from the pole into the street. He has sufficiently recovered to tell his experience. He says he suffered excruciating torture. Fitzpatrick is either particularly unfortunate or careless in the handling of electric wires, his experience of last week being the third time he has been knocked off a pole by a shock. On Aug. 2 he was knocked from a pole and was laid up for three weeks. He had been to work but a week when he was again knocked off a pole at Bowery and Third street.

The following named applicants for membership were admitted at the last meeting of the American Institute of Electrical Engineers: Alfred E. Braddell, Philadelphia, Pa.; William B. Knight, Kansas City, Mo.; William B. Keen, New York; Robert B. Faber, New Bedford, Mass.; H. K. M. Clay, Birmingham, Ala; S. D. Nesmuth, Cleveland, O.; Charles Hewitt, Brooklyn, N. Y.; Samuel Rodman, Jr., U. S. A.; Francis Forbes, New York; William B. Tobey, Ithaca, N. Y.; Osburn P. Loomis, Brooklyn, N. Y.; Alfred E. Woolf, New York City; George F. Atwood, Orange, N. J.; Harold Binney, New York City; H. St. Clair Putnam, Fremont, O.; Frederick A. C. Perrine, Trenton, N. J.; Ernest Merritt, Ithaca, N. Y.; William P. Hall, New York City. W. H. T.

Pittsburgh, Pa.

PITTSBURGH, Sept. 27.—The Westinghouse company is again pressed for room at its shops on Garrison Alley in this city, and several changes are being made to enlarge the company's facilities. The armature department, which was formerly on the ground floor of the main building on Duquesne Way, has been removed to the fourth story of the detail department on Garrison Alley. This change had to be made in order to afford additional space for the electric motor and dynamo departments, on account of the increase in that kind of work.

The East End Electric Light company of this city operating a Westinghouse Alternating Current plant of 18,000 incandescent and about 506 arc lamps, is again confronted with the necessity of making large improvements in its plant. The demand for electric lighting has increased to such an extent here that now instead of putting the gas pipes into newly built houses they are wired for electric lights. The company's business increases at the rate of 1,250 lights per month, and within six months the company expects to have a capacity of 25,000 incandescent lights. The Pennsylvania Railroad company has lately given the East End Electric company the contract to light up all the signal boxes along the railroad from Braddock to Pittsburgh. E. H. H.

Milwaukee, Wis.

MILWAUKEE, Sept. 27.—The common council has instructed the board of public works to advertise for new bids for electric street lights. The contract will expire on December 1, and it will take all of six weeks to go through the red tape proceedings necessary to secure new bids. The Badger Illuminating company, which has the contract now, made a determined effort to get the new contract, on the ground that it was the lowest bidder, but it was beaten at every point. After the city attorney had decided that the former proceedings were illegal, the company made the claim that the common council could award the contract without calling for any bids, but the city attorney again interposed his objections and the company had to submit. The Badger people, of course, will put in a new bid when the time comes but the new bid will not differ materially from the old one, which was $112.50 per lamp per annum for the whole city. The Milwaukee Light & Power company will try to get the contract for lighting the streets in the northern section of the city and nothing more. The officers of the company believe that in the portion of the city surrounding their plant they can furnish lights cheaper than the Badger company and they are hopeful of getting a slice of the contract. They have no arc plant at present. They declare that they are in a position to put in an arc plant on very short notice, but will not state what system they have secured. The general opinion is that the contract will be divided.

There is now some prospect of the street railway fight coming up in the court for determination. The Villard people did not want the questions involved decided by Judge Johnson, before whom the Pfister people brought its injunction suits, and the Pfister people on the other hand, would have abandoned the cases rather than have had them decided by Judge Gilson, in whose court the Villard suits were commenced. After considerable balk and delay a compromise was finally agreed upon and Circuit Judge Winslow or Circuit Judge Sloan will be called in from the interior of the state to try the cases.

The Villard company's project of building a line on the National avenue road from the city limits, where their present line ends, to the Soldiers' Home, has met with an unexpected set-back. The thoroughfare is a plank road and

is controlled by a toll company, organized under a very old charter. The franchise for the street railway extension was granted by the town supervisors. The plank road company presents its claim that it has the exclusive franchise and claps an injunction on the railway people. The result will undoubtedly be that the extension will not be completed until next season.

A sale within a few months of the Milwaukee Electric railway, owned by Hinsey of Milwaukee and Hinckley of Chicago, to the Milwaukee & Whitefish Bay Railway company, which is the Villard syndicate's most formidable rival, need not surprise anybody. The sale would have occurred sooner but for the large price asked for the Hinsey line. However, Hinsey and Hinckley continue to disagree and are not pleased with the financial part of the street railway business, so that they are very likely to lower their price.

Kansas City, Mo.

KANSAS CITY, Sept. 27.—The work of establishing a telegraphers' union is once more on foot and the projected organization will include both railroad and commercial telegraph operators. Since the great strike in 1883 there has been no powerful telegraph union. The failure of that movement demoralized the operators throughout the country. The railroad telegraphers have had an organization, protective and benevolent in character, opposed to strikes it was claimed, yet it was considered antagonistic to the interests of the roads and was therefore fought by the railroad corporations. Many of the leaders refusing to leave the organization were dismissed from service on account of their connection with the body. The association could not protect itself as it was opposed to strikes and it soon began to lose its influence. Former members of that organization are now in this city enrolling their fellow operators in a new organization which shall include both commercial and railroad men. The Brotherhood of Telegraphers, as the new organization is termed, announce that it shall be benevolent and protective in character, but its scope will not be limited to this field. It will perfect an organization if possible that will enable it to demand recognition from the corporations, and where arbitration fails or is denied them in their disputes they will use sterner means of securing their demands. The organization has been branching out considerably. Kansas City now has a lodge numbering over 100 members; St. Louis, organized less than thirty days ago, has 200; Chicago nearly 300, while New York is rapidly nearing the 1,000 mark.

The organizers for this section were in Omaha last week, and succeeded in interesting about eighty telegraphers, who will m et this week to organize. These organizers are E. L. Randall of Kansas City, and F. L. Palmer of St. Joseph. Mr. Randall was the original founder of the Order of Railroad Telegraphers, and was discharged and blacklisted by the Rock Island railroad for the part he took in the matter. Mr. Randall worked for the Order of Railroad Telegraphers until he saw it was bound to be a hopeless organization, and then he joined hands with the Brotherhood of Telegraphers.

The Missouri and Kansas Telephone company has been granted a ten years' franchise to operate a line in Kansas City, Kan. No exchange will be built there, but the telephones will be connected with the Kansas City, Mo., boards. A provision included in the franchise states the Kansas City, Kan., applicants shall be put on an equal footing with those from Kansas City, Mo., and that they shall have telephones put in in the order of their application.

The Inter-state Water & Electric River company of Kansas City, Kan, is preparing to proceed with condemnation against riparian owners to obtain rights to land abutting on the Kansas River from the proposed site of the company's dam, a short distance west of the city limits, to Bonner Springs. The company has been busily engaged for some time in securing contracts from property owners awarding it riparian rights. In the case of ten or fifteen property owners they have failed or the owners have demanded conditions which are less favorable to the company than in its opinion it can secure by condemnation proceedings.

The electric light fight in the city of Rosedale, Kan., is by no means settled. Ever since the Consolidated Electric Light & Power company of Kansas City, Kan. got its franchise from the city of Rosedale there has been a bitter opposition on the part of many citizens. A short time ago the city council refused to allow the bill of the electric light company of $214 for lights furnished, whereupon the electric light company brought suit in the circuit court to collect the money. The council disallowed the company's claim because it was brought forcibly to the city fathers' notice that the lights were not up to contract, which provides that the incandescent street lamps shall be of 25-candle power. It is claimed, moreover, that the lights furnished are but 14 or 15-candle power. The light company's suit will be contested. P.

THE ELECTRIC LIGHT.

An electric light plant will be installed at Stanley, Va.

The Louisiana Electric Light company will enlarge and improve its plant at New Orleans.

The Excelsior Manufacturing company, Washington, Ga., will install an electric light plant.

The Charleston, S. C., Electric Light company contemplates the erection of a new power house.

The city of LaGrange Ga., will issue bonds for $50,000 to enable it to erect an electric light plant.

An increase in the capital stock of the Citizens' Electric Light & Power company, Covington, Ky., to $100,000, has been authorized.

Buena Vista, Ga., wants an electric light plant for public uses, and the legislature will be petitioned to authorize the issuance of the necessary bonds.

The Hamburgh, N Y., Water & Electric Light company will probably purchase an electric light plant soon. The power house is now finished.

The Spartanburg, S. C., Gas, Electric Light & Power company contemplates increasing its capital stock to $75,000 to make extensive improvements.

The Citizens' Electric Light & Power company of Houston, Tex., has increased its capital stock $50,000, it is said, to enable it to make extensive improvements.

The River Forest Water Gas & Electric Light company has been incorporated at Springfield, Ill., with a capital of $15 000 by H. E. Broughton, F. C Smith and others.

The People's Light, Heat & Power company of Asheville, N. C , has awarded a contract to the National Electric Light company of Eau Claire, Wis., for a $40,000 electric light plant.

P. B. Bibb, W. H. Gesner, C. G. Abercrombie and others have incorporated the Ball Light & Power company for the purpose of erecting an electric light and power plant at Montgomery, Ala.

A feature of the festivities at the Sioux City Corn Palace this year will be the street parades at night. The handsomely decorated floats will be illuminated by electric light, operated by storage batteries.

Electric light plants are proposed at Springfield, Vt.; Glasgow, Va ; Tacoma, Va.; Buena Vista, Ga.; Hawkinsville, Ga.; Piedmont, Ala.; Greencastle, Ind.; Sandwich, Ill., Howell, Mich.; Cherokee, Ia.; Georgetown, Colo.; Sanger, Cal.; Walla Walla, Wash.

The Pine Bluff Water & Light company, Pine Bluff, Ark., has just completed a successful year of incandescent lighting for street and residence purposes. The system in use is that of the Thomson-Houston Electric company. Three circuits are in operation, each consisting of forty 25 candle power lamps in series on a 1,000 volt alternating current circuit. This plant is the first of the kind installed in the Southwest it is claimed The success which attended the operation of the plant will undoubtedly induce others to follow in the same line.

THE ELECTRIC MOTOR.

The United Electric Railway company of Memphis, Tenn., will, it is reported, erect a new power house.

Articles of incorporation of the Pacific Wenstrom Electric Railway company have been filed in San Francisco.

The lines of the electric railway at Amsterdam, N. Y., will probably be extended as far as Hagaman's Mills and Akin.

The Sacramento trustees have passed the ordinance granting permission to use the overhead electric system on the Central Street railroad.

Electric railways are proposed at Baltimore, Md., Petersburg, Va , Newport, Ky., Sioux City, Ia., Rockport, Tex., Dallas, Tex. and Corvallis, Wash.

The Peninsular Electric Railway company has been formed in Tacoma, Wash. It is reported that it will introduce the Thomson-Houston company's system.

The Westinghouse company has received the contract for the Flushing, N. Y. and College Point Electric Railway. The work must be completed by the middle of December, or the contract will be forfeited.

Earle's shipyards at Hull, Eng., are using electric drills on 2⅝ inch holes through 2½ inch steel decks. The royal dockyard at Devenport allows 2 men half a day to drill holes that are electrically finished in 21 minutes at Hull.

A dispatch from Alton, Ill., says: "Messrs. Rodgers and Donnavan, representing the Holmes street railway syndicate, have secured an option on the two street railroads between Alton and Upper Alton. If they conclude to purchase they will also build a road to North Alton, and operate all three by electricity."

The following recent incorporations are reported: Delphos, O., Electric Light & Power company; capital stock, $40,000. Citizens' Electric Light & Power company; Houston, Tex.; capital stock, $50,000. Howell, Mich., Electric Light & Power company; capital stock, $10,000. Citizens' Electric company, Dayton, Ky.; capital stock, $25,000 Portage la Prairie, Man, Electric Light company; capital stock, $20,000: Pocomoke, Md., Electric Light & Power company; capital stock, $10,000.

The Utica & Mohawk Railway company, which recently contracted with the Edison company for five cars and station equipment, has now been in operation for about three months, with most satisfactory results. Its picnic business has been very large, the road on some occasions carrying ten thousand passengers per day. The wisdom of President Mann's action has been thoroughly demonstrated. It is worthy of note that under Mr. Mann's management this road has become one of the best equipped and best paying properties in the state, although it was formerly a run-down horse car line.

A Colorado paper says: "The Denver cable companies are contemplating a change in the motive power by changing the cable system to electric, as the expense required will be but 40 per cent. of what it now costs. The only objection is the overhead wires which it is hoped will be abolished by an underground arrangement or a storage battery."

An application has been made to the Oakland, Cal., trustees for a franchise for an electric road from Eighth street and Broadway across the Eighth street bridge to Fifth avenue, to East Eighteenth street, to Fourth avenue, to East Nineteenth street, to Mound street, to Thirteenth avenue; along that avenue known as the County Road to Moraga Valley, to the city limits.

Among the recent railway contracts closed by the Edison General Electric company may be mentioned the following: The Minneapolis Street Railway company; The Savannah, Ga., Street & Rural Resort company; The Dallas, Tex., Consolidated Traction company; St. Johns, N. B., City Railway company; James Street Belt Line Railway company, Seattle, Wash.; St. Paul City Railway company; Tacoma, Wash., Railway & Motor company; Richmond, Va., City Railway company; Utica, N. Y., Mohawk Railway company; Elmira, N. Y., & Horseheads Railway company; Elgin, Ill, City Railway company; People's Street Railway company, Scranton, Pa.; Fort Scott, Kan., Railway company; Louisville, Ky., Railway company; Pittsburg, Pa., Railway company.

Occasionally a wagon gets knocked into splinters by an electric car in Boston, and the *Herald* of that city asks the public to observe that the trouble is neither with the system of electricity nor with the drivers of the cars, but with certain teamsters who take a malicious delight in annoying the car motor men all they dare. Commenting on this fact, an exchange says: "Human nature is much the same here. We think the majority of teamsters are considerate and accommodating in this matter, but one is occasionally found who will not pull out of the way as long as he can make any decent pretence of not hearing the car behind him, though it may be loaded with passengers anxious to reach the end of their journey. It is the public, not the street car driver or company, that suffers in these cases, and the servants of the public, the police, should make an example of some of these obstreperous fellows who love to annoy their fellow citizens."

Georgia has long been noted for its snake stories, but the boomers of the Cracker state do not appear content with the mild notoriety thus obtained. The inventive genius of the sensational advertiser has produced the following, which is now going the rounds of the daily press: "An accident has just occurred in Georgia which shows the necessity of the guard which is now generally fixed over the ventilating fans worked by electric motors. The manager of the engineering department of an electric light works had been superintending the putting in of a new exhaust fan, and was watching its first trial. As he was feeling the shaft to see if the journals were hot the suction drew his hand in, and in an instant it was cut off between the wrist and the elbow. The fan was revolving at the rate of 1,000 revolutions a minute, and it is said that the arm was cut off as clean as if it had beeen done with a knife." The dispatches do not specify whether the accident occurred at Social Circle, Richland, Cordell, Jasper or Cedartown.

The differences between the mayor of Oakland and the city council over electric roads continue. The mayor vetoed the Oakland & Berkeley Rapid Transit company's franchise to introduce electricity, and the council passed the franchise over the veto. A similar proceeding followed the introduction of a crosstown electric railway franchise and now the mayor has returned to the city council without his approval, the franchise to George W. McNear, W. D. English and others, for an electric railroad from West Seventeenth street and the line of the Northern Railway one block north of the Sixteenth street depot across the city by various streets and avenues to Twenty-third avenue, East Oakland. The veto is on the ground that there is no provision in the code for the use of electricity as a motive power for street railroads. The mayor says that his reasons for withholding his approval of the ordinance are set forth in his veto message of the ordinance granting to the Oakland & Berkeley Rapid Transit company a similar franchise which the council passed over his veto. It is probable the same course will be pursued in this case.

The progressive element in England is beginning to realize the necessity of radical changes in the system of street car propulsion now in vogue In a recent issue of *Industries* there appeared an illustrated article descriptive of the West end street railway system of Boston. Commenting on this the same paper says editorially: "The West End Electrical tramway is the largest electrical tramway system in the world. The company has about 250 miles of track, and between one and two thousand cars. A short time ago the Thomson-Houston company were invited to try electric traction, and they did so with such signal success that the tramway corporation at once decided to do away with horses altogether. Overhead wires are used almost throughout, and our chief object in giving the illustration is to show how little the overhead wires and poles interfere with the appearance of a handsome street. The engraving shows Trinity, or, as it is generally called, "Philip Brooks'" church, its schools, and the Hotel Brunswick. This is one of the grandest streets in Boston, and with its red houses with green blinds, and trees down the sidewalks, Boston is one of the most beautiful cities in the world. If Boston can put up with overhead wires, surely some of the suburbs of London will not be injured by them. The English objection to overhead wires is

Legge's sentimental. It may be well to point out that the disfiguring wires are so imperceptible that they are ex- [illegible] graph from which the engraving [illegible] station is the largest in the world, and is on the grounds of the old Hinkley locomotive works, between Harrison Avenue and Albany street. The boiler house, when finished, will be 160 feet by 80 feet, and the dynamo room twice those dimensions, or four times the area. The foundations consist of enormous blocks of granite resting on piles. Most of Boston gives trouble in foundation work. Much of it stands on reclaimed ground, and the building of Trinity church necessitated skilful engineering and heavy outlay. There are to be thirteen Corliss engines of 1750 horse-power each, driving 300 horse-power dynamos The cars are run faster in the United States than in England. Between Harvard Square and Arlington, a distance of four miles, the average schedule speed, including stoppages, is twelve miles an hour When we have as many electromotor cars going in the whole of England as the Americans are putting down in one town we may begin to think we are really making progress."

THE TELEGRAPH.

The Puget Sound Telegraph company has filed supplemental articles of incorporation, extending the existence of the corporation twenty-five years, to enable it to carry out the project of leasing the line to the Pacific Postal company for twenty years.

Some interesting features will be seen in the new signaling station which is to be established at Tory Island, between Ireland and Scotland. A large cable has been laid between the island and the shore, the chief use of which will be to announce the passing of vessels and the transmission of telegrams from them. An ingenious buoy-like waterproof dispatch case has been devised, which will contain any number of telegrams. This can be picked up by the boatmen from the island and conveyed to the signal station. The messages can then be telegraphed to any part of the kingdom, an arrangement which will be of the greatest convenience not only to travelers but also to merchants and shippers.

Miscellaneous Notes.

The Woodell Railway Electric Signal company has been incorporated at Richmond, Va.; capital stock, $100,000.

H. R. Parrish, secretary and treasurer of the Accumulator company, New York City, and his bride, are enjoying their wedding trip and receiving congratulations on all sides.

The Christy Telephone company has been formed in San Francisco. The company controls the rights of the Christy Whispering Telephone, and will, it is claimed, begin active competition with the Bell company.

The Great Western Electric Supply company of Chicago, has been incorporated to manufacture and deal in electric supplies; capital, $250,000. Incorporators—Henry W. Wolf, T. G. O'Donnell and A. A. Fliss.

Okonite has achieved another victory, this time on the ball field at Chicago. A club composed of employees of the Central Electric company championed the cause of okonite while a picked nine from the Western Electric company's factory represented kerite. The score was 28 to 9 in favor of okonite, and there was great rejoicing among the victors.

Business Mention.

The Aetna Machine company of Warren, Ohio, lately closed a contract with C. W. Tuttle & Co. for a 250 horse power engine to drive a train of rolls at Auburn, N. Y.

The Consolidated Electric Storage company has appointed Henry C. Whitney, formerly with the Crosby Electric company, superintendent of agencies. His office will be at 120 Broadway, New York City.

The Aetna Machine company, Warren, Ohio, has just closed a contract with the Oliver Iron & Steel company, Pittsburgh, Pa., for an engine to drive the machinery in its new plant which they are now building in that city.

The Electric Merchandise company, Chicago, has made arrangements for an exhibit at the Street Railway convention at Buffalo. The company has secured parlor F, Iroquois hotel, which will be its headquarters. W. R. Mason, general manager, and John Gustin, purchasing agent will represent the company.

In line construction it is often necessary to trim trees that project over the proposed route. The Great Western Electric Supply company of Chicago has introduced an improved tree trimmer which possesses many advantages which will be readily seen and appreciated by those who have had experience in this work.

The Sawyer-Man Electric company has elected N. W. Hebard, vice-president; Ph. F. Kobbe, treasurer, and J. E. Coggeshall, assistant treasurer and auditor. H. M. Byllesby has retired from active connection with the company, and will devote his attention to the Westinghouse Electric & Manufacturing company of Pittsburg.

The Peckham Street Car Wheel & Axle company will have a complete exhibit at the railway convention at Buffalo. President Peckham reports some decided improvements and makes the strongest claims for his new equipments which are now ready for the inspection of the street railway men. The exhibition will be viewed with interest by the attendants at the convention.

The new supply store of Messrs. Alexander, Barney & Chapin at 20 Cortlandt street in the Telephone Building, New York, will be formally opened October 6. The gentlemen composing the firm, who are well-known in every city of the country, have sent out invitations to the fraternity to attend and sample some of the goods. These invitations contain a menu of a feast which will be provided visitors.

The Crosby Electric company, New York, announces that it has purchased the business of the Hussey Battery company, New York, together with the stock and patents under which the Hussey patent blue stone battery was manufactured. It is well adapted for charging storage batteries for electric motors and domestic electric lighting on a small scale.

The Minnesota Electric company is a new concern which has recently opened a handsome store at 616 Hennepin avenue, Minneapolis. It is carrying a large stock of electric combination and gas fixtures. It also has a large assortment of mantels and fireplaces. A large stock of electrical supplies is carried by the company, and business is reported as quite brisk.

A unique switch, embodying many new features, will be placed on the market by the Great Western Electric Supply company in about ten days. It is claimed that this switch is constructed on an entirely new style and is both attractive and efficient. The same company is also getting a new fire alarm system ready for the market. This is said to possess many advantages over the release-key system now in general use, and will probably find special favor in small towns

The River & Rail Electric Light company of New York reports sales of its batteries in every part of the country. The largest electrical companies in the United States are buyers and the demand is so great that the present capacity of the factory is taxed to its utmost to fill the orders now on hand. The strong claims for this battery of indestructibility, large capacity, and high electromotive force recommend it to the purchasing public. In this branch alone not taking into consideration its motors and cars, the business of the company has surpassed all expectations. The new catalogue and price list of batteries will be out in about a week, so that the many inquiries for catalogues can be satisfied.

The Englund center curve insulator, exploited by the Electric Merchandise company, Chicago, is intended for use where unusual strains have to be met. The company has during the last few years experimented very largely with a view of securing a center curve insulator which, while being neat in appearance, would have the requisite strength needed for all demands. One objection to overcome was to secure the needed strength without making the insulator so heavy as to be unwieldy to handle, and heavy in appearance on the line. In former attempts to lighten it openings have had to be made which, filling with rain and snow, have destroyed the insulation. The present device is a solid, neat coil of rubber only nine inches in length, and when placed on the line is scarcely discernible. It is, however, protected on the inside of the rubber so securely that it will stand, it is claimed, any strain which may be put upon it, even to holding the extreme ends of the line.

The Electrical Supply company, Chicago, is exploiting the Bradner adjustable hanger for incandescent lighting, illustrated recently in the WESTERN ELECTRICIAN. It consists of a hollow and ornamental brass sphere, in which is firmly mounted a differential pulley. The incandescent lamp cord reaching to the lamp, passes through the sphere and around the pulley, and is taken up and played out in exact proportion as the lamp is raised or lowered, all the slack of the cord being taken up inside without kinks or disfigurement. Its construction is simple, and as there are neither springs nor small parts there is no opportunity for it to get out of repair. The hanger is designed for residences, offices, machine shops, factories, or indeed wherever a lamp is to be raised or lowered. By the use of a hook or other support a lamp may be brought from a distant part of a room and permanently placed in any desired position. This company has also issued a circular containing a list of its electric railway specialties.

Electrical Patents.

Issued Sept. 23, 1890.

436,777. Mechanical and Electrical Railway Signal. Benjamin R. Davidson, Fayetteville, Ark.

436,779. Electric Motor Car Truck. Elbert W. Goss, Amesbury, Mass.

436,804. Electro Osteotome. Milton J. Roberts, New York, N. Y.

436,814. Electric Arc Lamp. Auguste Wagniere, Los Angeles, Cal.

436,843. Electric Controller for Power Mechanisms. Robert D. O. Smith, Mishawaka, Ind.

The last claim reads as follows:

"5. The momentum device, the electrical releasing device, and the disconnecting mechanism, substantially as described, combined with the moving machine and a circuit closer automatically closed by the action of the said machine to effect its disengagement from its motor automatically."

436,857. Coupling for Electric Wires. Forrest R. Jones, Kearney, Neb.

436,864. Electric Heater. Ernest Abshagen, Chicago, Ill.

The invention relates to that class of electric heaters in which one or a series of resistances is placed in the circuit of an electric current operated in conjunction with a surrounding non-conductive heat-retaining material.

436,874. Electric Contact Device. John J. Hoppes, Springfield, Ohio.

The invention is adapted to be held by upward pressure in contact with an overhead conductor, a trolley or trolley-wheel to travel along said conductor, a catch mechanism to hold said contact device in operative position, and means for releasing said catch mechanism when the trolley is raised to an unusual position.

436,895. Process of Electro Depositing Aluminum. John A. Jeancon, Newport, Ky.

The process consists in suspending the cathode to be plated and an anode plate composed of aluminium and a separating substance not affected by the electrolyte or the electric current, in a highly heated saturated acid solution of an aluminium salt, and passing an electric current through the solution between said electrodes,

436,901. Speed Regulator for Dynamos. Samuel E. Nutting, Chicago, Ill.

The object of the invention is to regulate the speed of armatures in dynamo electric machines to constantly correspond to changes in the resistance of the circuit, so that the strength of the current will remain invariable whether the resistance be great or slight.

436,910. Electrical Weighing Machine. William Snelgrove, King's Norton, England.

436,923. Electric Railway. Hosea W. Libby, Boston, Mass.

436,944. Grooved Switch. William H. S. Wright, Elkhart, Ind.

The second claim follows:

"An electric switch consisting of a plate of conducting material connected to the conductors and provided with a central longitudinal block having inclined sides parallel to the edges of the switch and forming guides for the trolley."

436,952. Thermal Cut-out. George H. Whittingham, Baltimore, Md.

The invention which is the subject of this application is an apparatus by which a fresh fuse is supplied by simply turning a knob when the fuse has been burned.

436,961. Portable Electric Fire Alarm. Francis R. Upton, Orange, N. J., and Fernando J. Dibble, Peabody, Mass.

The invention relates to devices for giving an audible local alarm when the temperature at a certain point rises above the predetermined limit.

436,964 Commutator Brush. Charles Wirt, Orange, N. J.

Of the six claims the first is given:

"A commutator brush comprising in combination a central strip of good conductivity and on either side thereof a strip of poor conductivity, the ends of all the strips bearing simultaneously on the commutator cylinder."

436,968. Method of and Apparatus for Drawing Wire. Thomas A. Edison, Menlo Park, N. J.

436,969. Method of and Apparatus for Drawing Wire. Thomas A. Edison, Menlo Park, N. J.

436,970. Apparatus for Transmitting Power. Thomas A. Edison, Llewellyn Park, N. J.

436,979. Electric Signal for Velocipedes. Charles G. Jiran, Chicago, Ill.

The invention consists in combining with certain features common to all velocipedes, an electric battery, an electro magnet and armature, an insulated circuit wire, a contact spring and a bell.

437,008. Holder for Electric Light Shades. Lewis J. Atwood, Waterbury, Conn.

437,010. Telephone Exchange System. Edward M. Bentley, Boston, Mass.

The last claim is given:

"6. A telephone exchange system having a common return line extending through the district to be served and surrounding the central station, and one or more subscribers' stations outside the said return line, provided each with a parallel individual return brought back and connected to the common return."

437,011. Artificial Resistance. Edward M. Bentley, New York, N. Y.

437,012. Telephone Exchange System. Edward M. Bentley, Boston, Mass.

The invention relates to exchange systems in which part of the circuits are metallic and part grounded, or in which it is desired to change gradually from grounded to metallic circuits without any material alteration of the ordinary form of switch-board.

437,044. Method of Impregnating Parts of Electrical Apparatuses. Frederick L. Rawson, London, England.

437,069. Electric Distance Heat Indicator and Alarm. Frederick W. Wiesebrock, New York, N. Y.

437,079 Electric Belt. Lewis D. Ashbrook, Cardington, Ohio.

437,111. Rheostat. Josephus H. Gunning, New York, N. Y.

437,114 Incandescent Burner. Charles B. Harris, New York, N. Y.

437,116. Coupling for Electric Wires. James J. Hinphey, Bound Brook, N. J.

437,126. Underground Electric Conduit. Charles E. Loth, Troy, N. Y.

437,158. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

437,160. Dynamo Electric Machine or Motor. Max Mayer, New York, N. Y.

437,168. Clock Synchronizer. Arthur G. Wiseman, Webster Groves, Mo.

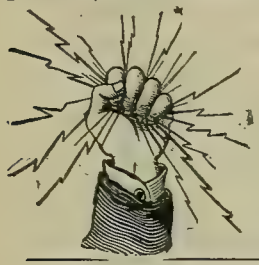
Claim one is

"In a timepiece, the combination of the seconds hand shaft, the seconds hand and the spiral arm and striker, said spiral arm curving around a complete circuit and in its operation always moving in a forward direction."

437,169. Nautical Magnetic Tracer Apparatus. Frederick Aramburu, Seville, Spain

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

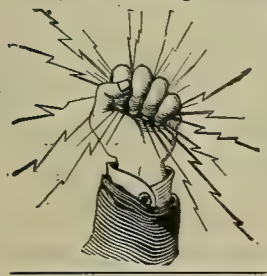
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

—MANUFACTURERS OF—

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

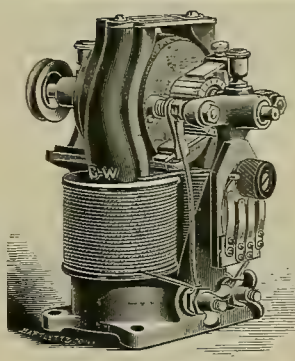
THE TURNER BRASS WORKS
MAKE ANYTHING IN BRASS.
4 LASALLE AVE CHICAGO.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE CROCKER-WHEELER

PERFECTED MOTORS.

Very Slow Speed Full Power—Perfect Regulation Forged Fields, Let into Base—Self-Oiling Bearings—Self-Centering Bearings—All Sizes—Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH ST., NEW YORK.

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

NO LOSS OF CANDLE POWER.

FOR PARTICULARS WRITE

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

OKONITE TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

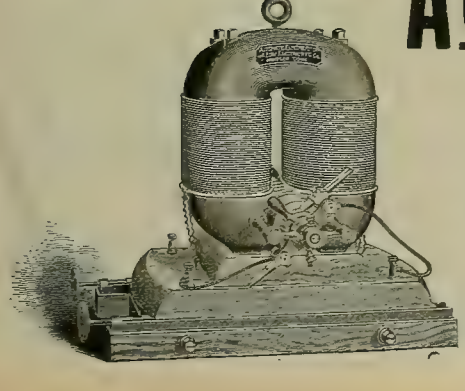
BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS

In all Sizes from One-half H. P. Upward.



High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 78 Customhouse St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

Cleverly
1018 CHESTNUT ST.
PHILA.

"Improved" Automatic Burner.

PATENT LIFT-OVER PENDANT BURNER.
AUTOMATIC BURNER KEYS.
SPARK COILS.
DESK PUSH BUTTONS

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO.

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

BALL AUTOMATIC CUT OFF ENGINE

MADE ONLY BY THE BALL ENGINE CO ERIE PA.

FOR SALE.

One 15-light	50 volt	Dynamo
One 25-light	50 volt	Dynamo
One 50-light	50 volt	Dynamo
One 75-light	110 volt	Dynamo
One 100-light	110 volt	Dynamo
One 150-light	110 volt	Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

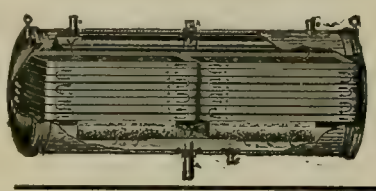
Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. Correspondence Solicited.

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue 1--66 of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets

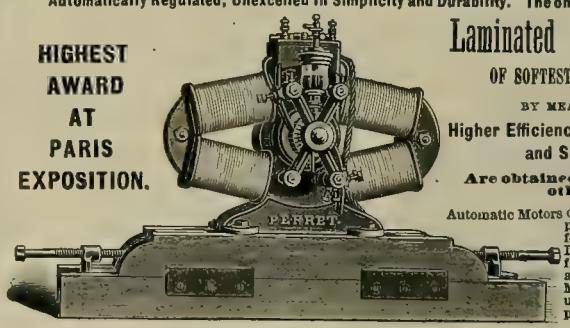
OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting, Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

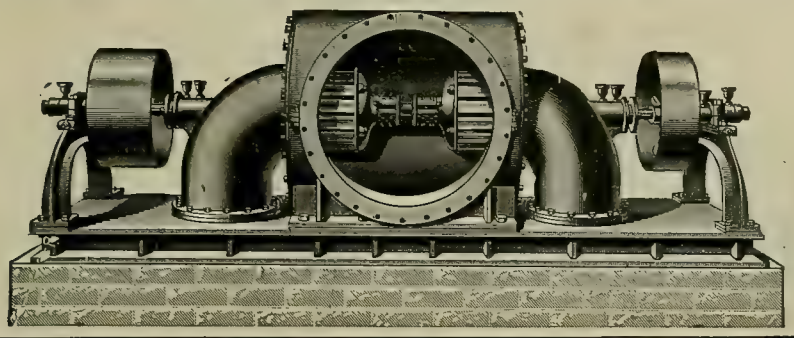
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft, with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

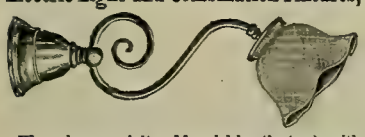
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO.

1221-1223 Union Ave.

KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

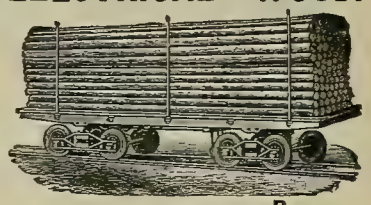
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.
Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

DOUBLE ARC LAMPS.

No finely geared clock work. No close fitting sliding solenoid cores.
No steel pinions or pivots to rust and stick. No gearing to clog with dust.
Practically and Theoretically the simplest and best constructed Double Arc Lamp.

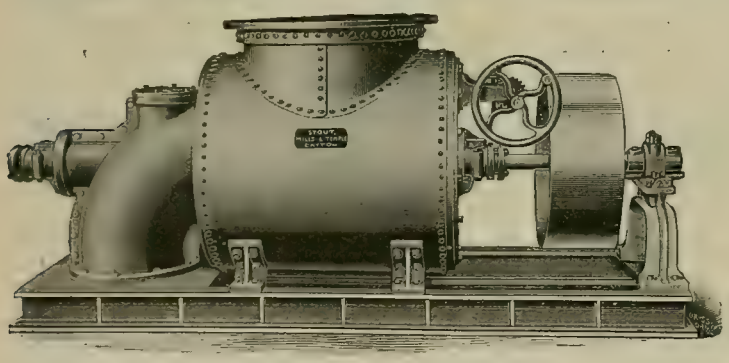
The ONLY DOUBLE ARC LAMP MANUFACTURED for both High and Low Tension Currents.

We offer to furnish Companies using high or low tension systems with new double arc lamps, guaranteed to work satisfactorily, and with guarantee against loss on account of suits for alleged infringement of patents.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

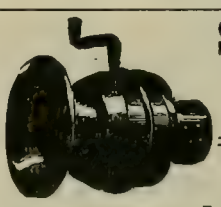
OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.



SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

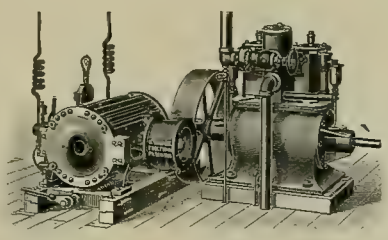
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

LIST OF PARTIES WHO HAVE ADOPTED THIS SYSTEM:

City of Boston, Water Department, Chestnut Hill, Mass.
City of Boston, Sewerage Department, Dorchester, Mass.
Pettee Machine Works, Newton Upper Falls, Mass.
Morgan Engineering Co., Alliance, Ohio.
Fitchburg Steam Engine Co., Fitchburg, Mass.
Portland Steam Packet Co., S. S. Portland.
Metropolitan Steamship Co., S. S. H. M. Whitney.
Chas. L. Seabury, yacht "Aztec."
Shoe and Leather Exchange, Boston, Mass.
Cocheco Manufacturing Co., Dover, N. H.
Hospital Cottages for Children, Baldwinsville, Mass.
Pennsylvania R. R. Co., Shops, Altoona, Pa.
Steamship Naugatuck.
Vanderbilt Building, New York.
William Tod & Co., Youngstown, Ohio.
Am. Waltham Watch Co., Waltham, Mass.



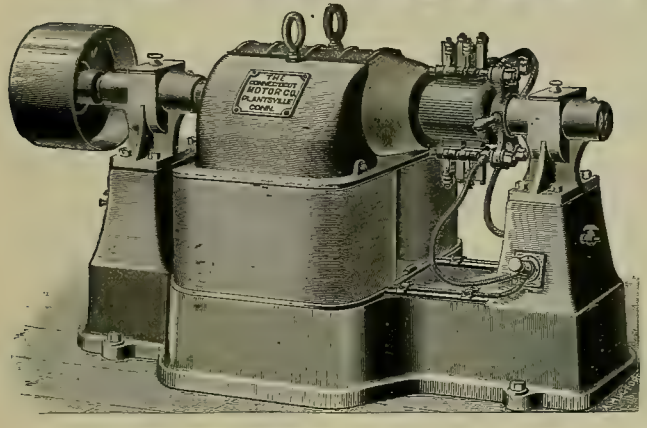
Seamless Rubber Co., New Haven, Conn.

C. F. Hovey & Co., Boston.
P. S. Malcolm, Portland, Oregon.
Chatham Hotel, Chatham, Mass.
Waltham Gas Co., Waltham, Mass.
Union Electric Light Co., Franklin, Mass.
Florence Electric Light Co , Florence, Ala.
Hutchinson Water, Light & Power Co., Hutchinson, Kan.
Walworth Light and Power Co., Boston, Mass.
North Attleboro Steam and Electric Co., Attleboro, Mass.
Jamestown Electric Light and Power Co., Jamestown, N. Y.
Weymouth Light and Power Co., E. Weymouth, Mass.
Leavenworth Electric Light Co., Leavenworth, Kan.
Willimantic Electric Light Co., Willimantic, Conn.
Towanda Electric Light Co., Towanda, Pa.
M. C. Dizer & Co., Weymouth, Mass.
Derby Gas Co., Derby, Conn.

AGGREGATING OVER 3,000 HORSE POWER.

THE EVANS FRICTION CONE CO., 85 Water St., BOSTON. Send for Catalogue D.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD WILKINS.

TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

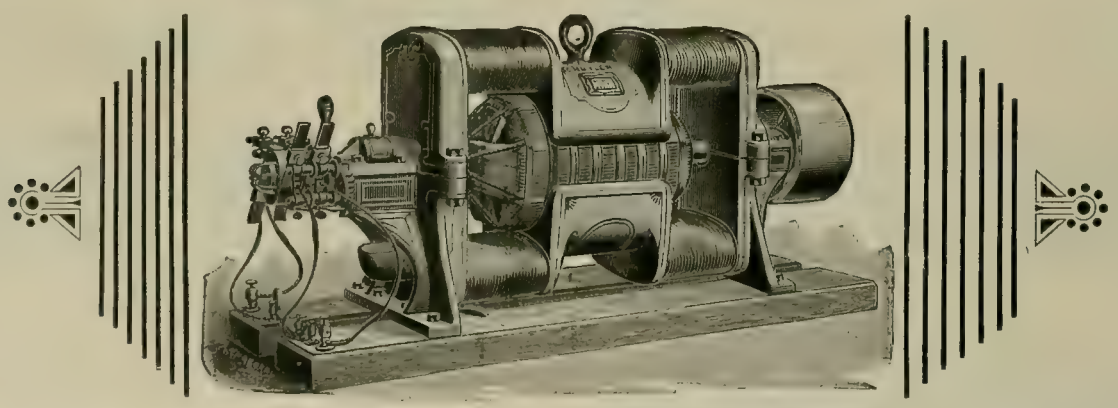
Manufacturers of Electric Light Carbons and Battery Material.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.



Office and Factory, MIDDLETOWN, CONN.

Western Office, Room 456, THE ROOKERY,

CHICAGO.

OKONITE
TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

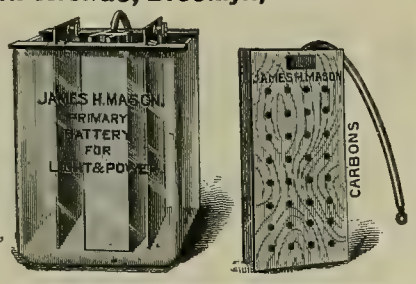
PRIMARY BATTERIES
— FOR —
Household, Experimental, Scientific and other Purposes.

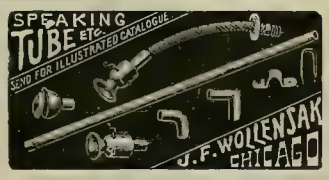
JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

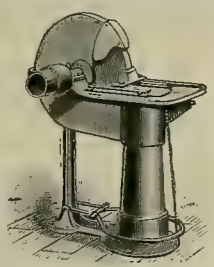
Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.





THE BARNES WATER EMERY Tool Grinder.



It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.

Sold subject to approval. Send for full description and price.

W. F. & John Barnes Co., Rockford, Ill..
Address No. 761 Ruby Street.

Barnes' Patent
UPRIGHT DRILLS.
20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.

Barnes' Patent
ENGINE LATHE,
15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.

They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to W. F. & JOHN BARNES CO., Rockford, Ill., Address No. 761 Ruby st.

SAFETY SEAMLESS RUBBER COVERED WIRE
IS THE BEST.

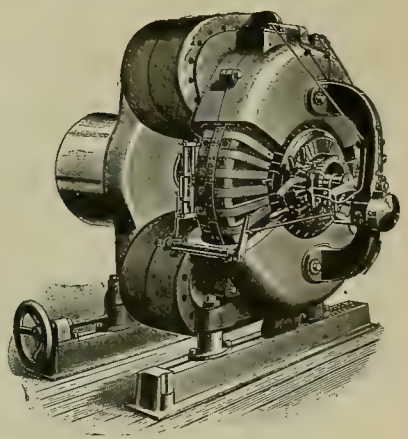
We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

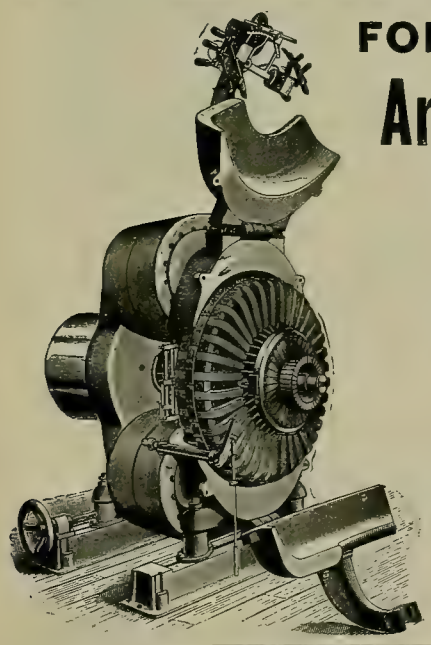
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

Arc and Incandescent Apparatus
FOR LIGHTING,
Arc AND Incandescent Motors,
Electro-Plating and Electro-Deposition Machines.





Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

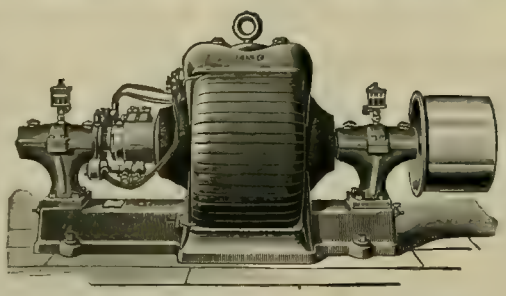
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

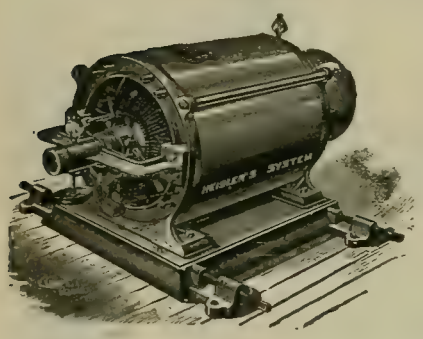
Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

THE HEISLER PATENT LONG DISTANCE
INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

EDISON MANUFACTURING CO.,
EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

——MANUFACTURERS OF——

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP
and 1914 Olive

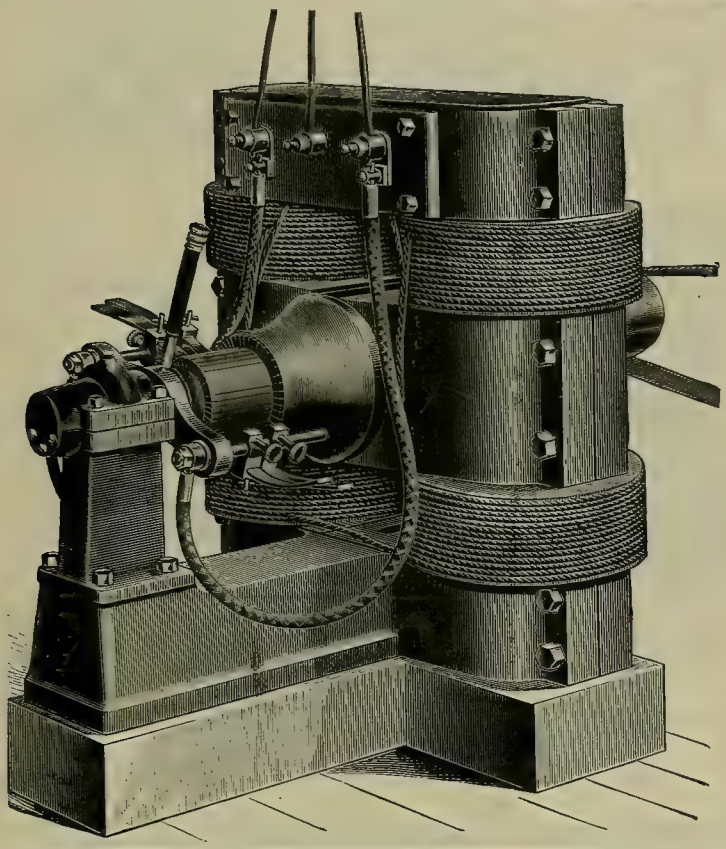
CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

FOREE BAIN,

ELECTRICAL EXPERT AND MANUFACTURER.



I have more Electric Motors in Practical Operation in Coal Mines than all other manufacturers combined. They aggregate over

350 H. P. to Date.

These installations are not experimental—the Motors are in actual service cutting coal; some of them have been working

20 Hours Per Day

for more than one year, and during this time not one of them has required repairing.

NO SHORT CIRCUITS.
NO BURN-OUTS.

I have secured patents on a full and complete system of Mining by Electricity. Contracts solicited.

84 Market St., - CHICAGO.

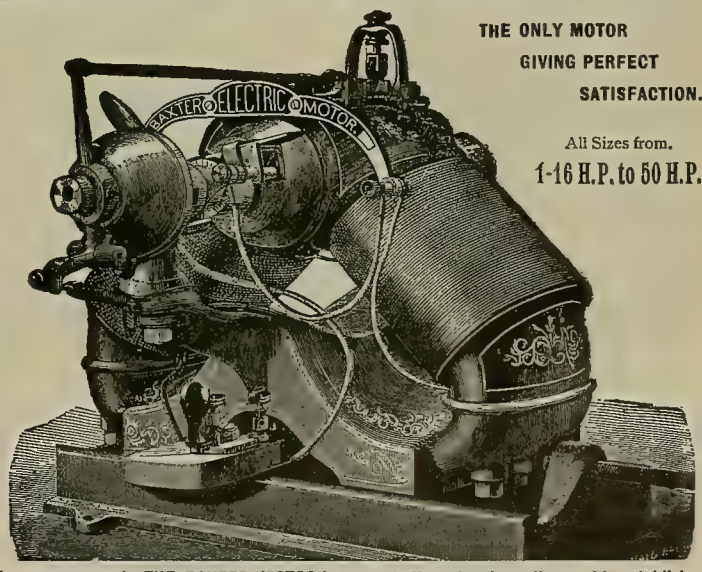
PHŒNIX GLASS CO
OF PITTSBURGH, PA.
MANUFACTURERS OF A FULL LINE OF
ELECTRIC LIGHT
GLOBES SHADES
BOTH ARC AND INCANDESCENT.
RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.
ADAPTED TO ALL SYSTEMS.
729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

To Arc and Incandescent
POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,
MANUFACTURERS OF
Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.



The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——
Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
—FOR—
ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.

POND ENGINEERING CO.,
ST. LOUIS, CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

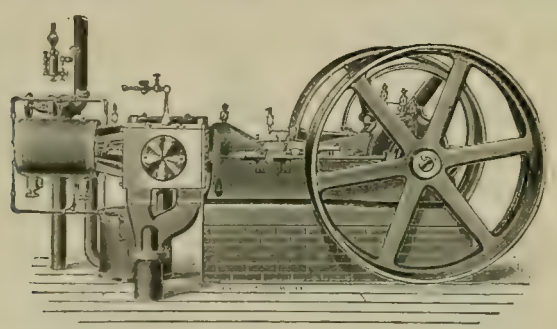
SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Low Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

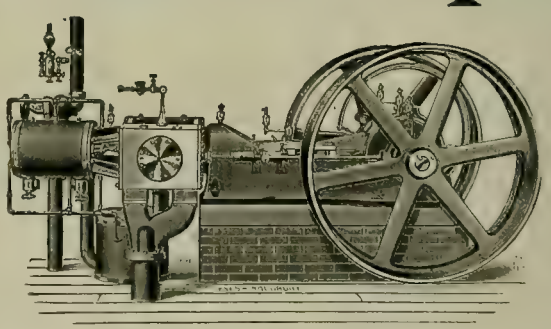
ELECTRICAL BOOKS
OF ALL KINDS.
Send for New and Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO, ILL.

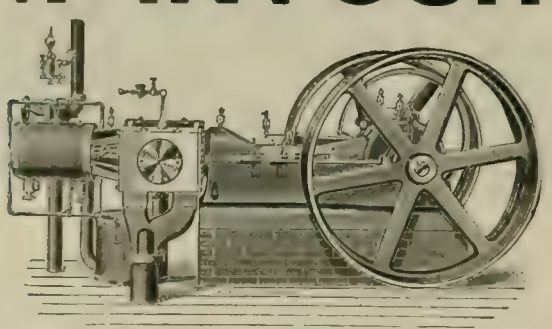
None so Good, None to Equal.



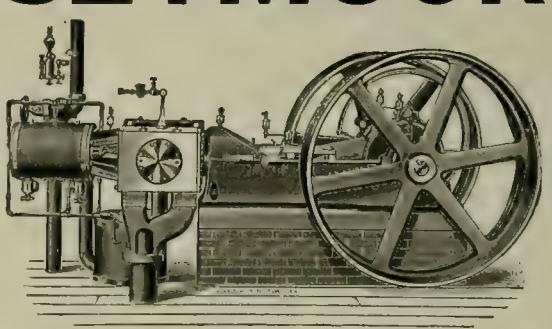
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED. 144 ADAMS ST., CHICAGO.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

WHIPPLE'S

Electric, Gas & Street Railway

FINANCIAL REFERENCE DIRECTORY

FOR 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

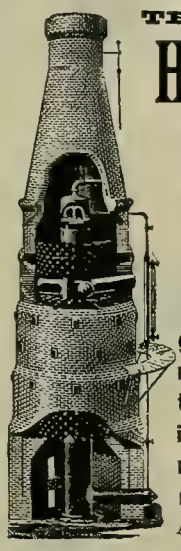
Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building. CHICAGO.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.

G. W. GRIFFIN, Superintendent of Construction.



THE Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

Binders FOR THE Western Electrician $1.00.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't. J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

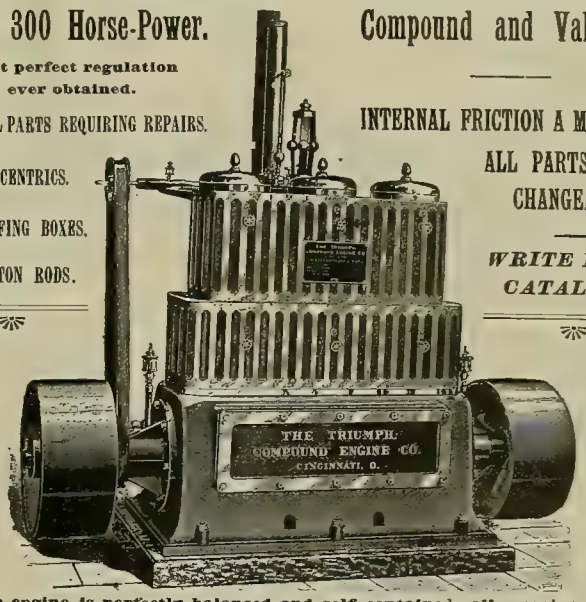
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

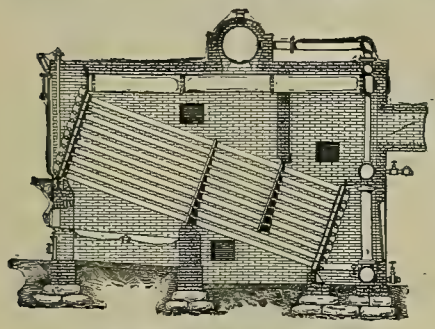
THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

ROOT'S WATER-TUBE BOILER.



ROOT SECTIONAL SAFETY BOILER.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the Edison Electric Light Companies at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

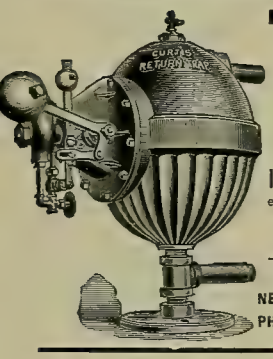
BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

A MODEL RAILWAY.

The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.



THE CURTIS

PATENT RETURN STEAM TRAP.

IT is noiseless, positive, rapid, will return all condensation back into the boiler, and works equally well in connection with reduced pressure or exhaust steam, also when the return is below the water line of the boiler.

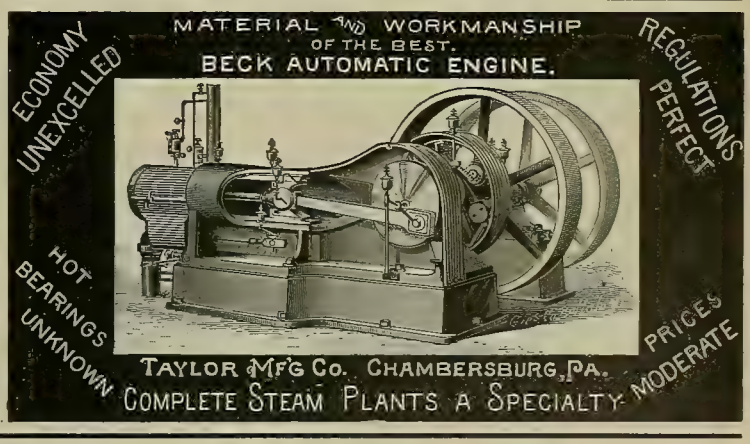
THE CURTIS REGULATOR COMPANY,

90 BEVERLY ST., BOSTON, MASS.

GENERAL AGENCIES.

NEW YORK, 109 Liberty st. CHICAGO, 218 Lake st.

PHILADELPHIA, 2035 N. Front st. MINNEAPOLIS, 210 N. Third st.



DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

ELECTRIC · STREET · RAILWAYS

EQUIPPED WITH THE

THOMSON-HOUSTON SYSTEM

ARE IN SUCCESSFUL OPERATION IN THE FOLLOWING PRINCIPAL CITIES

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND,
MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA,
DENVER, OMAHA, ST. PAUL and MINNEAPOLIS.

Under this System operating expenses are reduced from twenty-five to forty per cent., and receipts increased from fifty to three hundred per cent.

One of the strong features of the Thomson-Houston Railway System is the ABSOLUTE PROTECTION FROM LIGHTNING DISCHARGES by the use of Prof. Thomson's Lightning Arrester, which is fully covered and protected by Letters Patent.

If you want to equip your road Electrically, you should select a system which has been thoroughly tested during the storms of the winter and summers and not found wanting in any essential features. The public demands regularity of service, and you can't afford to take any chances. **THE THOMSON-HOUSTON RAILWAY SYSTEM** only will fill these important conditions.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

Is now ready for delivery. It was used exclusively by the West End Company, of Boston, last winter, and is fully indorsed by them, and other companies who have used it.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

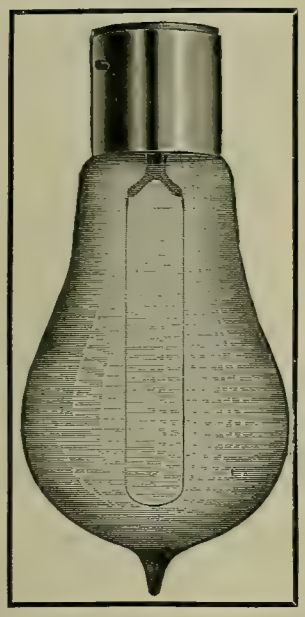
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

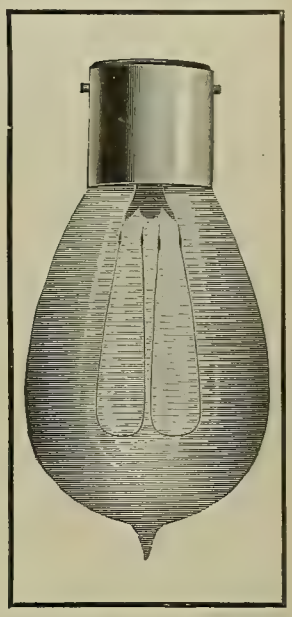
—— THE ——

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

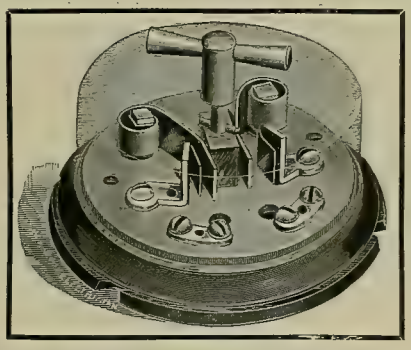
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

—— WE CALL SPECIAL ATTENTION TO ——

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

— FOR —

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

WESTERN AGENTS

HABIRSHAW WIRES, CABLES AND CORES.

A HIGH GRADE OF RUBBER INSULATION.

[CONTINUED FROM LAST WEEK.]

In our advertisement of August 30, we referred to the quality of Habirshaw Insulation, giving some letters from both experts and users. The week following we gave a list showing a few places where it had been used. The next week we illustrated some of the cores in the installations referred to. The week after we made some general statements as to what constituted the superiority of insulated wires. Last week we called attention to simple tests made of all of the different rubber insulations.

Below we illustrate the different sources of "rubber" supply:

(Pure Para Rubber Stock.)

("Recovered" Rubber Stock.)

THE TWO PRINCIPAL SOURCES OF RUBBER SUPPLY.

It is a fact, though not generally known, that the larger part of manufactured rubber goods is made from so called "recovered rubber," principally from old rubber boots, shoes, rubber hose, rubber springs, packing, etc. Rubber that has been vulcanized is no longer rubber but a chemical compound of sulphur and rubber, and is not capable of being treated or worked as pure rubber. Goods manufactured from "recovered" rubber bear the same relation to goods made from pure rubber that shoddy bears to genuine woolen goods.

The following extracts from a report of analysis and tests on various samples of insulated wire will be of interest in this connection. The authority from which we quote is one well known, and with a reputation second to none. We refer to the samples by letters in preference to using the trade names:

Sample "A" shows 15 per cent of a heavy hydro carbon similar to ozokerite, and assimilating to an article known in Europe as nigrite.

Sample "B" has been made over from "recovered" rubber, or a mixture of "recovered" rubber, and oxidized oils.

Sample "C" shows by analysis very nearly 30 per cent. of adulteration, consisting chiefly of oxidized oils. The process is known as "spurted" or "spewed" insulation. (See note below.)

Sample "D." Several samples of this insulation were taken, all of which varied. The composition of the rubber is "way off," being largely made up of a heavy substance similar to white lead. The white layer goes to pieces very rapidly.

Sample "E" [HABIRSHAW] is the only one of the samples tested, which by analysis shows that pure Para Rubber is the only organic substance used in the insulation.

Sample "F" has about 5 per cent. of resins. It is poorly manufactured, the "spurted" process being used.

Sample "G" is made and built upon the same plan as "F" containing a mixture of resins. This insulation is perhaps the poorest made of any, and shows a very imperfect knowledge of manufacture. The "spurted" process is used.

NOTE:—"Spurted" or "spewed" insulation, so far as I know (and I have investigated the process thoroughly) can not be made of pure rubber compound. The only claim that can be made for it is that it produces an insulation which is seamless, *but this condition is got at the expense of the quality of the insulating material.* On this question of having a seam, there is only one view to be taken, it is stronger than the other, provided the manufacture is carried on correctly; if not it is like all other badly made things, "good for nothing."

The Habirshaw insulation fulfills all requirements in places demanding the "BEST," and in that field finds no successful competitors.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

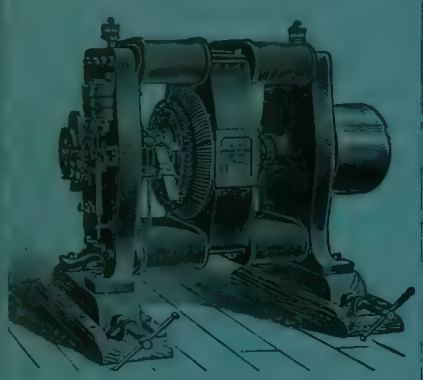
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



WOOD ARC DYNAMO.

MAIN OFFICE:

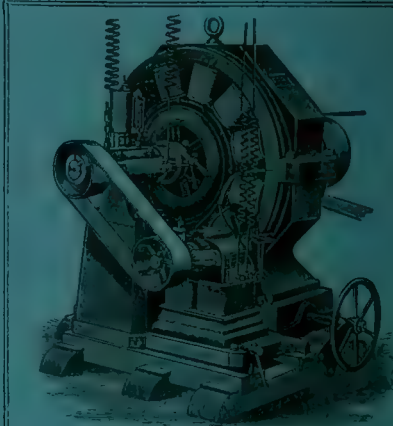
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

The Consolidated Electric Storage Co.,

MANUFACTURERS OF

THE JULIEN

ELECTRIC STORAGE BATTERY.

Exclusive licensees for the whole of the United States of the Storage Battery Patents of Charles F. Brush [lately owned by the Brush Electric Company], and sustained by the Circuit Court of the United States.

Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

BATTERIES FOR LIGHT AND POWER,

Sold at Prices so Low as to Defy Competition.

For Agencies and Licenses apply at the Company's Office at

120 Broadway, NEW YORK CITY.

All other inquiries, more especially those in relation to Purchase of Batteries, should be addressed to the Philadelphia Office of the Company.

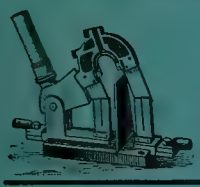
926 Drexel Building, PHILADELPHIA, PA.

Western Electrician.

$8 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, OCTOBER 11, 1890. No. 15

"AJAX SWITCHES"

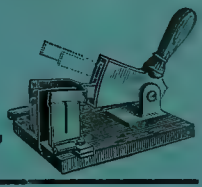


In all Sizes, for any Potential,
Single, Double and Treble Pole

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,
74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas.
{ PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

CABLES AND WIRES FOR Electric Railroads, Telephone and Telegraph, Electric Lights.

STANDARD UNDERGROUND CABLE CO.,

NEW YORK. PITTSBURGH. CHICAGO.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4⅞-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use.

Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York.
{ 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

THE EDISON DYNAMO

SEE PAGE 8.

CENTRAL DISTRICT OFFICE, RIALTO BUILDING, CHICAGO.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4 h St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment.
Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	[illegible]
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	[illegible]
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	[illegible]
Waterhouse	222	. ..	222
Heisler	.. ..	500	500
Remington	159	300	[illegible]
Sperry	130	.....	130
Excelsior	90	... ..	90
Hochhausen	60	. ..	60
Weston	30	.... .	[illegible]
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,067
Edison	..	13,853
American	1,537	[illegible]
United States	632	6 141
Schuyler	1,766	.....
Ball	962	6
Western Electric	[illegible]	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	[illegible]
Remington	129	.....
Sperry	[illegible]	.....
Excelsior	205	30
Hochhausen	70	. .
Weston	[illegible]	.....
Fuller	10	.....
Reliance	30	.....
National	. . .	1,000
Bernstein	. ...	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889.	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45.055
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%

	Arc.		Incandescent.	
	T. H. System.	All other Systems	T. H. System.	All other Systems.
Lights in use as per clipping, June 14, 1890	16,927	14,631	45,055	87,716
Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Increase	5,843	4,402	36,229	40,652
Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co.....xxx
Abendroth & Root Mfg. Co.. —
Alexander, Barney & Chapin.. xii
Allis, E. P. & Co.....xxiv
American Electrical Works.. xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co.....vii
Baggot, E.....xvi
Bain, Foree.....xvi
Ball Engine Co.....xxiv
Barnes, W. F. & Jno.....xxi
Barton, Geo. P.....xxv
Baxter Electric Motor Co.....xxx
Bernstein Electric Co.....—
Bleckert & Nelson.....xvii
Brown, Frank T.....xvi
Brooks Underground Tel. Co..xiv
Brush Electric Co.....xxix
Bunnell & Co., J. H.....—
Butler Hard Rubber Co.....xx
C. B. & Q. R. R.....xxv
C. & C. Electric Motor Co...xxii
Central Electric Co.....xi
Cleverly Electrical Works...xvi
Colburn & Co., I. W.....xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co.....—
Consolidated Electric Storage Co.....—
Continental Dynamo Co.....iv
Crocker-Wheeler Motor Co..xv
Crosby Electric Co.....iv
Curtis Regulator Co.....—
Day's Kerite Insulation Co....i
Dayton Globe Iron Works Co.xviii
Eastern Electric Cable Co. xv
Eddy Electric Mfg. Co.....xv
Eddy, Henry C.....xiv
Edison Mfg. Co.....xxii
Edison General Electric Co.,— Lighting Dept.....viii
Edison General Electric Co.,— Wire Dept.....i
Edison Lamp Co.....xxi
Electric Construction & Sup. Co iv
Electric Merchandise Co.....xvi
Electrician Publishing Comp'y, xxv, xxiii, xxiv
Electrical Supply Co.....xxviii
Elektron Mfg. Co.....xvi
Empire City Electric Co.....xviii
Empire China Works.....xvi
English, Morse & Co.....xvii
Eureka Tempered Copper Co..xvii
Evans Friction Cone Co.....xix
Excelsior Electric Co.....xxi
Fibrone Mfg. Co.....xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works....xx
Fort Wayne Electric Co.....xxx
Gibson Gas Fixture Co.....xviii
Globe Carbon Co.....xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S.....xiv
Harmount, G. A.....xvi
Hawkeye Electric Mfg. Co....iv
Hazelton Tripod Boiler Co....xxv
Heisler Electric Light Co.....—
Hill Clutch Works.....xix
Holmes, Booth & Haydens.....xvii
Holmes & Co., C. H.....xvii
Holtzer-Cabot Electric Co.....i
Humphrey, H. H.....xiv
Illinois Electric Material Co....xiv
India Rubber & Gutta Percha Co. i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L.....—
Jewell Belting Co.....xv
Jones Bros. Electric Co.....vii
Knapp Electrical Works.....xxvii
Laminar Fibre Goods Co.....xvii
Law Telephone Co.....xv
Leclanche Battery Co.....vii
Magnolia Anti-Friction Metal Co i
Monitor Electric Co.....xvi
Munsell & Co., Eug.....xv
Munson Belting Co., Chas.....xiv
National Carbon Co.....iv
National Electric Mfg. Co.....x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T.....xxv
N. Y. Belting & Packing Co...—
Okonite Co.....xv
Ostrander & Co., W. R.....xviii
Page Belting Co.....—
Paiste, H. T.....xiv
Partrick & Carter.....xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co.....—
Pond Engineering Co.....vii
Powell Co, Wm.....—
Pumpelly Storage Battery Co. vii
Queen & Co.....xvi
River & Rail Elec. Light Co.. ix
Roeblings' Sons Co., Jno. A....xix
Sawyer-Man Electric Co.....xii
Schoverling, A.....xix
Schuyler Electric Co.....xx
Shultz Belting Co.....vii
Southern Electrical Supply Co. xxi
Sperry Electric Co.....xviii
Standard Electrical Works....xvi
Standard Paint Co.....xiv
Standard Underground Cable Co. i
Standard Carbon Co.....xx
Stanley & Hall.....xiv
Stephenson & Co., Jno xxii
Stiff, E. D. & Co.....xvi
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co..xxi
Sunbeam Incandescent Lamp Co.xv
Taussig, S.....xvi
Taylor Mfg. Co.....xxv
Thomson-Houston Electric Co. Lighting department.....ii
Thomson-Houston Electric Co., Railway department.....xxvi
Triumph Compound Engine Co.....xxv
Turner Brass Works.....xv
Union Hardware Co.....xiv
United Electric Traction Co....vii
United States Electric Lighting Co.....xiii
Van Nuis C. S.....i
Wanted.....xiv
Western Electric Co.....xviii
Western Power Construction Co. xxiv
Westinghouse Electric Co.....—
Weston Electrical Instrument Co.....xiv
White, R. T.....iv
Wollensak, Jno. S.....xxi
Woodbridge & Turner.....xvii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S..
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
N. Y. Belting & Packing Co
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Brooks Underground Telegraph Co.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brooks Underground Telegraph Co.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
Northwest Thomson-Houston Co.
Pond Engineering Co.
River & Rail Electric Light Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Const
White, R. T.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
River & Rail Electric Light Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Contd.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

DAISY CHAIR

For T Girder or Rail, having a T Form of Base.

R. T. WHITE,

PATENTED MATERIAL FOR

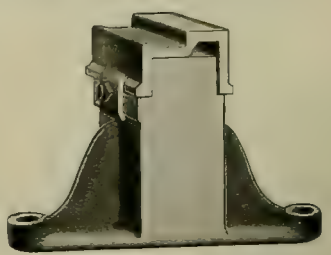
STREET RAILWAY ROAD-BEDS

Also Cable, Electric and Elevated Railways,

12 PEARL STREET, Rooms 6 and 7, BOSTON, MASS.

NEW YORK OFFICE, 52 Wall Street, Room 41.

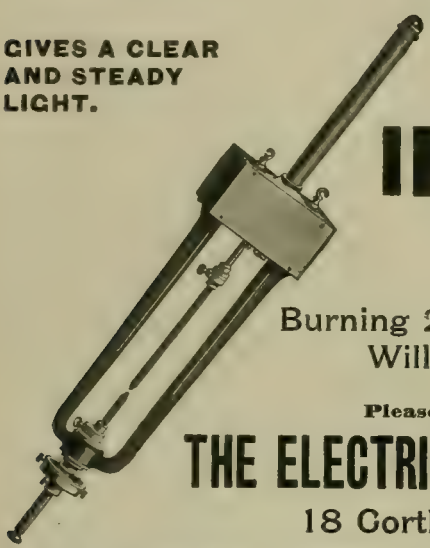
Patented January 28, 1890—No. 420,135. *CORRESPONDENCE SOLICITED.*



EUREKA CHAIR

For Channel Iron Form of Rail.

GIVES A CLEAR AND STEADY LIGHT.



THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

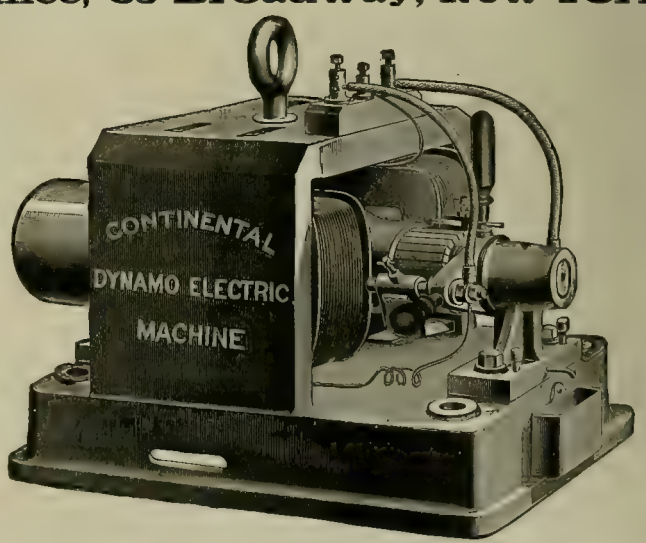
JUDGE BUILDING, Fifth Ave. and 16th St., NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 68 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St —**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St—**NASHVILLE,** Tenn., J. W. B aid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192 FIFTH AVE., CHICAGO.

Makers of the Choicest Electrical Supplies.

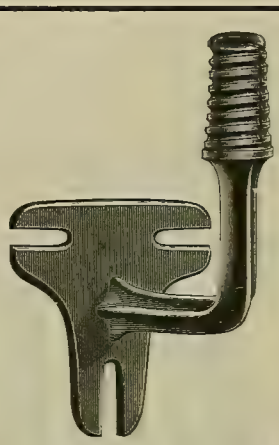
CHUBBUCK BREAK ARM.
Malleable Iron. PATENTED.

GENERAL WESTERN AGENTS:

PETTINGELL, ANDREWS & CO., K. W. Cut Outs.

MASSACHUSETTS ELECTRICAL ENGINEERING CO., Tested Fuse Wire.

THE ELECTRIC GAS LIGHTING CO., Gas Lighting Apparatus, Samson Batteries.

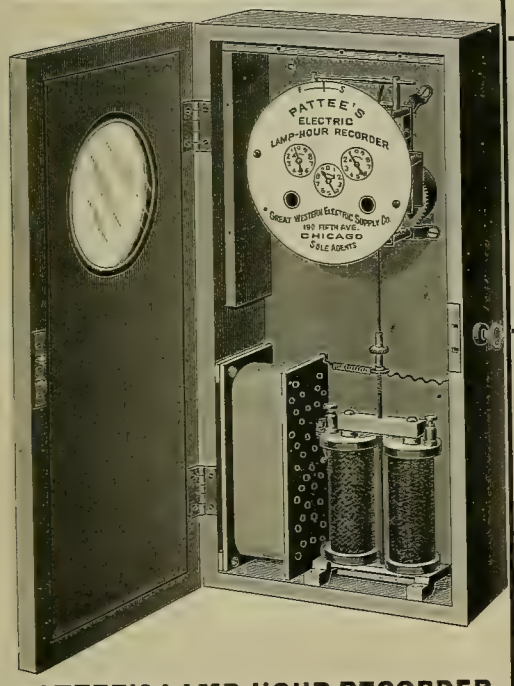


CHUBBUCK BRACKET.
PATENTED Sept. 9, 1890.

THE WIRE THAT GIVES THE HIGHEST LINE INSULATION.

SIMPLEX

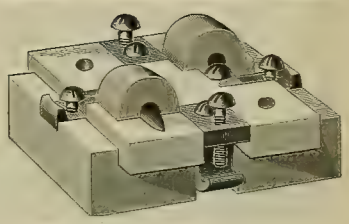
THE WIRE THAT PAYS BEST IN THE LONG RUN.



PATTEE'S LAMP-HOUR RECORDER.

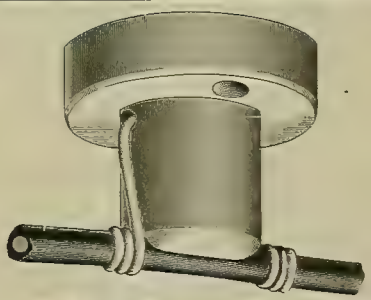
TREBLE CURVE INSULATOR.
Greatest Strength and Highest Insulation.

POLE TOPS, RAIL BONDS, ARMATURE PINIONS, and other novelties of merit, with a full line of all the standard
Electric Railway Supplies.

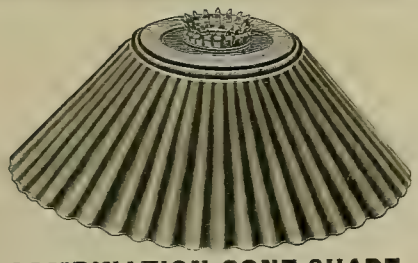


CUTTER'S PORCELAIN BRANCH CUT-OUT.
Fuse Covers and Base made out of one solid piece.

ELECTRIC FIXTURES, Many New Designs.
ELECTRIC SHADES, Large and Complete Stock.
ARC GLOBES, Good Figures in Quantities.
TELEGRAPH APPARATUS, A Fine Line.
ANNUNCIATORS and BELLS, All Sizes.
LINEMAN'S TOOLS, Choice Assortment.

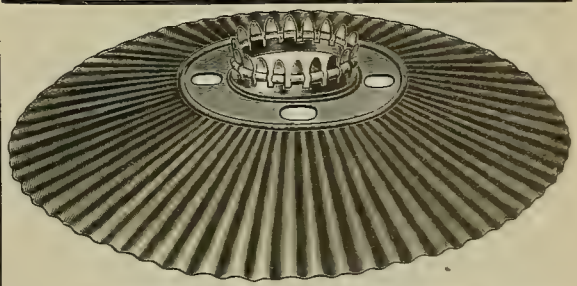


CUTTER'S E. L. INSULATOR.
Gives High Insulation even on Damp Ceilings, and Prevents the Unsightly Blackening.



COMBINATION CONE SHADE.
PATENTED.

CUTTER'S COMBINATION SHADES.
Fit T-H., Westinghouse or Sawyer-Man Sockets.
ALSO MADE FOR EDISON SOCKETS.
No Tools, No Trembling, No Holder.
THE MOST ECONOMICAL SHADES MADE.



COMBINATION TIN SHADE.
PATENTED.

Send for Special Circular describing any of the above, or write us of your needs, and we will cheerfully give our advice.

IF YOU HAVE NOT YET GOT A COPY OF OUR
Sketch Catalogue,
BE SURE TO SEND YOUR BUSINESS CARD FOR ONE

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

405 Sibley Street, ST. PAUL. PORTLAND, ORE., Branch, 266 1st St.

ELECTRICAL SUPPLIES.

Having recently reorganized our supply department and greatly enlarged our quarters, we are prepared to fill all orders promptly, from our stock, to which we would call attention as the largest and most complete line of **ELECTRIC SUPPLIES,** in the Northwest. We invite correspondence and will cheerfully quote prices or give any information in our power.

WRITE TO US FOR PRICES ON CARBONS.

Let us quote you bottom figures on

Wire and Incandescent Lamps.

A large line of Porcelain Articles constantly on hand.

Send for CATALOGUE and DISCOUNT SHEET.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

BRANCHES: 161 Summer St., Boston, Mass ; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St Louis, Mo.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

POND ENGINEERING CO.,

ST. LOUIS. CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

UNITED Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

TRADE **GONDA** MARK.

PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889

The Standard Open-Circuit Batteries of the World

THE LECLANCHE BATTERY CO.,

149 West 18th Street, - - NEW YORK.

CINCINNATI HEADQUARTERS

ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.

WEATHER-PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE
FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.

The JONES-BROS-ELECTRIC-CO. 28 30 & 32 West Court St.

THE EDISON DYNAMO

Is the Standard Electric Generator of the World.

OVER 3,000 MACHINES IN DAILY USE,

DELIVERING

80,000 HORSE POWER

—TO—

LIGHTING CIRCUITS.

—AND—

31,000 HORSE POWER

—TO—

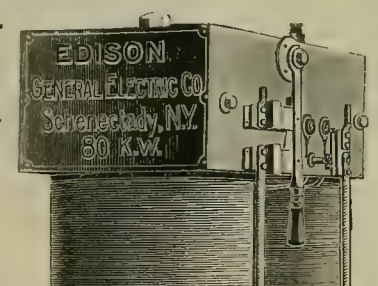
RAILWAY CIRCUITS.

STANDARD RAILWAY SIZES:

No. 16	40,000	watts,	53 H. P.
" 20	50,000	"	65 "
" 32	80,000	"	110 "
" 60	150,000	"	200 "

LARGER SIZES IN COURSE OF CONSTRUCTION.

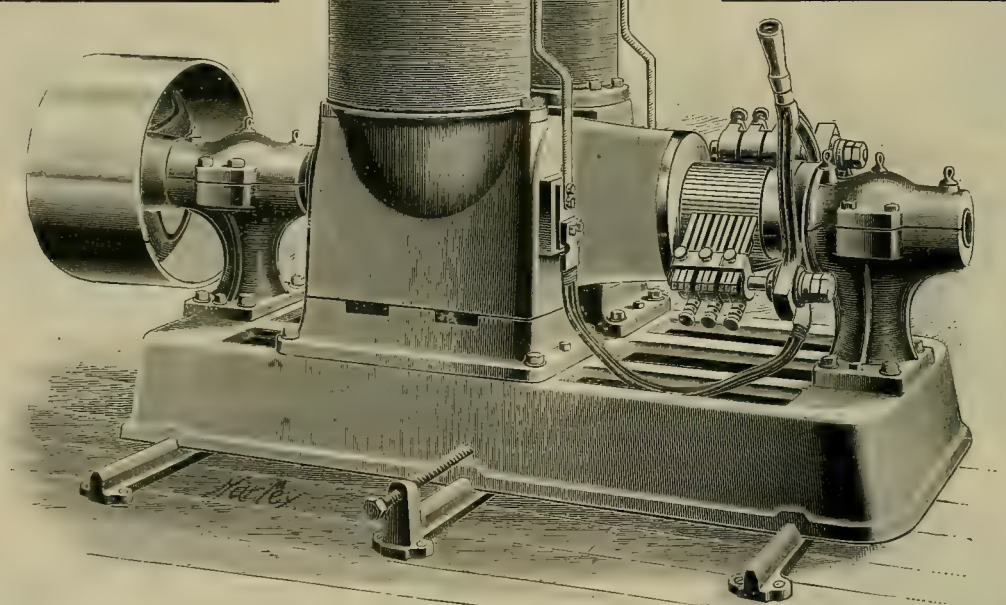
Efficiency 92 to 95 Per Cent., according to Size.



☞ 29

200-Horse Power DYNAMOS

Ordered in Eight Days of July, for use in Five Large Cities of this Country.



ADOPTED BY THE LEADING STREET RAILWAY SYNDICATES

FOR USE IN

BUFFALO, PITTSBURGH, LOUISVILLE, MINNEAPOLIS, ST. PAUL, ST. LOUIS,
CLEVELAND, CINCINNATI, CHICAGO, MILWAUKEE.

EDISON GENERAL ELECTRIC COMPANY,

Edison Building, Broad St., NEW YORK CITY.

DISTRICT OFFICES:

NEW YORK, Edison Building.
CHICAGO, Rialto Building.
DENVER, COLO., Masonic Building.
NEW ORLEANS, LA., Cotton Exchange.
BOSTON, MASS., 38 Pearl Street.
SAN FRANCISCO, CAL., 112 Bush St.
PORTLAND, ORE., Fleischner Building.
TORONTO, CAN., Bank of Commerce Building.

☞ Please address all communications to nearest District Office. ☜

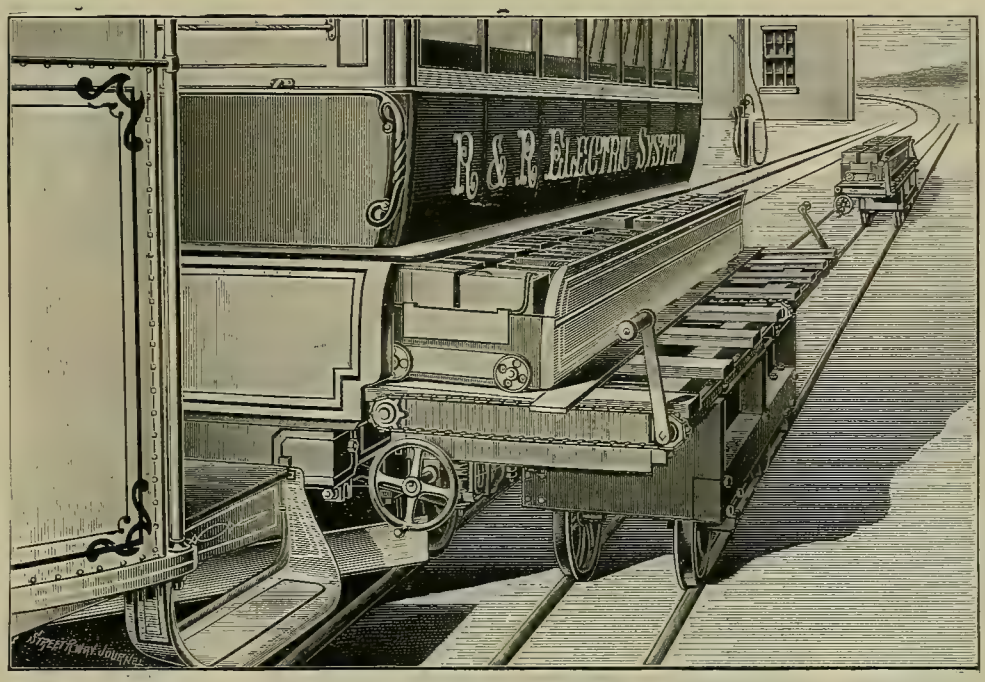
FACTORIES:—New York City. Schenectady, N. Y. Harrison, N. J. Hamilton, Ontario. Sherbrooke, Quebec.

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



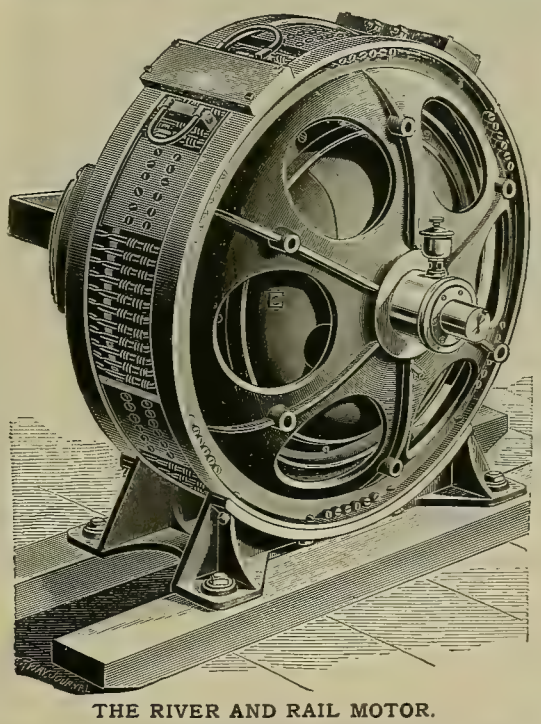
METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

Cars are Lighted by Batteries That Propel The Motor.

THE MAIN Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

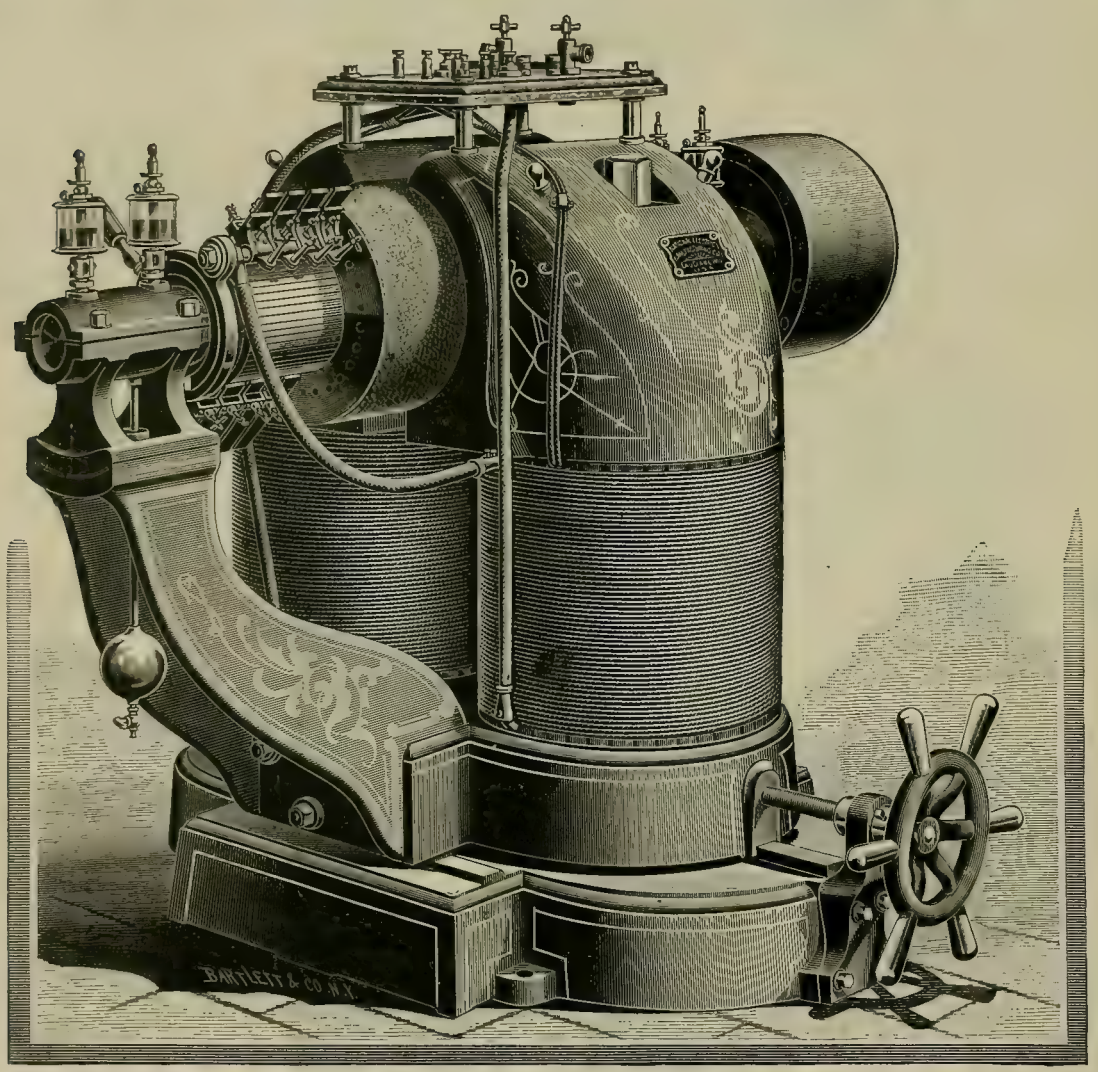
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMOS, CAPACITY 500 16) C. P. LAMPS.

COMPLETE

Central Station Equipments

—FOR—

LIGHT OR POWER

DISTRIBUTION.

OUR APPARATUS

IS OF THE

Highest Efficiency,

MECHANICALLY AND ELECTRICALLY.

We guarantee its operation and

PROTECT OUR CUSTOMERS.

COMPLETE

Direct Current System

—FOR—

ISOLATED LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building. St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

ELECTRIC RAILWAY SUPPLIES.

BARE TROLLEY WIRE,

INSULATED FEEDER WIRE,

JORDAN'S TROLLEY WIRE INSULATOR AND SUPPORTER.

Absolutely Safe and Reliable. No Soldering.

Connected by Private Wire with Postal-Telegraph Cable Co.

OKONITE TRADE MARK.

General Western Agents for Okonite AND Candee Wire.

The Central Spark Arrester.

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting into the globe.

THE HOT WIRE

LIGHTNING ARRESTER.

No Magnet or Self-Induction.
Furnishes Absolute Protection,
And is Automatic in its Action.
Our Price on these Instruments is very Low.

THE PERRY WIRE PEELER.

This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs,
Cleveland Switches, Paiste Switches,
Branch Blocks,
And all kinds of Electrical Supplies.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

CENTRAL STATION TELEPHONE TELEGRAPH RAILWAY } SUPPLIES.

MEASURING AND TESTING INSTRUMENTS.

Alexander, Barney & Chapin,

TELEPHONE BUILDING,

20 CORTLANDT STREET, **NEW YORK.**

SAWYER-MAN LAMPS,

Any Candle Power,

To Fit Any Socket.

NEW SERIES LAMP AND SOCKET FOR

ARC CIRCUITS.

SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

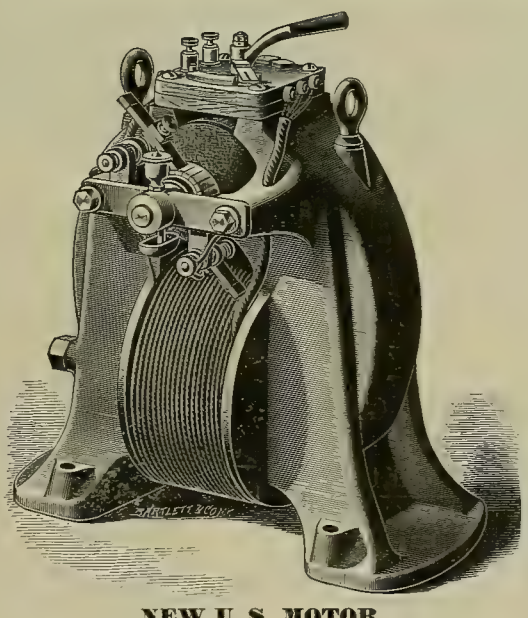
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

Cheaper than Overhead Wires,

MORE THAN TEN TIMES AS DURABLE.

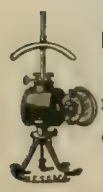
Guaranteed to stand a pressure of 100,000 volts when used for Electric Light Mains. Write for Estimates to the

Brooks Underground Telegraph Co., 207 Walnut Place, Room 5, Philadelphia.

THE E. S. CREELEY & CO.,

GENERAL ELECTRICAL SUPPLIES,

5 and 7 DEY ST., NEW YORK.



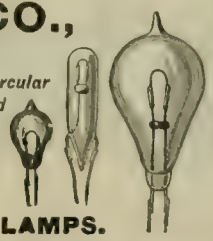
ELECTRICAL MEASUREMENT

Instruments and Batteries of the Very Highest Grade,

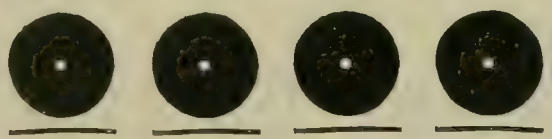
Precision and Constancy, Quality and Finish, the Best in the World.

Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.



MINIATURE INCANDESCENT LAMPS.



DUST-PROOF BELLS.

None Genuine Without the Washer.

STANLEY & HALL,

(Formerly **HAZAZER & STANLEY.**)

32 and 34 Frankfort St.,

NEW YORK.

BUSINESS CHANCE.

WANTED.

To place, at a bargain for buyer, within 30 days, a Steam Engine and Boiler plant. No real estate.

Address,

"CODAC,"

Care of WESTERN ELECTRICIAN.

INCANDESCENT and ARC LIGHTING and MOTORS.

Isolated Lighting a Specialty.

H. H. HUMPHREY,

1034 New York Life Building.

Contracting and Consulting Electrical Engineer. **OMAHA, NEB.**

HENRY C. EDDY,

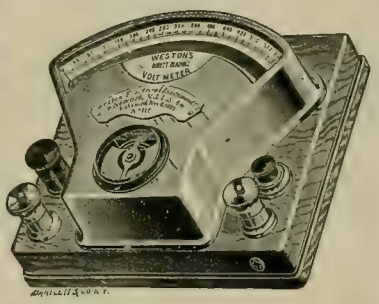
MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St., CHICAGO.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

Newark, N. J.

"CANVAS JACKET" LINE WIRE

MOISTURE & FIREPROOF.

ILLINOIS ELECTRIC MATERIAL CO.,

POLES

"BISHOP" RUBBER CABLES.

COVERED WIRES AND

"The Rookery," CHICAGO, ILL.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO.,

16 & 18 Broad St., New York.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

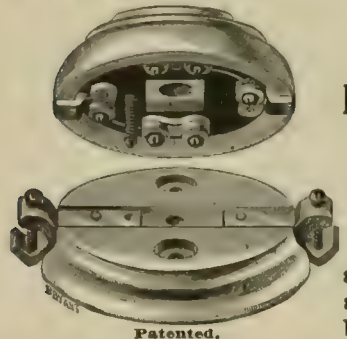
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.



DOUBLE POLED.

CAP EASILY DETACHED.

ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

Patented.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.

Kept in Stock and for Sale by all Prominent Supply Houses.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co.

MANUFACTURERS OF

EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

GET THE BEST!

P. and B.

INSULATING COMPOUNDS,
ARMATURE VARNISH,
INSULATING TAPE,
INSULATING PAPERS,
MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

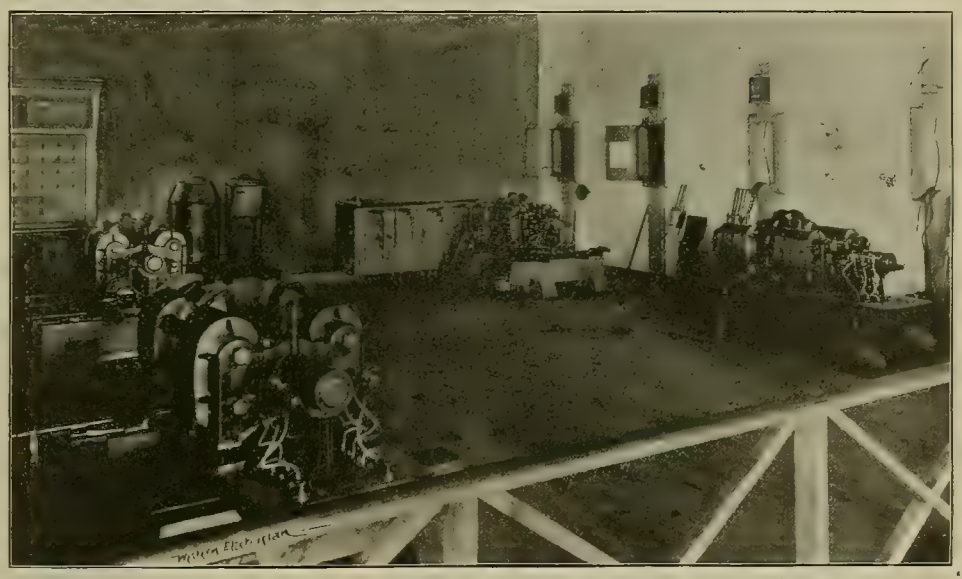
Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, OCTOBER 11, 1890. No. 15

Chicago City Electric Light Plant.

In the accompanying cut is represented the last plant started by the city of Chicago for the illumination of its streets. This station is located at the corner of Rice and Lincoln streets, in the northwest part of the city, and in appearance resembles the other city power houses. A substantial two-story brick structure, with a long one-story addition for the accommodation of the steam plant, etc., comprises the power house. The first floor of the building contains the engines. A part of this floor is also set aside for a repair shop. On the upper floor is the dynamo room. As will be seen from the view there are only four machines at present installed. These are 60 light Brush dynamos. They are belted direct to two Ide engines on the floor below. These engines are 125-horse power each, of the type recently described in the WESTERN ELECTRICIAN. An extra engine has been installed for an emergency. The steam plant consists of four tubular boilers, each of 140-horse power. They are provided with Roney stokers.



CHICAGO CITY ELECTRIC LIGHT PLANT—DYNAMO ROOM IN THE BRUSH STATION.

The district supplied with electric lights from this station includes Milwaukee avenue from Kinzie street to North avenue, Lincoln street from Milwaukee avenue to Indiana street, Indiana street from Milwaukee avenue to Lincoln street, Chicago avenue from Lincoln to Division street, Halsted street from Indiana street to Chicago avenue and the viaducts. There are 220 lights in this district, and no additions will be made this year. As in all the other city plants, the wires are buried. There are fifteen miles of underground cable in this district.

Meeting of Chicago Telegraph Operators.

A meeting of railroad and commercial telegraph operators was recently held in Chicago. The meeting was called by the organizers of the Brotherhood of Telegraphers for the purpose of endeavoring to effect an affiliation between the commercial and railroad operators. About sixty-five operators were present.

The organizer, A. L. Morris, explained that the brotherhood had now nine active lodges and nine others in the course of organization. He stated in an address that the difficulty which telegraphers were laboring under at present was disorganization between the commercial and railroad men. He said that when any difficulty arose with the commercial men, railroad operators could be obtained by the Western Union or Postal from the railroads, and vice versa. If the men, threfore, would only organize and bring about an amalgamation of the two bodies they could maintain the rate of wages, and instead of first-class men earning $65 per month they could demand the standard pay of $80 to $90. He thought organization of both bodies of men in one brotherhood would deter rather than promote a strike, as the mere fact of such a brotherhood existing would prevent the cutting down of wages.

Before the meeting adjourned a number of commercial and railroad operators joined the new organization.

Electric Poles in Rochester, N. Y.

The citizens of Rochester, N. Y., have decided to inaugurate a war on electric poles in certain districts. There has been considerable trouble over the street railway company's poles and that company is not using any in the business district where they can be dispensed with, the supporting wires for the trolley wire being fastened to the business blocks on either side of the street.

The residents of Lake avenue have sent a communication to the executive board requesting that body to cause the removal of the Brush company's tall poles from that thoroughfare. It is claimed that the poles are unsightly and owing to their immense proportions they are dangerous to life and property in case of violent storms visiting that city. It is further claimed that the presence of the poles depreciate the value of property.

The telephone company has of late come in for its share of attention. There is very little Rochester capital invested in this enterprise and therefore little sympathy can be expected. The exchange is directed from the Buffalo office and this is not pleasing to Rochesterians. About a week ago the company sent a communication to the executive board through the superintendent of the fire alarm service stating that the underground cables had already been laid in Main street and were now being put down in State street and asked that certain poles be allowed to remain as terminal and distributing poles to carry the wires from the cables to users of telephones. The adoption of the following resolution was the only response which the board deemed called upon to make:

Resolved, That the clerk be and hereby is directed to at once notify the Bell Telephone company to remove all poles which said company agreed to remove in its contract with the city of Rochester on or before November 1, 1890, and that the superintendent of the fire alarm telegraph take immediate steps looking to the removal of the city wires from the telephone poles.

Owing to the public discussion of electric poles and overhead wires a conference of representatives of all the companies interested was held. There were present, George A. Redman, superintendent of the Brush Electric Light company; John A. Almstead, superintendent of the Rochester Electric Light company; L. P. Ross of the Rochester company; H. L. Brewster, secretary of the Edison Electric Illuminating company; George Raines, attorney for the Bell Telephone company; John N. Beckley and Mr. Crawford, representing the Rochester Railway company; Julius Armbruster and George W. Aldridge of the executive board and C. R. Barnes, superintendent of the fire alarm and telegraph department of the city. It was agreed that every pole should be painted some uniform color to be designated hereafter. The cross-arms are to be straightened up where necessary and held squarely by iron braces. It was also agreed that all extension fixtures on the poles be done away with and that the poles be protected from defacement by bills and signs. The superintendents promised, in addition, that hereafter the ladders of the linemen should not be allowed to hang on the poles, and that the men should not be permitted to use "climbers" on the poles nearer than 15 feet from the ground. Poles located on corners are to be straightened and all dead wires removed. All these improvements are promised with the idea of making the poles less unsightly and therefore not so obnoxious to the public. Superintendent Barnes endeavored to have the 90 foot poles in the business districts replaced by 45 foot poles but the companies would not agree to this and the matter was held open for further consideration.

Chicago Electric Club.

The Chicago Electric club will open its regular winter season Monday evening, Oct. 20th, at 8 o'clock, when an interesting programme will be presented. A business meeting will also be held, and as there are several very important topics for discussion a large attendance is desired. The literary exercises will consist of readings by C. C. Haskins and a paper by B. E. Sunny, the title of which will be announced hereafter. It is expected that a large number of new members will be admitted.

Experiments are being made with electric search lights at forts at the Isle of Wight. Nine or ten of the torpedo boats anchored in Totland Bay tried to pass round the Needles under cover of the darkness. The search lights were used to prevent their progress, and fire was opened from the forts as soon as the lights revealed their whereabouts. Only one of the torpedo boats "escaped."

Electricity in the Service of the Chicago Fire Underwriters.

Several months ago the inspection department of the Chicago Fire Underwriters' association, which is in charge of Charles Squires, decided to establish a test department for the purpose of experimenting with automatic sprinkling apparatus. To L. M. Johnston, inspector of automatic sprinkler equipments, was allotted the task of arranging a test room and designing apparatus with which the sprinkler systems might be easily and quickly tested.

As in making the experiments, it would be necessary to employ a convenient and easily handled heating apparatus, and also to have a well lighted room and a small power plant, Mr. Johnston decided to use electricity, if possible, as a heating agent as well as for furnishing light and power. An arrangement was therefore made with the Carpenter-Nevans Heating company of Minneapolis to construct an electric heater of special design which might be operated by current from the Chicago Edison company's 220-volt circuit. After a number of experiments a heater was built which fulfilled the requirements, and the Chicago underwriters are now possessed of a test room which illustrates in the highest degree the utility and convenience of electricity.

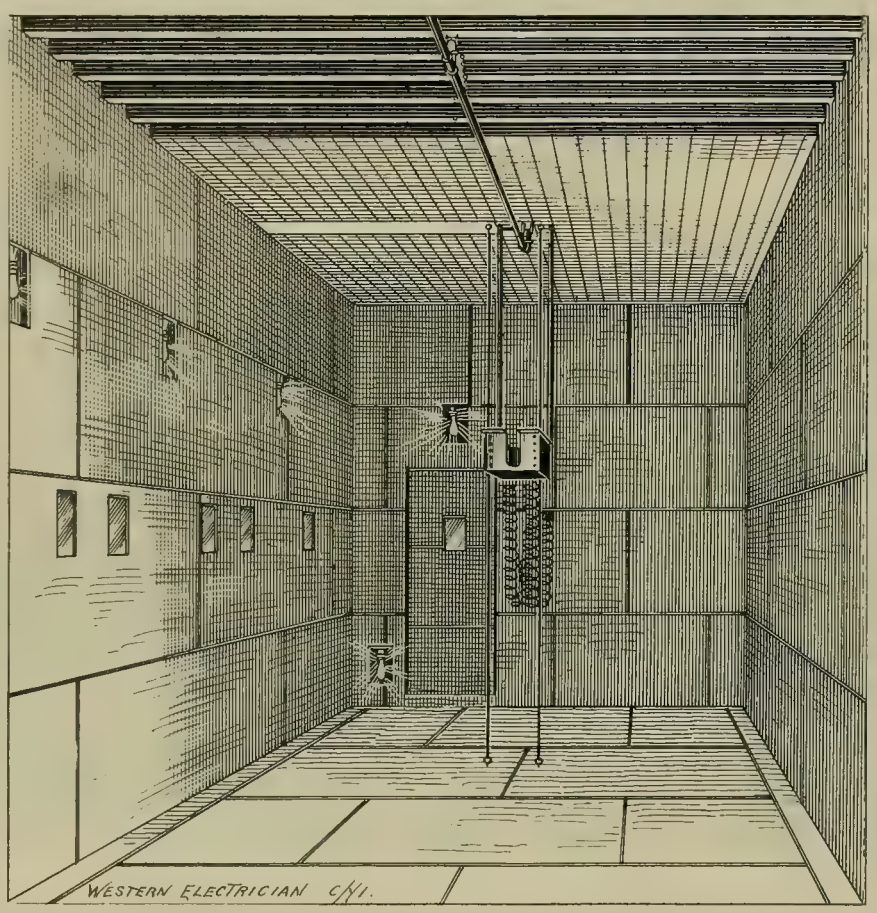
In order to thoroughly understand the features of this novel installation, it will be necessary first to explain in a general way the action of the automatic sprinkler.

The most essential feature of these systems is, of course, the sprinkler proper. The sprinklers are attached to a system of piping extending into every room in a building. This piping along ceilings with its little sprinkler attachment is, doubtless, a familiar sight to many. Attached in the main pipe of the system at a convenient point between the source of water supply and the piping in the building, is an automatic valve of special design. This valve is so constructed that it opens and admits water to the system when the pipes throughout the building are freed from a charge of compressed air previously pumped into them. The fact that if water was kept constantly in the pipes it would at times freeze, necessitates the use of the automatic air-and-water valve. The valves in the sprinklers proper open and permit the escape of the water when the temperature in the room rises above 155 degrees. Pressure to force the water through the system is obtained in general practice, either by a "gravity tank" or by means of air compressed by a pump and kept stored until allowed to act on the water.

It will be readily seen that a sprinkler system is necessarily somewhat complicated, and as such systems are introduced into buildings with the object of lessening the fire risk, and thereby securing a lower rate of insurance, it will be appreciated that it is of the greatest importance to all parties concerned that the insurance inspector should have every facility to acquaint himself with the efficiency of the apparatus.

It was with this object that the inspection department undertook to equip the special test room.

In Mr. Johnston's room, which is in the building on Monroe street, Chicago, now occupied by the Chicago Fire Insurance patrol, a number of the automatic valves of different patterns are arranged along the walls in closets and are connected with a common source of water supply. The valves are piped so that any one of them may be tested separately at pleasure. A couple of air pumps driven by a 1-horse power Detroit motor, keep up a pressure in two tanks which supply the valves. Connected with all these different styles of valves, and so arranged that any valve may be operated in conjunction with it, is a sprinkler pipe. This pipe runs into a zinc-lined apartment which was built in the test room especially to facilitate the experiments with the sprinklers. The interior of the sprinkler room which is twenty feet long, ten feet wide and twelve feet high, is represented in the accompanying illustration. A glance will give the reader a good idea of its construction. This apartment is built of wood and its interior is zinc-lined and water-tight, except the ceiling, which is half sheathed and of wood, as indicated. At the center is shown the electric heating device. This might be described as a metallic box measuring 12x12x12 inches, the three sides and the bottom of which are constructed of Carpenter-Nevans heaters. The one side toward the observer is of plain sheet zinc slotted to permit the raising of the heater until it presses against the ceiling and envelopes completely the sprinkler at the end of the pipe. The outer surface of this box is, of course, thoroughly insulated electrically from the heating coils. The switch to control the current is on the outside of the apartment. The heater is wound for a 220-volt circuit, and when in operation takes on an average sixteen amperes. To prevent any swinging motion guide wires are strung as shown, and two cords fastened to the heater, and passing over pulleys in the ceiling, permit the raising and lowering of the heater from the outside. In the ceiling with its bulb set just above the sprinkler on the end of the pipe, is a mercurial thermometer which will indicate a temperature from freezing point to 465 degrees. This instrument is so arranged that its indications may be read on the outside of the apartment. The room is well lighted, in the manner shown, by nine incandescent lamps. Small windows in the sides of the room permit a close observation of the action of the sprinkler. When a sprinkler is to be tested it is only necessary to attach it to the end of the pipe, connect the valve, etc., on the outside, and then apply the heater. By means of the cords the heater is hoisted until it incloses the sprinkler. Current is then turned on until the temperature rises to the point at which the sprinkler opens. After this the heater is lowered and the form of the water jets may then be closely observed. A temperature of 221 degrees at the sprinkler has been attained through the use of the method and a higher degree of heat could be obtained. The sprinklers, however, are designed to open at about 155 degrees.



ELECTRICITY IN THE SERVICE OF THE CHICAGO FIRE UNDERWRITERS.

Telephoning Between London and Paris.

The question of telephone communication between London and Paris is occupying the attention of European experts and is watched with no little interest in this country. *La Nature* furnishes the following interesting information on this subject: At a meeting of the English Association for the Advancement of Science, at Newcastle in 1889, Mr. Preece made known the reasons and described the experiences which had led him to believe it possible and practicable to effect telephonic communication between London and Paris. Since that time the movement has been gradually assuming tangible form. The aerial lines of copper wire are in course of construction between the two capitals and their respective coasts. A double cable will be laid between the coasts of Kent and Sangate to join with the aerial lines, which will establish a complete metallic circuit between the two capitals. The expense of manufacturing the cable will be equally divided between the two governments. It is possible to foresee that the telephonic communication will be excellent for the product of the total resistance of the line (in ohms) by the total capacity in microfarads will not exceed 5,900 while in the telephone line established between Buenos Ayres and Montevideo, the product is equal to 10,400. The cable to cross the English channel will have 4 wires and the specifications relative to its construction have been established by extensive experiments. This cable is now in course of construction and it is hoped that before the end of the year telephonic communication between London and Paris will be an accomplished fact.

Fort Wayne Electric Club.

The Fort Wayne Electric club held an interesting meeting Thursday evening, Oct. 2. An excellent programme was presented, the musical features being particularly attractive. Senator Robert C. Bell presided and introduced the speaker of the evening, Prof. Kimball, who gave an illustrated lecture on the development and application of electricity.

M. M. M. Slattery gave some illustrations of the application of electricity to domestic work, especially cooking, and explained the system which he showed.

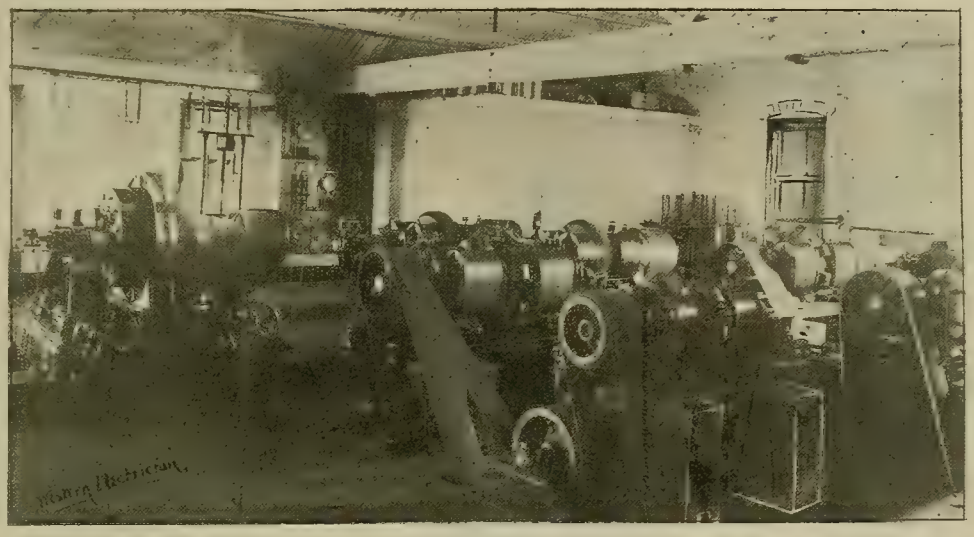
The Titusville, Fla., Electric Light company, capital $10,000, has been formed and will soon erect a power house.

It is stated that the cost of an electric light installation for the purpose of facilitating the work in a somewhat cramped goods yard of a London railway station was entirely paid for by the amount saved through decrease in the annual robbery of goods. At another large goods depot the night traffic had so increased that everything was blocked. The goods trains were stopping the passenger traffic and it was impossible to handle it. At this juncture it occurred to the manager to throw more light into the goods sheds and yards. The loading stages and the shunting grounds were practically flooded with light. The men worked with freedom; the hand lamps were set on one side, and the time occupied in handling them was bestowed on the actual work of loading and unloading the goods. The trains were soon disposed of, and traffic went on as usual.

Power Plant of the Muskegon Electric Railway.

The accompanying illustration is an interior view of the original electric power equipment of the Short Electric Street railway at Muskegon, Mich. As will be readily seen the station is a combination of a lighting and power plant. The machine shown prominently at the left is the now well-known Brush alternator. The railway switch-board appears in the cut back of the dynamos.

The first order for electrical equipment for this road consisted of five motor cars and two 40,000 watt generators. This apparatus did the work of the six horse cars, and one car was held as a reserve. It is stated that on the introduction of the electric system the road immediately showed an increase in traffic of 40 to 50 per cent., with a decrease in operating expenses. The company has also equipped an extension of this line to Lake Michigan, a distance of 2½ miles. Additional cars and motor trucks from the Short Electric Railway company have been received and two generators each of 125-horse power capacity are to be started. It may be mentioned that a new and more complete station is shortly to be in running order. When completed the road will consist of about 11 miles of track and the rolling stock will comprise twelve motors and twelve trail cars.



POWER PLANT OF THE MUSKEGON ELECTRIC RAILWAY.

American Street Railway Association.

The American Street Railway association will hold its annual convention at Buffalo, Oct. 15. The headquarters of the association will be the Iroquois hotel, where arrangements have been made to accommodate a large number of delegates and visitors interested in street railway work. It is anticipated that this convention will be one of the most important meetings of the year from an electrical standpoint. Street railway conventions have come to be practically electrical conventions, and the one to be held at Buffalo will not be an exception. The following is a list of the officers of the association: President, Thomas Lowry, Minneapolis, Minn.; first vice-president, C. Densmore Wyman, New York; second vice-president, J. C. Schaffer, Indianapolis, Ind.; third vice-president, Robert McCulloch, St. Louis, Mo.; secretary and treasurer, Wm. J. Richardson, Brooklyn. The executive committee is composed of the president, vice-presidents and the following named gentlemen: Geo. B. Kerper, Cincinnati, O.; Geo. W. Kiely, Toronto, Can.; R. Semmes, Memphis, Tenn.; F. H. Monks, Boston, Mass.; Francis M. Eppley, Orange, N. J.

A glance at these names is sufficient to show the interest that the association must necessarily take in electrical propulsion.

Calumet Electric Street Railway, Chicago.

A trial trip of the Calumet electric street railway, the first in Chicago propelled by electricity, was made Saturday afternoon. At 3:30 a car left the northern end of the line, bearing C. E. Loss, the contractor, Columbus R. Cummings, N. K. Fairbank, S. E. Gross, W. V. Jacobs, representatives of the press, and a few invited guests. The new line is but the beginning of an extensive system to connect the manufacturing and residence suburbs which now lack proper communication. It extends from the South Chicago rolling mills by way of Eighty-ninth street, Mackinaw avenue, Harbor avenue, Ninety-third street and Stony Island avenue to Ninety-fifth street. The company secured its franchise before the territory it traverses was included in the city proper, and it therefore has the advantage of having an "overhead ordinance." The Rae system is used and the cars will be operated at a speed of twelve to twenty miles per hour.

On Saturday the party examined the line that has already been completed, and others now in course of construction. The power house was also visited and a lunch served. The electrical apparatus for the entire plant is not yet installed, but within a couple of months the system will be complete. One line is now nearly finished from Pullman to Cottage Grove avenue and Eighty-seventh street. By Dec. 1 a connecting line will be opened from South Chicago to the Pullman line at Cottage Grove avenue and One Hundred and Fourth street. As soon as practicable the system will be extended to One Hundred and Fifteenth street, through One Hundred and Fifteenth street, Michigan avenue, One Hundred and Eleventh street, and Vincennes road, around Washington Heights and Morgan Park. Further extensions will probably follow.

Electricity and the World's Fair.

Electrical matters in connection with the world's fair begin to occupy the attention of the commissioners. The committees of the local and national boards having charge of this particular department have been formed, and last week the local committee organized, electing Col. R. C. Clowry chairman. Col. Clowry's knowledge of the wants of the electrical industries and his experience in handling large enterprises will prove valuable to the commissioners. Mayor Cregier, of Chicago, who is also a member of the committee, will bring to this work his valuable experience in engineering work. The world's fair commissioners and the electrical industries have reason to congratulate themselves on the outlook in this department.

The *Evening Post*, Chicago's leading evening paper, contains the following:

"The WESTERN ELECTRICIAN, of this city, is doing yeoman service in behalf of the world's fair. It has camped on the trail of every electrical convention that has been held this year, and has insisted in at least one double-leaded editorial on each occasion that there be some sort of recognition of and preparation for the world's fair. Its towline, too, has been wonderfully strong, for all the conventions have bowed before the edict and have stood up to be counted. By the way, has it ever struck electricians that their journals are head and shoulders above those of any other profession or trade extant? It is true. Their illustrations are always of the finest that art can produce; their leaders are the product of the pen of thoroughly versed scientists and good writers, and nowhere else is there the enterprise manifest in these bright, newsy exponents of electricity. What other classes of journals take the trouble or go to the expense of sending for stenographic reports of all the special conventions held in the interest of the science?"

Electrical Industries and the Census.

The National Electric Light association continues to advocate the proposition to have a complete electrical department in the census, and in order to keep the matter in the minds of those engaged in electrical pursuits it has prepared circulars on this subject, requesting the members to correspond with George C. Maynard, 1409 New York avenue, Washington, D. C., expressing their views on the subject. The importance of this matter cannot be overestimated.

Air Ships to be Operated by Electricity.

The Mount Carmel Aeronautic Manufacturing company has been formed at Chicago with a capital of $20,000,000. The object of this company is to build and operate air ships. Electricity will be employed. The incorporators are E. J. Pennington and Richard Butler of the Mount Carmel Machine and Pulley works, at Mount Carmel, Ill.; W. C. Dewey of the Grand Rapids Furniture Manufacturing company of Grand Rapids, Mich.; E. L. Chamberlain and James A. Pugh.

The members of the company claim to have unlimited means at their disposal and they assert that they are backed by wealthy English capitalists. They say there is not a share of stock for sale and that they will offer none to the public until the ships are built and operated regularly.

The ship is shaped much like the hull of an ordinary sea vessel. It requires only two men to operate it, the switches, guides, etc., being controlled by electricity. It has on either side and extending the entire length, large wings arranged so as to turn into a parachute in case of accident. At the corners of these wings there are propeller wheels, enabling the ship to be raised or lowered at will. A large propeller wheel at the bow gives the ship power either to go backward or forward. Above the buoying chamber is a rudder for steering horizontally. Just in the rear of this is a smaller one to steer either to the right or left. The cabin or car is suspended immediately beneath this frame work and beneath this are the storage batteries, which also act as ballast. In the front of the car is a place for the pilot, who is provided with levers for switching the electric appliances, the rudders and propellers being controlled by electricity.

The projectors of the enterprise claim that they will have a car in Chicago in about six months. They will erect an immense building at Mount Carmel, Ill., where they will manufacture their apparatus. They are certainly enthusiastic over their scheme, and are evidently confident of success.

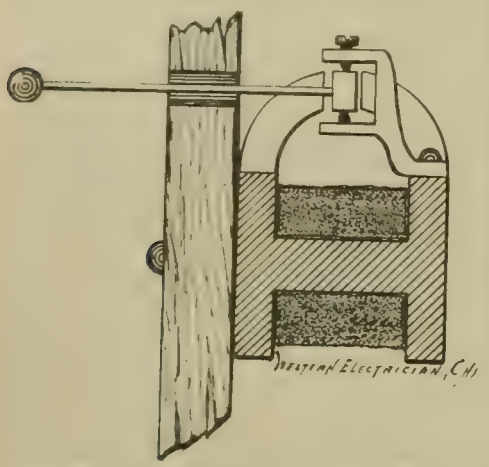
The Telegraph in New Zealand.

The report of the postoffice and telegraph department of New Zealand for 1889, just received, contains a vast amount of statistical matter. The receipts in the telegraph department were $531,270 while the expenditures, exclusive of salaries, was $237,275. It would appear that about $225,000 should be charged to this department for salaries. This would bring the cost to $462,275, and leave a net gain of $68,995. This department controls the telephone as well as the telegraph and both are included under one head in the report.

Pipes for gas, water and electric cables, made of paper, have recently been exhibited in Vienna. The width of the paper is equal to the length of a given pipe. The paper runs first through molten asphalt and is rolled upon a mandril of wood, the size of which determines the inside diameter of the pipe. When cool, the mandril is removed and the inside of the tube covered with a kind of enamel, the composition of which is kept secret. The outside is covered with a bituminous lacquer and sand. It is stated that a pipe of 2 centimetres thickness of material stands an internal pressure of 1,000 kilogrammes.

Signal Bell Electro-Magnet for Bridged Circuit Telephone Systems.

The cuts illustrate a new form of "ringer" magnet especially designed for service on lines, each of which connect several subscribers. This electro-magnet is also adapted for circuits on which it is necessary to use retardation coils.



SIGNAL BELL MAGNETS FOR BRIDGED CIRCUIT TELEPHONE SYSTEMS.

The construction is so clearly indicated in the illustrations that an explanation is hardly necessary. A permanent magnet is pivoted as shown over the magnet coil. The coil has an ohmic resistance of 1,000 ohms. The core is of cast iron and is provided as shown with horn-shaped pole pieces. These polar projections extend upward and inclose the bar magnet. The relative polarity of each part is indicated by the letters. The inventor, J. J. O'Connell of the Chicago Telephone company, claims for the device great simplicity of construction and a very high retardation. It is stated that in a comparative test with the well known tubular retardation coil of the same ohmic resistance, it was impossible to detect with the ordinary operator's telephone outfit, the presence of the new type magnet. The presence of the tubular coil however, was readily detected.

Electro-Magnet Winding Machine.

In the winding of electro-magnets, especially those wound with fine wire in many convolutions, it is the usual practice to fasten the spool of the magnet on a spindle and rotate it while a workman directs the wire onto the spool in successive layers by passing the wire through the hand and moving the hand from side to side so as to cause the wire to travel from end to end of the spool. Considerable skill is required in this operation, and at best the layers are unevenly wound, so that the wire is not laid as compactly as is desirable. The machine illustrated in Fig. 1 is designed to facilitate the winding process and also to enable the operator to make the layers more regular, while at the same time requiring less skill on the part of the operator. The invention consists essentially of two parallel rotative spindles having spiral grooves similar to screw threads. These spindles serve as guides for directing the wire to the spool and regulating its travel from end to end. The operator has only to hold the wire against

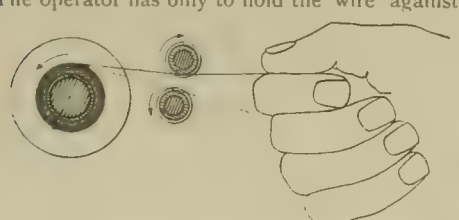


FIG. 2.—ELECTRO-MAGNET WINDING MACHINE.

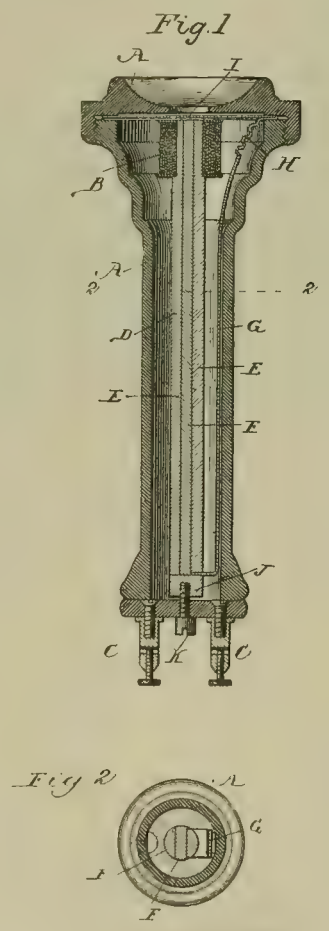
one of the spindles, Fig. 2, so that it enters the proper groove to be propelled in one direction along the spool, and when it reaches the end of the spool the operator has only to move the wire out of the groove of this spindle and into the groove of the other spindle, which is so directed as to propel the wire in the opposite direction along the spool.

This machine is the invention of J. J. Wood, Brooklyn, N. Y.

The D'Unger Telephone.

Frequent references have been made during the last few weeks to the D'Unger telephone, in the discussion which the druggists of Chicago have engaged in over the prospect of a rival for the Chicago Telephone company. There are now two ordinances pending before the Chicago city council—the Chicago Long Distance Telephone company's and the Subscribers' Telephone company's. It was announced by a gentleman who was supposed to be an authority that the Subscribers' company would adopt the D'Unger telephone, but this is positively denied in a letter to the WESTERN ELECTRICIAN by the president of the Subscribers' company and others interested in it. It is claimed by these gentlemen that they have no connection with any other company. It is possible that the Subscribers' company contemplates awaiting the expiration of the Bell patents.

On the other hand it is now announced that the Long Distance Telephone company, Chicago, controls the "D'Unger patents." As this company has a petition before the city council of Chicago for a franchise and as it will soon appeal to the people of Chicago for support there is much interest manifested in the "invention" on which it bases its claims for public uses. This D'Unger "telephone" has been persistently pushed before the public and the druggists of Chicago have "approved" it according to the statements of its exploiters. Stamped with



THE D'UNGER TELEPHONE.

the approval of such high authority it is not to be wondered that public curiosity has been awakened.

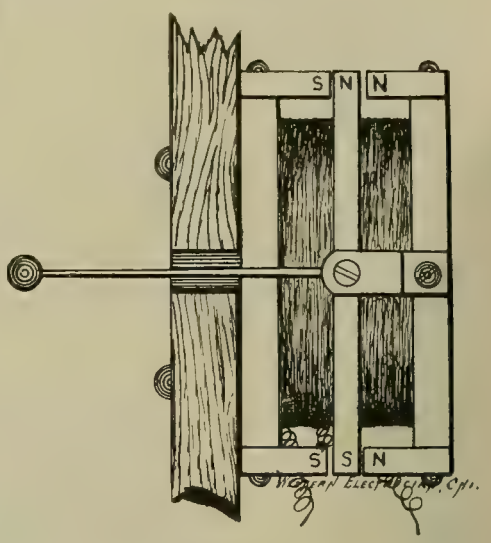
With a view, therefore, of giving the readers of the WESTERN ELECTRICIAN an opportunity to compare the D'Unger instrument with the Bell receiver, with which the public generally is familiar, the accompanying cut and a copy of the patent claims and specifications are presented. It may be mentioned that the illustration is a photographic reproduction of the patent drawing. An abstract of the specifications and all the claims follow:

R. D'Unger of Chicago, Ill. Telephone Receiving Instrument. Patented Aug. 27, 1889. Patent No. 409,736.

"My invention relates to the construction of a diaphragm and magnet of a receiving instrument.

"In the accompanying drawings, Fig. 1 is a longitudinal section and Fig. 2, a cross section, on line 22 of Fig. 1, of an instrument containing my invention.

"*A* is a case of substantially the ordinary form.



SIGNAL BELL MAGNETS FOR BRIDGED CIRCUIT TELEPHONE SYSTEMS.

"*B* is the coil or helix.

"*C* are the binding posts for connecting the instrument to line wires.

"*D* is the bar or magnet upon the end of which the coil *B* is placed.

"In the instrument shown in the drawings the bar *D* is made of three pieces, the outer ones *E* being of hardened steel and the inner one *F* of soft steel or soft iron. This soft iron central piece is longer than the others, and its end is drawn out, as at *G*, to a size and form sufficient to extend from the back end of the bar forward through the case to the front again, where it is flattened so as to form the diaphragm *I*. At *H* this return piece is corrugated, as shown in Fig. 1, so as to permit the adjustment of the diaphragm and magnet with reference to each other without straining any of the parts. To the back end of the bar is secured a button *J*, of brass or other suitable material, to receive the screw *K*, by which the adjustment is effected.

"By this construction the diaphragm forms one pole of the magnet, the other pole being the end of the bar adjacent to the diaphragm."

The claims are as follows:

"1. In a telephone receiver, a magnet having the coil upon one end and having its other end flattened to form the diaphragm with the corrugated portion *H*, substantially as set forth."

"2. In a telephone the combination of the hardened steel portions *E*, the soft metal portion *F*, the return bar *G*, having its end flattened into the diaphragm *I*, and the corrugated portion *H*, substantially as set forth."

The Natural Bridge to be Lighted by Electricity.

The Natural Bridge will soon be lighted by electricity. L. N. Cox of Washington, representing the National Electric Manufacturing company, has just closed a contract with Gen.

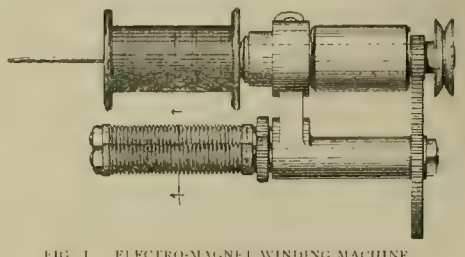
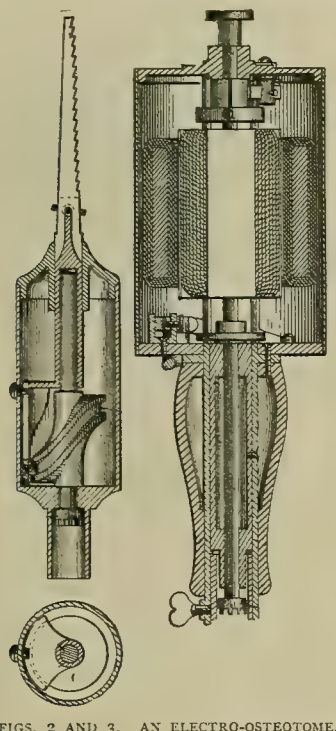


FIG. 1.—ELECTRO-MAGNET WINDING MACHINE.

Fitzhugh Lee for an electric light plant to light Glasgow and the Natural Bridge. The plant will be run by water power. Besides lighting the bridge, streets and hotels, lights will be furnished for stores and residences. There will be fifty arc and 1,500 or 2,000 incandescent lights.

An Electro-Osteotome.

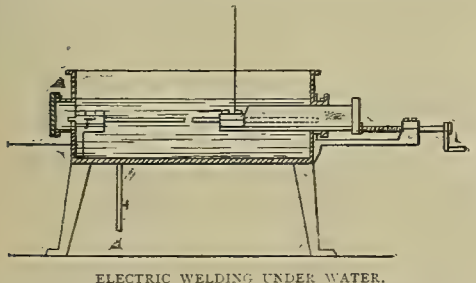
One of the latest applications of the electric motor to special work is shown in the accompanying illustrations. The apparatus is named by the inventor an "electro-osteotome." In plain English it might be called a bone dissector. The tool is designed to facilitate operations in bone surgery. Its general appearance is indicated in Fig. 1. The osteotome proper consists of a hand-piece which contains a small electric motor, Fig. 2, so arranged as to impart motion to special tools at the end. An adjustable crane attached to the operating table supports the hand-piece by means of an elastic cable and permits its movement in any desired direction. Small switches conveniently placed on the hand-piece control the motion of the motor. The special form of holder-end to be attached when a small circular saw is to be used, is shown in detail in three different views embodied in Fig. 4. The reciprocating tool holder with a small saw in place, is represented in Fig. 3.



FIGS. 2 AND 3. AN ELECTRO-OSTEOTOME.

Electric Welding Under Water.

The process of making an electric weld while the articles to be joined are submerged in water has been developed by Charles L. Coffin of Detroit. The advantages claimed to be attained by the use of water in the novel manner described are that the water retards the formation of oxides and scales upon and within the two pieces of metal which are being operated upon and also that the water "materially increases the effect of the current." The cut illustrates diagrammatically the apparatus employed in the process.



ELECTRIC WELDING UNDER WATER.

To Utilize the Power of Niagara.

A dispatch from Niagara Falls, Oct. 4, says: Niagara rejoices to-day over the commencement of the tunnel, which, by the development of power that it will bring, will place her in a position to be rightly termed the "Manchester of America." The first sod was lifted at 10:42 A. M., by C. B. Gaskill, president of the Niagara Power company, the implement used being a nickel-plated shovel. The air was filled with the shrill notes of the whistles of the mills and the clanging of church bells. A shovelful of earth was also removed by each of the following gentlemen: Alexander Porter, Francis Delano, W. Caryl Ely, Benjamin Flagler, Peter A. Porter, Myron H. Kinsley, John B. Pfetsch, E. A. Wickes, William B. Rankin, John Bogart and Albert H. Porter. Cablegrams were sent to Sir William Thompson, Prof. Mascart and Col. Turretini, members of the International Niagara Commission of London, Eng., to pass upon the competitive plans for the development and transmission of power.

Must Pay for Franchises.

Mayor Cregier of Chicago has written the city council that it should pass an ordinance providing for the payment by corporations of a tax or premium for franchises. The mayor has submitted a proposed ordinance containing the provision that where special authority is given for the use of the public streets, upon the surface, below it or above it, to a private corporation or association or individual, for purposes of monetary profit, the grant shall contain the express condition that 5 per cent. of the gross earnings shall be paid into the city treasury in consideration of such grant.

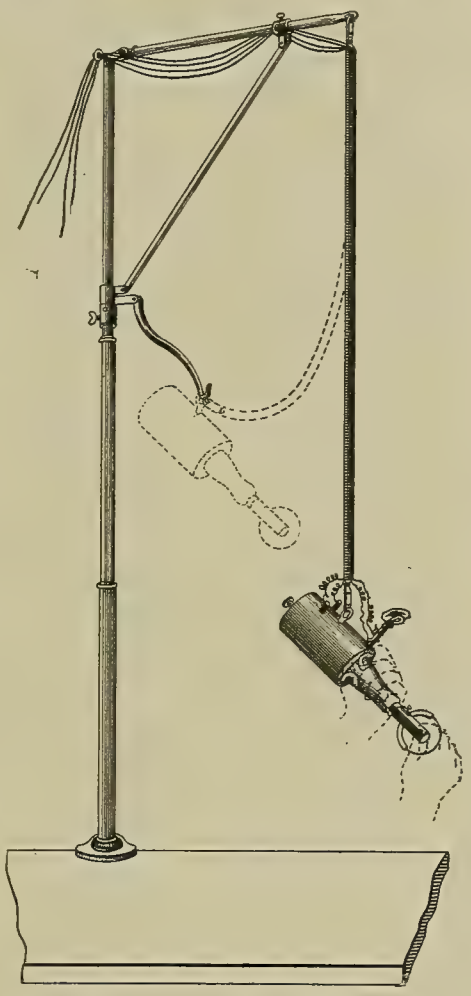


FIG. 1. AN ELECTRO-OSTEOTOME.

The passage of such an ordinance at this time would materially affect a number of electrical concerns which are seeking franchises. Among these are the following: Garden City Electric Light company, Underground Electric Light company, Fort Dearborn Light & Power company, Subscribers' Telegraphic and Service company, Chicago Long Distance Telephone company, Arcade Rapid Transit company. The representatives of all these companies are opposed to the enactment of this measure. They call attention to the fact that the companies now in existence pay no tax of this kind, and the new corporations would be working under a disadvantage.

The Telephone at Christ Church, Birmingham, England.

A dispatch from London states that evening service on Sunday, September 28, in Christ Church, Birmingham, England, was successfully telephoned to London, Manchester, Derby, Coventry, Kidderminster and Hanley.

The several transmitters were attached in various positions in the chancel. One instrument was hung on the lecturn, another was suspended by a cord to the gas bracket behind the communion rails, and on the edge of the pulpit there was a small brass frame carrying two more of the instruments. In the choir stalls there were four transmitters, two on each side affixed to the woodwork. The instruments were in cases of nickel and ebonite. Switches were provided by which the choir leaders could, unseen, turn the choir off or on. The lecturn transmitter was also controlled from the choir switch. An account of the experiment is given by a correspondent as follows:

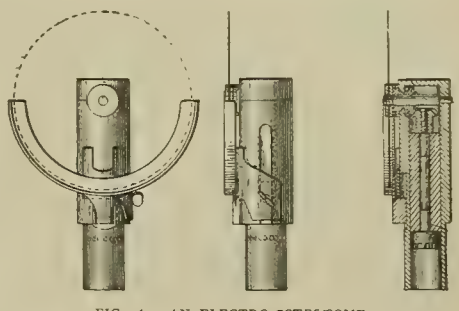


FIG. 4. AN ELECTRO-OSTEOTOME.

When the morning service commenced there was what appeared to be an unseemly clamor to hear the services. The opening prayer was interrupted by cries of "Hello, there!" "Are you there?" "Put me onto Christ Church." "No, I don't want the church," etc. But presently quiet obtained and by the time the Psalms were reached we got almost unbroken connection and could follow the course of the services. We could hear little of the prayers—probably from the fact that the officiating minister was not within voice-reach of the transmitter. The organ had a faint, far-away sound, but the singing and the sermon were a distinct success.

New Dining Room Push Button.

It would seem that so simple a device as a push-button leaves little room for improvement or change, but such is not the case. In pushes used in connection with the wall or floor connection and a flexible cord, the extension part of the floor push is now considered quite essential. Still the push-button which is in use may be on the table or on the lap of the hostess, or very likely on the floor, unless special pains are taken to look after it. Chas. G. Armstrong has designed an attachment illustrated herewith which holds the push in any desired place. The new push can readily be slipped on the edge of the table, or on one of the side panels, or even on a chair. Whether the push is uppermost, or is concealed by being turned downward, it is always at hand in the position desired when wanted. Any style of push-button can be furnished with this improvement. The device is exploited by the Great Western Electric Supply company of Chicago.

NEW DINING ROOM PUSH BUTTON.

Washington, Pa., has contracted with the Edison company for forty-six street arc lights at $75 per light per annum.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } Associate Editors.
F. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Chicago City Electric Light Plant. Illustrated 191
Meeting of Chicago Telegraph Operators 191
Electric Poles in Rochester 191
Chicago Electric Club 191
Electricity in the Service of the Chicago Fire Underwriters. Illustrated 192
Telephoning Between London and Paris 192
Fort Wayne Electric Club 192
Power Plant of the Muskegon Electric Railway. Illustrated 193
American Street Railway Association 193
Calumet Electric Street Railway, Chicago 193
Electricity and the World's Fair 193
Electrical Industries and the Census 193
Air Ships Operated by Electricity 193
The Telegraph in New Zealand 193
Signal Bell Electro Magnet for Bridged Telephone Systems. Illustrated 194
Electro-Magnet Winding Machine. Illustrated 194
The D'Unger Telephone. Illustrated 194
An Electro-Osteotome. Illustrated 195
Electric Welding Under Water. Illustrated 195
Must Pay for Franchises 195
To Utilize the Power of Niagara 195
The Telephone at Christ Church, Birmingham, England 195
New Dining Room Push-Button. Illustrated 195
Editorial 196
Austin's Hand Dynamo. Illustrated 197
Progress of Work on the Ferranti System, London. Illustrated. 197, 198
Two Cases of Lightning Stroke. By Prof. H. I. Carhart 198
Electricity in the Navy 198
The Telegraph in South Africa 198
An Electric Ghost 198
Favored by the Fraternity 198
Development of Electrical Science 199
Electric Lamps as Press Recorders 199
Electric Light in the South 199
First Steps Toward Nationalism. By Edward Bellamy 199
Interesting Telegraph History 199
The Compensation of Alternating Current Voltmeters. By J. Swinburne 199
Electric Blow-Pipes 199, 200
Lightning in a Central Station 200
Dangers of Electric Wires 200

DEPARTMENTS.

Correspondence 200, 201
The Electric Motor 201
The Electric Light 201
The Telegraph 201
Electrical Patents 202

WE congratulate the *Electrical Review* and the *Electrical Engineer* on the marked improvement in their appearance. Both journals have changed their form of make up, discarding their old style to follow the more modern appearance of the WESTERN ELECTRICIAN. Our contemporaries have frequently signified their approval of our policy by adopting our methods, but modesty has restrained us from acknowledging each of these little compliments as they appeared. Now, however, when both of our contemporaries make such a radical change, we feel constrained to assure them of our approval of their decision.

THE making of an electric weld under water is, to say the least, a novel process. In another column a method is described by which two articles are welded by passing the current through them while completely submerged in water. Although certain advantages are claimed for the action of the water on the heated metal, it is a difficult matter to see anything but practical disadvantages in thus complicating what would be ordinarily an extremely simple process.

The inventor claims that "the water retards the formation of oxides and scales upon and within the two pieces of metal," and also "materially increases the effect of the current." He fails to state, however, whether or not the steam arising from the boiling of the water by the heated metal, would diminish the practicability of the process.

THE D'Unger telephone is described in this issue. This telephone has been repeatedly referred to by the daily press as the instrument which might be used in Chicago by the Subscribers' and Long Distance Telephone companies should one of these organizations be successful in the fight for a place in the field against the Chicago Telephone company. For the benefit of those of our readers who are not familiar with the features of the D'Unger receiver, we have reproduced the patent drawings and present them together with a copy of the claims and the specifications to enable the reader to judge for himself the merits of the "invention." The construction of the Bell telephone is well known, so that there will be no difficulty in making the comparison and forming an opinion as to the value of the D'Unger patent in a legal contest with the Bell company.

THE investigation by the insurance people of the various kinds of electrical apparatus, necessitated by the extensive utilization of electricity as an agent for the distribution of light, power and heat, has undoubtedly opened their eyes to its advantages. The insurance inspector of to-day has added another branch of study to his already extensive curriculum and he may now be found busily engaged in devising schemes whereby his work, through the aid of electricity, may be facilitated. In another column is presented a description of an interesting installation recently fitted up by the inspection department of the Chicago Fire Underwriters' association. In this test room we find electricity producing light, power and heat, and all from the same wire. Electric heating, under all circumstances, can not be said to be inexpensive, but in the present instance it would have been difficult to find any agent whose convenience would equal that of electricity.

A CURIOUS effect has been observed during the testing of the Ferranti concentric mains which are to supply alternating current in London from Deptford, England. We are informed through the columns of a contemporary that when current at high pressure, say 10,000 to 20,000 volts, is turned on a length of conductor, the concentric main "acts in the manner of a condenser, and a certain quantity of the current is required to charge the mains themselves, and the pressure on the mains in a long length seems to 'pump up,' as it were, and add together, so that the pressure on the other side of the transformer is far higher than the ratio would seem to indicate. Thus a transformation which would give 20,000 volts on a short length, if applied to a fairly long length of some miles, the pressure may rise to 25,000 or even 30,000 volts, and possibly to a far higher point."

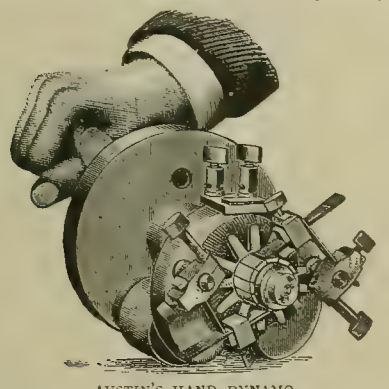
While it is difficult from the above to understand the exact nature of the effect observed, the phenomenon referred to is evidently a peculiar one. It is interesting from a scientific point of view, and it also serves to illustrate how the pioneer of any great electric system has at the start to meet and overcome innumerable and unlooked for difficulties. It is an easy matter to sneer and croak about the feasibility of a new system or invention before it has been fairly tried, and the ever existent small defects remedied. No one can predict with certainty whether Ferranti's great work will be a success or a failure, but whatever may be the result, the Deptford system will never be looked upon as anything other than a noble effort to perform a great feat of electrical engineering.

EDWARD BELLAMY has presented his views on "First Steps toward Nationalism," in the October *Forum* and his arguments for governmental control of the telegraph, telephone, light, power and transit service are reproduced in another column in this issue. He believes if his suggestions are accepted and executed his "ideal" system of government will soon follow. His plans as presented in the article quoted will provide for the public employment of a body of nearly two million workers, and the establishment of a system of great national stores for the supply of the necessaries and luxuries of life, strictly at cost, would soon follow. It is scarcely necessary to say there is little hope that the notions of this dreamer will be humored by the present generation. The mere fact that the proposed system would entail the employment by the government of such a number of men would of itself condemn the whole scheme. There is too much jobbery, too many public scandals, in fact too much boodle in public service to-day to permit of wise and honest administration of such vast interests. The temptation to turn these elements of power to political service would be too great for the average political boss to overcome. The present system will undoubtedly admit of many improvements but the adoption of the Bellamy plan would make matters worse rather than improving the tone of public affairs.

SURPRISE has been expressed in certain quarters that the WESTERN ELECTRICIAN should have taken the stand it did last week regarding the Subscribers' Telephone company, and the impression seems to have been made that our editorial was intended to express hostility toward the new enterprise. There is no ground for such a conclusion. We simply desired the Subscribers' Telephone company to know the position in which it would be placed if it undertook to operate an exchange under patents conflicting with Bell's. The WESTERN ELECTRICIAN thoroughly believes that there is no electric telephone which does not infringe the Bell patents. There is and has been plenty of money to exploit any new electric telephone which does not infringe the Bell patents; but no such telephone has ever been found and, in our opinion, no such telephone exists. Therefore, if the Subcribers' Telephone company endeavors to go ahead with some infringing telephone it will be promptly shut up by the Bell company, and it was for this reason and to prevent waste of energy and money, that the WESTERN ELECTRICIAN took the position that it did last week. We believe the Subscribers' Telephone company to be a genuine organization, formed for the sole purpose of reducing the charges for telephone service in Chicago and ready to go to the extent of establishing a new exchange system, if necessary, to bring about that result. We believe it is sound financially, and is not a mere stock jobbing scheme. This belief in its honesty of purpose has led us to inquire into its plans. It positively refuses to say what instrument it will use and it has been intimated that it will use the Bell telephone. In other words it will await the expiration of the Bell patents before opening its exchange. It is no small matter to plan and equip a telephone exchange for a city the size of Chicago and it is possible that no more time intervenes than is required to get a satisfactory franchise through the council and equip an exchange ready for operation. If this is the situation as regards the Subscribers' Telephone company, well and good. Its enterprise will then be an entirely legitimate one and it will have a reasonable chance of success. But if it endeavors to operate a telephone exchange in Chicago or anywhere else in the United States before the expiration of the Bell patent it will lose every dollar it puts into the business.

Austin's Hand Dynamo.

This little dynamo is of English manufacture and was designed for experimental work in the laboratory or on the lecture table. The output of the machine is claimed to be equal to about that of six or eight quart Bunsen cells. The machine all complete weighs only sixteen pounds. It can be fixed either temporarily or



AUSTIN'S HAND DYNAMO.

permanently to a bench or table. Six different leverages can be obtained by altering the position of the handle. The cut is taken from the London *Electrical Review*.

Progress of Work on the Ferranti System, London.

Some miles of the Ferranti concentric mains that are to supply London on the high pressure system from Deptford are, as we have already informed our readers, now laid, says the London *Electrical Engineer*. All these mains as they are laid have to be very carefully tested, as the enormous pressure used may be expected to be far different in its action to any other that has yet been employed in practical working. To test underground mains which are to work at a normal pressure of 10,000 volts is a matter requiring no little care and discrimination, and it can be well believed that such a ticklish matter as turning on a current which itself is sufficient to send a $\frac{5}{8}$-inch spark through air is one which does not come within the ken of many even of the most experienced of our present electrical engineers.

We have, therefore, thought that a description of the tests now being applied to the Ferranti mains will have an interest of a double value—first, as to the methods adopted for such an experiment in electric testing, and secondly, as to the results found and the differences experienced in dealing with such high potentials in long lengths of cable.

We must promise in the first place, that any one who expects delicate manipulation and elaborate mechanism either in the apparatus to be experimented upon or in the methods employed has but little understood the manner in which Mr. Ferranti has organized the lighting system from Deptford. We well remember asking Mr. Ferranti to explain the method upon which he tested the transformers and switches to be sent out for his high tension system and what instruments he used. "We couple two 10,000 volt transformers in series," he said, simply, "and connect up with the pressure of 20,000 volts. If there is anything left it is passed as good." The explanation, if a little off-hand, serves very well to indicate the kind of testing that has to be dealt with in the whole system. One other illustration will serve to indicate the way in which the problems as they arose have been tackled. A certain electrical engineer, himself well enough known both in cable and in alternate current work, remarked that one point over which Mr. Ferranti might be expected to experience great difficulty was the arrangement of the expansion joints, evidently figuring a complicated arrangement of sliding contacts. In reality the device adopted by the Ferranti system as expansion joint is nothing more complicated than one length of the main, bent by a rail bending machine into a long S form, the expansion serving simply slightly to increase the bend.

At the present time there is a total of 21 miles of the main laid and jointed along the route from Deptford to London. These are to form four parallel mains from Deptford. None of them are yet in one length, but are being connected together as fast as the curves across the railway bridges can be laid. The mains are laid mostly four in one trench, and the line is complete from the Charing Cross end to the Grosvenor in Bond street.

The London Electric company have obtained a site in Red Lion yard, Cockspur street, and it is to this place that the ends of the cable are led, and here they have been tested day by day as the lengths are connected on. This station we have had, through the kindness of the company's engineers, the opportunity of inspecting while the tests alluded to were being carried on, and these tests we now propose to describe.

In the first place all lengths of concentric main are tested as they come from manufacture at Deptford It will be only necessary to say here that the mains each consist of two concentric lengths of thick copper tube run one inside the other, separated by a special insulation of waxed paper and protected on the outside by a steel sheath, also separated from the outer conductor by a thinner insulation. The mains are manufactured in 20 feet lengths, each main being coned or tapered down at one end and similarly bored out at the other, so that they can be pressed together when slightly heated, and the joint becomes a solid mass. So much is this so that when occasion arises to break the joint the material often breaks clean across instead of separating along the coned surfaces. These 20 feet lengths are tested at Red Lion yard, ten being connected in parallel, with a pressure of 20,000 volts in the manner to be presently described, and it is a remarkable and noteworthy fact, as stated by the engineers, that although many hundreds of these lengths have been so tested, not a single one has yet broken down or any way failed.

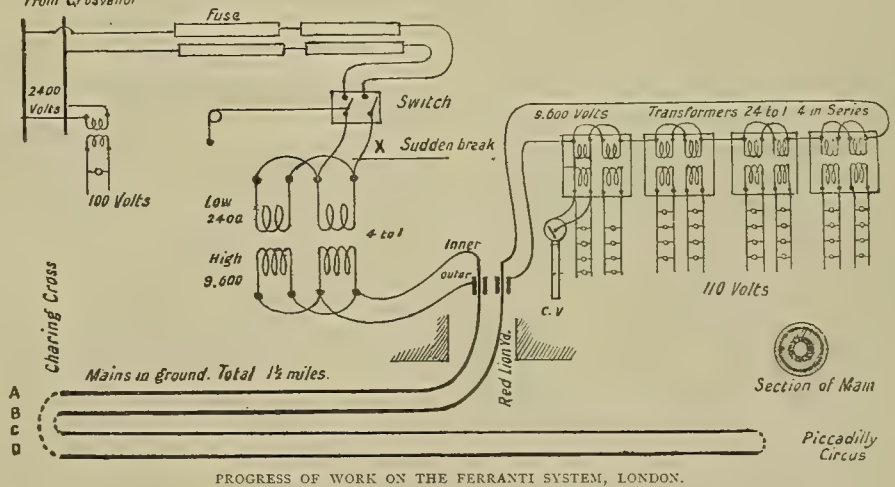
The mains are next laid in the street. Trenches are dug, thin boards, well creosoted or pitched, are formed into a trough, and the mains, which are to some extent flexible, are laid therein, bitumen is poured over them, the top board is put on and then a layer of asphalt is poured on top of the board, thus forming a most efficient protection against injury by a pick or other tool, and then the earth is covered in. As each length is laid and the joint is finished, the conductors are tested for continuity. It would be a little bewildering to one who knew somewhat but not quite enough about this testing to see 10,000 volt mains tested with a simple four volt cell and detector. The next test is that of outer conductor to sheathing. This is first done with an eight cell battery and a sensitive pivoted galvanometer to make sure of no accidental circuit. The work of laying then proceeds until the evening, or until such time as a high volt test is to be made. For this purpose the whole of the various mains are connected up in series so as to make simply one long length to be tested, the ends being already within the station at Red Lion yard. For the 10,000 volt test it is sufficient if at the further end the two adjacent cables be connected together—inner to inner and outer to outer—by two ordinary highly insulated cables laying along the trench in the roadway, and this method is adopted when the two cables have not both exactly the same length laid, and therefore do not finish quite at the same place. But for the 20,000 volt current to be put on requires both cables to be finished to the same point and connected across by a piece of the true Ferranti main, otherwise sparking or other effects occur on the cable along the trench. When properly connected the mains are first generally tested with a 100 volt current to make sure the insulation has no accidental small fault, and then the 10,000 volt current is turned on.

Here we must allude to a phenomenon which has not yet come beneath the notice of electrical engineers. If any electrical transformation at ordinary pressures, the transformed current comes out at a pressure of the ratio of the transformer used, or, indeed, slightly less, due to loss in the transformer. Curiously enough—a matter of considerable importance to alternate current engineers—this is by no means always the case when the alternate current is of high pressure, that is, of the nature of 10,000 or 20,000 volts combined with a concentric cable. When a length of concentric main is connected thereto, it acts in the manner of a condenser, and a certain quantity of the current is required to charge the mains themselves, and the pressure on the mains in a long length seems to "pump up," as it were, and add together, so that the pressure on the other side of the transformer is far higher than the ratio would seem to indicate. Thus a transformation which would give 20,000 volts on a short length, if applied to a fairly long length of some miles, the pressure may rise to 25,000 or even 30,000 volts, and possibly to a far higher point. It was evident at an early stage that other effects than those generally experienced had to be dealt with, as in testing, if the length were long, the fuse which connects the main was found to give way at once with the sudden rush of current required to charge the conductor. For example, when the mains were laid to Blackfriars the four sets were connected all in series as before mentioned, and the 20,000 volt current was turned on. At once the fuse connecting them went. Another fuse was put in and again went, and so on, until the mains were disconnected, and one length only was connected when (the charge for the length being less) the fuse stood, and no bad effect was observed. It has been found necessary, therefore, to always connect transformers at the further end and draw off some current—in other words, always to have some load on the main. This is necessary both on account of the precaution, and also as it is otherwise impossible to judge how far the pressure actually does rise in the mains. Even in this case, and when running some score or two of lamps the potential, which at the generating end would be normal (say 2,500 volts transformed up to 10,000), has shown up to 160 volts on the lamp circuit when transformed down again, instead of 100 volts, thus indicating the pressure in the charged length of main to be raised to $160 \times 24 \times 4 = 15{,}360$ volts, instead of the original 10,000 volts. This result is sufficiently remarkable, and will, no doubt, be the occasion of much speculation and observation by electrical engineers.

In practice the dynamo would be run slower, or the exciting current used would be less to obtain the 10,000 volt pressure desired. It is not yet definitely known whether this high pressure has the power of self-regulation to one uniform pressure in the whole main, or whether there is still a certain fall of pressure over a long length of main due to the ohmic resistance, as would, of course, have been expected were it not for the new conditions which obviously rule as shown in the rise in pressure we have described

The diagram given herewith shows the method of connection for the testing of the mains when laid with the 10,000 volt pressure. The ordinary mains from the Grosvenor are led in at 2,400 volts. From these wires are taken, passing each through two long high pressure fuses, and then by a double pole switch to two 10,000 volt transformers connected in parallel. These transformers have a ratio of four to one, so that the exact pressure on the terminals is 9,600 volts. The Ferranti mains end, as we have seen, in a cone, the inner conductor projecting forward. In the tests which we witnessed on August 30, the four lengths of underground main were previously connected in series as shown, so as to make one length of about one and a half miles, commencing at the testing station, going down to Brewer's Lane, Charing Cross, returning to Piccadilly Circus, doubling back to Brewer's Lane, and so returning to the testing station at Red Lion yard. The wires at 9,600 volts were led to one end, and connected to the inner and outer conductors, so that the whole length had this pressure between its two concentric tubes. The circuit finished at the end of the second main at the testing station, and from there was led off to a discharging arrangement. This is shown in diagram in the figure, and consists of four sets of small transformers, ratio 24 to 1, connected two in parallel and the four sets in series, thus reducing the pressure again to $(9{,}600 \div 4 \times 24)$ a nominal 100 volts. The current was taken off each transformer separately by four 100-candle power lamps, or eight 50 candle power, as the case may be, each transformer thus giving 15 amperes, or each set of two 30 amperes. As the ratio of reduction is practically 1 to 100, the current in the 10,000 volt main was about 0.3 ampere only When the current was turned on, as a matter of fact the lamps were considerably over incandesced, and the Cardew voltmeter which was connected to the lamp circuit indicated 110 volts. When only one set of transformers is attached to discharge the mains, the pressure has been seen to rise to 130 volts on the voltmeter, and with a longer length of main even to 160 volts.

The above is a statement of the arrangement for testing adopted on our visit. The current was kept on some minutes, and then the fuse went. This was owing to the fact that three strands of fuse only had been used to charge the mains for some time. New lengths of main had been added and this, as we have said, causes the rush of current to be greater as the length increases, due to the condenser action of the main, the greater current reappearing in increased electrical pressure. Four strands of fuse were inserted, and then the 10,000 volt current was kept for some quarter of an hour or so upon the 1½ miles of newly laid main.



PROGRESS OF WORK ON THE FERRANTI SYSTEM, LONDON.

The tests with 20,000 volt current were not taken at the time of our visit, but it is easy to see the arrangement adopted. The two first transformers in this case are connected in series instead of in parallel, as shown, and the discharging transformers are also connected all in series. This higher test cannot always be taken, as the mains must be closely connected, as already mentioned, with concentric main at the ends. The distance between the inner conductor and the copper sleeve projecting from the outer conductor is only ½ inch through air, and over this distance on damp days the 20,000 volt current will spark across with loud cracks like a pistol report. This highest potential is therefore not always employed, but the main has been repeatedly tested under this enormous pressure on many occasions.

After the main insulation has been tested, the insulation between outer conductor and the steel sheathing is tested in a similar way with transformers at a pressure of 500 volts, a discharging transformer being connected at the further end as before, the current in this case being absorbed by a metal resistance.

The work of laying the mains is now progressing rapidly.

The four sets of main are practically complete to London Bridge; three sets are complete across the Charing Cross railway bridge. The mains are also laid as far as the Grosvenor Gallery. Some thirteen gangs of men in all are working at them, and twenty-one jointing appliances are in use. During the week ending August 30, the Deptford station ran the whole of the load of 38,000 lights without any assistance from the Grosvenor, by the present temporary cables at 5,000 volts continuously without stopping from the Monday morning till the Saturday night. The opportunity has been taken to make some interesting experiments with the Grosvenor dynamos, such as running them in parallel and running them as motors from each other, and from Deptford. It is interesting to state that the Grosvenor dynamo has run as a motor, turning itself, and running the engine, with an expenditure of energy calculated from the current and pressure readings of 50-horse power. Since this date the two dynamos at Grosvenor have supplied the circuits in parallel.

Two Cases of Lightning Stroke.

By Prof. H. S. Carhart.

In the neighborhood where I lived when a boy, a barn which I remember well, was struck by lightning a few weeks since and burned. This barn did not stand on elevated ground, but on the border of rather low meadow land and was surrounded with hills, except on one side. The special point of interest attaching to the case is one touching the protection afforded by lightning rods, coupled with the additional fact that, notwithstanding the old adage lightning does sometimes strike more than once in the same place.

Twenty years ago and more this particular barn was provided with an iron rod which was carried down on glass insulators and into the ground at the end of the barn where the earth, a heavy clay soil, was always moist and generally wet. My brother, who lived there for several years and was familiar with the place, testifies that not infrequently after a heavy thunderstorm there was undoubted evidence that the rod had been struck, for the earth had been thrown away from the lower end of the rod to a depth of some six inches and for a considerable lateral extent. Just how often that occurred was not noted, but it was often enough to attract attention. My brother removed from there many years since, but I heard the same report recently from a reliable old gentleman who has lived there nearly all his life.

For some time the rod has been out of repair, and it was finally removed from the barn. How long since that occurred I did not learn. But four weeks ago the lightning apparently struck the weather-vane, and set fire to the barn. While the rod remained on the barn the evidence is strong that it carried more than one lightning discharge safely to earth.

Another case was related to me. A few miles from the barn referred to was a church, which at one time had a rod running from the spire to the ground. But in the course of time the rod became separated somewhere on the roof and was left out of repair, probably because of insufficient faith in lightning rods. This lack of faith was somewhat dearly paid for, because lightning struck the rod, was carried safely down as far as the attached end, thence downward, it expended its energy on the building. It was not fired but damage to the extent of several hundred dollars was done. The cases above, in which the lightning discharge followed the rod, may have been instances of Prof. Lodge's "steady strain," and not of the "impulsive rush" variety. But both go to show the usefulness of rods properly erected and in repair. Both accidents happened only after carelessness allowed the rods to fall into what was doubtless thought to be "innocuous desuetude."

Electricity in the Navy.

The prominence which electricity has assumed in naval matters has long been a matter of interest in electrical circles, but the public generally has not realized the number of uses to which it has been applied. A navy officer remarked recently in commenting on the provisions for electrical apparatus in the naval appropriations: "It is difficult to realize that the force that ten years ago could only be utilized in ringing a call bell or exploding a primer is now employed for the fabrication of the cables upon whose strength the safety of the ship depends."

Electric welding machines will be used in the navy hereafter in large numbers. Some time ago the board of naval officers investigated the process of electric welding and reported in favor of its use in naval service, both ashore and afloat, for welding breaks in rods and angles, for welding copper, brass, cast iron and other metals, for heating metals and for welding wire cables. A lighter class of welders is designed for use on shipboard, where space must be economized. Ensign Wilkes says that there is much navy yard work that can be better accomplished by the electrical welder than by any other known means, citing the operations of welding cast iron and of welding dissimilar metals, of repairing old boiler tubes and joining wire rope, besides completing the links in chains better than can be done in the smithy.

A Washington correspondent writing on the application of electricity to modern warfare says: "Each year adds to the uses to which electricity is put on board ship either for purposes of comfort and convenience or for those of adding efficiency in navigation and in battle."

The progress of lighting of ships by electricity has been very great during the last seven years. In 1883 an electric lighting plant was put into the Trenton as an experiment. There are now about twenty vessels built or building in which this apparatus is used, and of course every new ship forms an addition to the number. Ensign Wilkes says that the first dynamo afloat in our navy, the old L machine in the Trenton, ran during the fatal hurricane of Samoa, where the Trenton perished, until the water had put out the fires under the boilers. The two-wire system has always been used in the naval service, the ship never being allowed to form the return circuit. Ensign Wilkes shows that on shipboard electric motors have thus far been used only in driving small fans up to one-horse power hoists, but in one case, on the Chicago, a motor has been used for training a heavy gun. The tendency is to increase the capacity of the dynamo plant on board ship, so that electricity may before long take the place of some of the numerous small steam engines used on a man-of-war, provided its apparatus can take up less room at no greater cost. At the Brooklyn navy yard electrical motors are used for drilling purposes with good results. Various other applications of electricity are made in the navy. Of course, communication by electric bells is established on shipboard for giving orders in the engine room and elsewhere. The electric search lights, which have long been in operation, play an important part in the prevention of the surprise of a war vessel by a flotilla of launches or torpedo boats. In night firing they have been used with advantage in the Italian evolutions to throw light from the ship upon the shore targets. The use of electricity for the firing of heavy guns has already been referred to, and recently on the tug Nina, some remarkable experiments were made in firing Gatling guns by electricity. Electricity also plays its part in some of the torpedoes and submarine mines in various ways, and furnishes the motors for several well-known systems of submarine boats, among them being the Peral and the Goubet. Many British war ships are provided with electrically illuminated night sights. The front sight consists of a metal socket with a small cone of pale green glass, point up, only the rear half showing. Beneath is a small incandescent lamp whose light shines up through the base of the cone, and is reflected to the rear. The rear sight has, instead of the cone, a V-notch, and a light is reflected from a ruby-colored glass. In sighting, the two colors are brought into coincidence at the bottom of the notch. The current comes from a small battery for each gun in a water-tight box. The naval officers are all favorable to the introduction of electricity in all its forms in naval work.

The Rochester, N. Y., Electric Street Railway company is pushing its construction work to a speedy completion The controversy over the style of poles to be used in certain residence districts greatly delayed the work.

The First Presbyterian church of Brooklyn has been supplied with a "C. & C." motor for operating its organ. Current is secured from the Edison company's central station. The C. & C. company has now installed twenty plants of this kind.

The Telegraph in South Africa.

The telegraph is pushing its way into the wilds of Africa. The New York *Sun* calls attention to the work now in progress in the dark continent and says editorially: "The most interesting thing to be seen just now is the work of extending a railroad and telegraph line from the diamond fields of Kimberley far north toward the Zambesi. Three thousand men are laboring with pick and shovel, grading the roadbed in regions which a few years ago were visited only by hunters and missionaries Such a scene of bustling activity was never witnessed there before. Hundreds of wagons, loaded with implements, explosives and everything required in road building, accompany the laborer. This month the railroad will be completed from Kimberley to Vryburg, 125 miles, and early next spring, it is expected, trains will be running a hundred miles further north in Mafeking. It is only a few years since Mafeking was known merely as the home of a poor native chief and a field of missionary enterprise. Now it is a prosperous town, with a bank, a newspaper and a thriving trade. The work of telegraph building has pushed far ahead of the railroad enterprise. This month the line is expected to reach the new capital of King Khama, 1,700 miles in an air line northeast of Cape Town. Savage Africa will thus be joined with civilization by electric wires. Two hundred and sixty wagons, each drawn by from ten to twelve yoke of oxen, have taken their way northward loaded with nothing but telegraph wires. To support the whites now engaged on these tasks, and the 700 armed men sent by the Imperial British South African company to open Mashonaland, 1,500,000 pounds of provisions have been forwarded by wagon as far north as the Macloutsie River, within easy reach of Mashonaland, of whose healthful climate and riches in gold and agricultural resources the most glowing reports are made. No recent enterprises of the sort surpass in magnitude or in the energy in which they are being pressed forward, these railroad and telegraph projects, now far advanced in South Africa."

An Electric Ghost.

An interesting story comes from New York city of the means employed by a contractor to regain possession of a house he had been obliged to part with at a considerable financial loss. The contractor in question undertook the construction of an apartment house, but before the structure was completed his money failed him, and he was unable to secure enough money to enable him to complete the building. He was, therefore, compelled to sell and he disposed of the property to a capitalist who proved to be extremely superstitious. When the contractor learned this he took occasion to awaken the purchaser's suspicions. As soon as the new owner took possession of the house he was alarmed by noises which could not be explained by natural causes. Every night he heard rappings and other strange noises, but the tenants did not know anything about the trouble, and were not disturbed. The unfortunate owner was so disturbed that he brooded over the matter until his mind became affected and he attempted to commit suicide. He was caught, however, just as he was about to dash himself from the roof to the ground. An examination led to the discovery that the original owner of the building had been working on the superstitious fears of the purchaser of the building. The contractor was confronted with these facts and he confessed that he had hoped to frighten the second owner out of the property by preying on his superstition and that he had an electrical knocker, which was hung over the roof to the proper floor, and worked to the terror of the owner.

Favored by the Fraternity.

Mr. A. C. Durborow, Jr., business manager of the Western Electrician, has recently been nominated as the Democratic candidate for Congress in the Third district of Illinois. He is exactly the kind of man who deserves support regardless of party affiliations, and should he be elected will carry with him to Washington those qualifications of energy, honesty and industry so greatly needed in public life. We trust he may have the opportunity to represent not only his constituents in his own district but his co-workers on the technical press throughout the country.—*Electric Power*, New York.

Development of Electrical Science.

The interest manifested in electrical development by the general public is shown by the eagerness with which everything that promises a substitution of electricity for present methods is received. So rapid have been the advances of late that the New York *Sun* recently expressed its wonderment in the following editorial query: "As one watches an electric motor does he wonder whether a hundred years hence a horse will not be as rare as a camel or elephant is to-day?" An apt reply to this is found in an article by Sir David Salomons recently published in *Lippincott's*. "It would be possible," he remarks, "to speculate to an unlimited degree as to the future of science, but experience shows that the knowledge of to-day is as nothing compared with that of to-morrow. A few new facts often upset pet theories. One cannot but be reminded of the words spoken by one of the greatest philosophers who ever lived, Sir Isaac Newton, who is reported to have said when dying: 'I seem only like a child playing on the sea shore and diverting myself in now and then finding a smoother pebble or prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.'" Sir David's remarks on the development of the science are interesting. He says: "Although electricity was known to the ancient Greeks, the uses to which it might be applied have remained unknown for thousands of years. It was reserved to Ampere, Volta, Faraday and a few others, to discover the laws which govern this force. The development of the science in its application to the practical needs of human life may be considered to date from the time of Faraday whose career ended about the middle of the present century. In the past forty years electrical science has advanced in a degree probably unequaled by the progress of any other science, since the commencement of the world's history. The electrical telegraph was discovered about fifty years ago. The transmission of messages across the ocean dates so recently as to be within the memory of those who can look back some thirty years. The electric light can only be considered to have entered the practical stage since 1880 and though the advances during the last three years have been great we know that greater achievements are in store for the present and future generation."

Electric Lamps as Press Recorders.

An interesting application of the electric light is made in a large printing establishment, and is thus described by an exchange: "In the office of the superintendent ten electric lamps are arranged in separate compartments of a frame or box, somewhat similar in appearance to the annunciators seen in hotel offices. The lamps are concealed from view, apertures in front of the compartments being covered with colored glass, each having its distinguishing color. The lamps are connected by means of electric wires with the automatic counting machines on the ten large printing presses located in an adjoining building. When the presses are in operation, the electric circuit is opened and closed by the working of the counting machines, causing quick flashes of light in the lamps. Thus every sheet of paper printed in the establishment telegraphs its record to the office, where the operation of each machine can be seen, and its speed or delays noted. In this connection it may be interesting to note that the speed of the large perfecting press is so great that it was found necessary to record each two sheets printed instead of single sheets, and even then the flashes of its lamp are almost continuous in appearance, showing that while the press is not quite as quick as lightning, it is too fast for the eye to follow.

Electric Light in the South.

As evidence of the industrial progress of the south the *Manufacturer's Record* publishes a list of 3,172 companies that have been organized during the last nine months. This is indeed a most gratifying showing. It is a noteworthy fact that 172 electric light companies have been established in the time specified and only 19 gas companies formed. This proportion, it might be added, holds good for the rest of the country.

First Steps Toward Nationalism.[1]

By Edward Bellamy.

I think I am safe in saying that all nationalists agree that the first business to be nationalized should be the telegraph and telephone services. The constitution of the United States makes it the duty of congress to establish and to conduct a postoffice. The business of a postoffice is to furnish facilities for the transmission of intelligence. At the time the constitution was adopted, the transmission of intelligence was effected wholly by the carriage of letters; and providing for the carriage of letters the government discharged its full duty under the constitution. Since then electrical invention has rendered the telegraph and the telephone essential and all-important factors in this work. Was it not manifestly the duty of congress under the constitution to attach these services to the postoffice department as soon as they were found necessary adjuncts to the business of that department? This, however, has not been done; and by failing therein the postoffice service has fallen behind the world's progress and has become relatively a less complete and efficient organization, for the purposes of its establishment, than it was a hundred years ago. At that time the postoffice provided the people with complete facilities for the transmission of intelligence; at present it provides only partial facilities for that purpose, leaving the people to supply its deficiencies, if they can, by bargaining with private corporations, whose cheapest rates are rarely less than several times what a national service would need to charge. The matter of the precise amount of exorbitance on the part of the corporations which supply the deficiencies of the postoffice, is not, however, material to the present contention, which is that, even if the service could be performed no cheaper by the postoffice, it is the business of the postoffice to do it, and that congress fails to discharge its constitutional duty to maintain a postoffice so long as it neglects to complete its facilities in accordance with modern standards. It is not merely constitutional to establish a government telegraph; it is unconstitutional not to do so.

It should be understood, moreover, that no sort of plan for employing private corporations through the government to do telegraph work for the people at a profit upon a preposterously inflated stock, will be accepted by the people in place of a government telegraph service to be conducted by the government, as the present mail service is, at cost. Of course it would be only fair for the government to offer to purchase at a fair appraisal any existing telegraph lines, satisfactory in equipment, which might be offered it; but the country certainly would not consent to an appraisal which should exceed the cost of duplicating such lines. As to the advantages to the people which would result from a government telegraph service it is sufficient to refer to the fact that the corporation which at present does nearly all the telegraph business of the country, pays out of its profits a good interest on a capital about four times as great as the expenditure which would be required to duplicate the entire plant, the latter figure being admittedly less than $20,000,000. The government telegraph service could then be furnished at one-fourth the cost of the present service, even assuming that the same interest would be paid on the investment, which is an unnecessary assumption, as there would be no need to issue bonds for the small sum required to buy or to build the lines.

To all or any objections to the advantages of a government telegraph, the example of Great Britain alone, not to speak of the many other countries which have adopted it, is an answer so absolute and conclusive as to render any other superfluous. The British people are more like ours than any other, and certainly in love of liberty and hatred of officialism they are quite equal to Americans. They find, however, that government telegraphy is so far superior to their former private facilities, as well as so much cheaper, that any proposition to return to the latter would be laughed at in England.

[1] Abstract of paper in *The Forum*.

Interesting Telegraph History.

James D. Reid, U. S. Consul at Dumferline, Scotland, contributes interesting historical facts pertaining to the early days of telegraphy in a letter to the New York *Sun*, The occasion that prompted this contribution was the statement in the *Sun* that Mr. Reid was the first superintendent of telegraphy the world ever saw. Mr. Reid says:

"Although I am not at all anxious publicly to claim the peculiar and very interesting place my friends and you seem to take so much pleasure in assigning to me, there is this to be said as a matter of correct telegraph history, that neither Prof. Morse, with whom I was on the most intimate terms, nor Mr. Vail, who was also my very valued friend, ever had, at any time, any supervision or official direction of any kind with any telegraph line built for commercial uses or employment. Prof. Morse superintended the construction of the Government experimental line between Baltimore and Washington, Mr. Vail acting as his assistant, their appointment ceasing with the delivery of the line to the Government and the abandonment of the line to private purchasers by the postmaster-general as 'athing that wouldn't pay.'

"I became superintendent when the first telegraph line was built for commercial uses, and superintended both construction and management, and of which the government experimental line soon formed a part. And it seems a very curious fact that such, for a time, was the dearth of the material out of which telegraph superintendents was made, that for several years I was superintendent of four, and, for a time, of five distinct telegraph companies, performing all my duties without aid of secretary, assistant, or clerk, and receiving a comfortable salary from each.

"Naturally I delight in such a memory of work and fellowship such as marked those early heroic years, when labor to all was an honor and a glory. I am grateful that I retain in my new sphere all my ancient love for work, and that I have health far in advance of that with which I entered my telegraph life in 1845.

"One error made by one of the prominent scientific papers in New York may as well be corrected. Henry S. Potter of Rochester, N. Y., was the first president of the Western Union Telegraph Company. Hiram Sibley became president in 1861. Jephtha H. Wade was elected president in 1866, refused re-election July 10, 1867, and was succeeded by William Orton, who died April 22, 1878, when, after a short interval, Dr. Green became and is now president. The name of 'Western Union' was given to the company by Ezra Cornell."

The Compensation of Alternating Current Voltmeters.[1]

By J. Swinburne.

In 1887 I had the honor of bringing before this section several methods of compensating voltmeters and resistance bridges for variations of temperature. Wires with different temperature co-efficients were used, by which means errors from change of temperature can be avoided. Methods of compensating watt meters for the errors inherent in them were also explained. The present communication relates to a somewhat analogous arrangement for compensating alternating voltmeters for changes of frequency.

It is much more easy to make a current indicator for alternating than direct currents, for troubles from hysteresis do not come in, and the slight tremble makes the moving part hang freely. If it is attempted, however, to use such an instrument as a voltmeter, the self-induction makes the reading far too low, and the error varies with the frequency.

To get over this trouble, a voltmeter may have a non-inductive, or nearly non inductive, resistance put in series with its active coil. A coil with an adjustable iron core is then pat in shunt to the active coil, this shunt coil having a very much larger time constant. Though both coils have iron cores, they have open magnet circuits, so they have practically constant co-efficients of self-induction. When the frequency increases, the current through the whole instrument under a given pressure falls; but the back pressure of the shunt coil increases more rapidly than that of the active coil, so that it takes less than its share, while the active coil gets a larger share of the reduced current; the actual current, and therefore the reading, in it remaining constant. The instrument is calibrated with a direct current. An alternating current is then put on, and the core of the shunt coil regulated till the readings agree with those of the direct current.

A similar effect might be obtained by putting a condenser in shunt to the non-inductive series resistance; but it does not look so promising, and I have not gone into the size of condenser needed in practice.

[1] Read before the British Association in Section A, Leeds, September, 1890.

Electric Blow-Pipes.

During the past year a number of articles have appeared relative to the process of welding with the electric arc, devised by C. L. Coffin of Detroit, Mich. In a recent article which reviews certain of Mr. Coffin's inventions, the statement is made that "the fundamental principle involved therein can be called that of an electrical blow-pipe;" furthermore, it is stated that the idea of handling the electric arc as one would a blow-pipe with a magnetic blast instead air, is certainly a very beautiful and ingenious application of theory.

A writer in the London *Electrical Review*, A. M. Tanner, takes exception to this and in an article under the above heading writes substantially as follows:

From this it would appear that Mr. Coffin, or the writer of the article in the aforesaid journal, is without knowledge of the electric blow-pipes of Wedermann and Jamin, and the fact that the action of electro-magnets upon the electric arc has frequently been studied, notably, by Quet (see *Comptes Rendus*, of French Academy of Sciences, Vol. 34, A. D. 1852, page 805). Quet states that Davy was the first to experiment upon the voltaic arc with magnets, and that Despretz and others had also studied the same phenomenon. In referring to his own experiments, he says:—

I caused a very powerful electro-magnet, made by Rhumkorff, to act upon the Davy arc, and I transformed the column of light into a long rushing point of an intense heat, and similiar to the blow-pipe flame. I obtained this result by placing the carbons perpendicularly to the common axis of the electro-magnet coils. In order to explain my idea, I will suppose this axis to be horizontal, the carbons vertical, and their points placed between the neighboring poles of the apparatus. In these conditions, instead of a vertical column of electric light a horizontal point is formed (dard) perpendicularly to the axis of the coils, just as when the blast of a blow-pipe is directed upon a flame. The analogy is so complete that, by reason of the noise produced by the arc, it appears as if some one were blowing. The light of this point has neither the whiteness nor dazzling character of the electric column it displaces; nevertheless, its heat is very great, because it is capable of melting platinum. Because of this last mentioned property, and the form taken by the arc, it appears to me that this kind of *electro magnetic blow-pipe* can be usefully applied in the arts. The electric point (*dard electrique*) is remarkable for its length. In my experiments, it was eight or ten times more than the maximum length of the luminous column. Quet also states that the carbons can be placed at an angle, or one at the side of the other, in which case the electric point is formed laterally and parallel to the carbons. It will readily be perceived that Quet foreshadowed Coffin's process, in which the arc is formed between two converging carbon pencils and is blown downward upon the metal surfaces to be heated by the influence of an electro-magnet. An arrangement of parallel carbon electrodes (as in Jablokoff candle) and electro-mag-

ret is shown by Richard Werdermann in his English patent No. 735 dated April 24th, 1874, for a method of cutting rock or stone, etc. I can do no better than to quote the description of this patent, bearing upon an electric blow pipe, particularly as the article on Coffin's welding process states that an air blast is sometimes used for deflecting the arc. This is also an idea disclosed by Werdermann, as will be seen from the following abstract of the description found in the patent, viz., 'When the rock is very hard as porphyry, granite, gneiss and the like I prefer to use an electric blow-pipe. In the apparatus the carbon points of the electric light are fixed on a suitable handle or frame provided with pinions and racks to regulate their distance. I blow through the voltaic arc over the two carbon points, a powerful current of air or steam or other suitable vapor or gas. For this purpose I provide a carbon tube, arranged over the carbon points and provided with an adjusting pinion and rack. The air, steam or gas is supplied to the carbon tube by a pipe. When the blast is in operation through this tube, and the light is burning, the flame of the voltaic arc will produce the effect of a powerful blow pipe. An apparatus is also described in which the carbon points are arranged between the two poles of a powerful electro-magnet, and the blow-pipe is not used. As soon as the light is produced and the electro-magnet set in action, the voltaic arc is repelled and pointed like the flame of a blow pipe. The heat obtained by the apparatus is so intense that the hardest granite is thereby not only calcined *but is fused* in a few seconds."

Another electric blow pipe (*chalumeau electrique*) is described by Jamin in the *Comptes Rendus* of the French Academy of Sciences, Vol. 88, A. D. 1879, page 544 After having described an electric lamp with parallel carbons, and the effect of an electro-magnet upon the electric arc, first discovered by Quet, Jamin states: "The fusion of lime proves that the arc thus projected by a magnet effect is capable of considerably heating all bodies; it is a genuine blow-pipe, and probably the most powerful of all. I recommend it to chemists and physicists."

The blow-pipes of Wedermann and Jamin, although not specially designed for such purpose, are adapted to be used for the electric welding of metals, since they have parallel electrodes arranged in such a way that the arc can be projected upon surfaces placed beneath the arc. There is another more recent reference to be considered which is also an electric blow-pipe, and is especially designed for welding and soldering metals. The English patent of Bernardos and Olszwsk, dated October 28th, 1885, No. 12,984, describes and illustrates in figure 35, an "Electric Solderer," which has two parallel carbon pencils fastened in a holder and arranged above an anvil on which the work is placed. The anvil is surrounded by a wire coil, so that when the electric current produces the arc between the parallel carbons and flows through the anvil coil, the anvil is converted into an electro-magnet "whereby the flame of the arc is drawn to the object to be operated upon."

I think I have satisfactorily shown that Mr. Coffin did not invent the electric blow-pipe. Quet having fused platinum with a so-called "electro magnetic blow-pipe" in 1852, and Wedermann having subsequently applied the same instrument to the cutting and fusion of mineral substances. Du Moncel, the eminent historigrapher of the applications of electricity, says in his work: "I desire to be impartial in my writings and a rendre a Cesar ce qui appartient a Cesar." It is well that this should be observed in the modern age of electricity, and credit bestowed where credit is due.

Lightning in a Central Station.

The appended account of the action of lightning on electric lighting apparatus in a Michigan town during storms on August 8th and September 6th will prove of interest to central station men. The storm of August 8th was at its height between the hours of 6:30 and 7:30 A. M. These accounts, which are abstracts from reports made to the manufacturers of the electrical machinery in service, are as follows:

"It was daylight on August 8th and the alternator was not running, but our wires were right in the storm. Lightning struck a house and tree in the town 600 feet from our circuit leading to the residences. In the mill premises it struck the south end of the island tramway near where the circuit crosses the river. The river spans had not been strung; and there was nothing struck on the west side of the river. The wires under the tramway, which were struck, were an incomplete secondary about 1,200 feet long intended for a ten-light converter. The converter was not set or connected, but the platform prepared for it was wrecked by the lightning. The posts on which the wire was strung were chipped, but neither wire nor insulators show any marks. From the converter platform a pair of wires had been run to a pole carrying a primary circuit 150 feet distant from the converter platform. The wires were not connected to the primary but were hanging from the insulators ready to connect up when converter arrived. The crossarm, which carried these wires, was knocked into splinters but the pole is untouched and there is no trace of lightning anywhere else on the primary pole line. At the station, the lightning arresters were marked by discharges and must have acted several times as the springs which were left wound up the night before were almost run down, and the revolving arms had burned marks at each end The discharge combs or saw teeth were burned considerably, one tooth being fused enough to make contact with the plate opposite itself causing ground connection.

"The main switch was open, the voltmeter and ammeter were cut out, so that nothing was in circuit at the station except the lightning arrester. The primary fuses of five converters were blown on both sides. There were six converters connected at that date and the one which did not blow was a ten-lighter. The others were two of fifty lights' capacity; one of forty lights, and two of thirty lights. The secondary of the ten-lighter was open, so its impedance was at its maximum. One of the fifty-lighters had its secondary open also but lost its primary fuses just the same. All the other secondaries were closed through incandescent lamps and each fuse holder which blew was lifted clear off its contact pins and dropped down loose in the box. They were not put on loosely either, because I examined a lot of these same fuse holders and made sure they were tight when I was there the preceding week.

"In this connection the men say that last week one primary fuse holder jumped off during the run and put the lights on that converter out. The fuse did not blow and there was no one at the converter, and the hour was 5 A. M. The man who said that fuse holder jumped off without assistance is a careful, sober man and fully credible, or I would not repeat the story. I can understand the explosion of a fuse by lightning lifting the holder off the contacts but that the holder should climb off itself in fine weather is a little hard to believe. One converter tested after the storm, was found to be all right. The others appeared none the worse for their experience. When I heard of the storm I wrote to my man on the spot to test them all for short circuit, using his magneto and applying his tongue for testing, if he could not get a ring or shock through his fingers. This perhaps is not a definite way of testing but was the best available, and as he could not taste any current from a good magneto, I feel certain that these converters were not injured. On the secondary circuits a ten-ampere branch fuse was knocked out and fifty-two sixteen candle power lamps had filaments broken.

"All the lamps that were up seemed to have been strained as they are breaking rapidly. Those put up to replace breakages seem likely to last the normal time. A peculiar thing about the fuse being blown is that there was no circuit through it, the lights which it protected having been all turned off the night before and at least three fourths of the number of lamps which were damaged were turned off by key or switch, indeed some of them were absolutely disconnected from the converters, the mains feeding the upper floor of the island mill (where a lot of filaments broke) having been disconnected entirely to prepare for connection of a switch.

"The filaments in some lamps were blown to pieces, in others they had broken away from both platinums and were sticking to the inside of the glass. I have observed this latter effect in lamps which had been held near fast belts to get the static glow.

"The insulation in the city is very good, unusual pains being taken with it, both on primaries and secondaries, and there is no sign of a break to earth from the circuit anywhere. Whatever effects followed the lightning are not due to our circuits acting as a lightning rod."

The report of the storm of September 6th was substantially as follows:

"Saturday, September 6th, was for this season and latitude a remarkable day. From early morning the mercury ran high—by noon it had reached eighty-five degrees—by some reported ninety degrees—and at this point it stood through the afternoon and well into the night. The air was close and oppressive during the entire day. At 9 P. M. clouds gathered and by 10 o'clock there was lightning and thunder. By 11 o'clock the flashes had become frequent and the engineer of the electric plant was obliged to wind up the lightning arresters every fifteen or twenty minutes. A high wind set in about midnight and from that time on for about three hours it approached a tornado. Between 2 and 2:15 A. M. the electric flashes were apparently continuous and very intense, the whole atmosphere seemingly ablaze. The thunder claps followed one after the other with scarcely an interval between. During this time the engineer stood by the lightning arresters constantly winding them up. By 2:15 A. M. the saw teeth plates on the switch-board had melted at the edges and fused together so that the current generated by the dynamos ran straight to the ground, and he was compelled to shut down. The magnets of the lightning arresters were slightly burned, and the coil of wire above the upper one was scorched and broken in two places. As to the damage to the plant, not a lamp was broken. A converter (ten lights) on the tramway seems to have caught the current in some way as the binding posts are melted down and the wire coils inside burned. This was on the east side mill tramway near the barn On the west side one fuse block on the tramway was burned out. The only damage in the station was the fusing of the arrester saw teeth and this we have easily repaired."

Dangers of Electric Wires.

Captain William Brophy, chief inspector of the Mutual Electric Insurance company, Boston, read a paper before the State Firemen's association at Lawrence, Mass., on electric light wires and the best methods to be adopted by firemen in case of coming in contact with live electric light wires at a fire. In the course of his remarks Capt. Brophy referred to the opposition to electric light and power wires as follows: The electric light, the electric motors and electric car have come to stay. Like all other great inventions they have their faults and they are not free from danger. What form of energy is? Like the steam railroad, the steamboat, illuminating gas and many other great improvements, they have met with stubborn resistance, but in time this will all cease.

When railroad trains leave the rails and crush the human form into a shapeless mass, the public do not ask for the abolition of such roads. When swinging gas jets start a conflagration, or when some unsophisticated person blows out the gas and lies down and passes into eternity, no one demands the abolition of gas works. Why then should an unreasonable outcry be raised against the electric light and power industry when this subtle fluid leaves the path chosen for it and causes accidents to persons and property? From my own observations and an intimate knowledge of the difficulties that it was necessary to overcome, I am astonished at the small number of accidents that have occurred since the introduction of high potential currents. While the business of electric lighting has grown tremendously, accidents of all kinds resulting from its use have steadily decreased. This in itself is sufficient evidence of the improvements made and the care exercised by those engaged in this business

CORRESPONDENCE.

New York Notes.

NEW YORK, Oct 4.—The annual meeting of the American Institute of Mining Engineers was held at Chickering Hall on Monday and Tuesday. The sessions were interesting and a number of papers referring to electricity in mining work were presented. H. C. Spaulding of Boston read a paper on "Electric Power Transmission in Mining Operations," giving in detail the advantages of electricity in mining work. A paper by Jas. Douglass, Jr., on the 'Copper Resources of the United States" was of special interest to the electrical manufacturers. Distinguished guests from abroad, including the delegates to the International Convention of the Iron and Steel Institute, were present, also members of the American societies of civil, mechanical and electrical engineers.

The meeting of the British Iron and Steel Institute was held on Wednesday, Thursday and Friday at Chickering Hall and the papers presented were the productions of Americans chiefly. Ex-Mayor Hewitt's address which was not personally delivered on account of sudden illness contained a carefully prepared historical account of the American industries. An interesting reference to the relations of capital and labor added much to the value of the address. The presentation of the Bessemer gold medal to Mr. Hewitt for his distinguished services to the iron and steel trade and the unveiling of the bronze bust of Alexander Lyman Holley in Washington Square were features of the second day's proceedings. The third day of the meeting was devoted mostly to visiting places of special interest to the institute. Dr. S. S. Wheeler conducted a party to the Telephone Exchange, the Western Union Telegraph office and the Brush and Edison electric light plants. Another party visited Edison's laboratory at Llewellyn Park where Mr. Edison served a bountiful lunch. An interesting paper was presented by Prof. Elihu Thomson on "Welding by Electricity." At the close of the meeting previous to adjournment Sir James Kitson presented a set of resolutions thanking the American Institute of Mining Engineers and others for the courtesies extended on account of which the New York meeting had been "one of the first of the present age."

The inaugural banquet of the winter season of the Electric club was held Thursday evening. About 140 members were present with their guests and the most successful banquet in the club's history was enjoyed. President O. E Madden presided and the after dinner speeches were of a most entertaining nature. The present prosperous condition of the club is an indication of the influence and usefulness in the electrical fraternity.

The report comes from Birmingham, Conn., that clay containing a large percentage of aluminum has been found in that vicinity at only one to two feet beneath the surface of the ground. The deposits are of a grayish color which turn white on exposure. The beds will be worked immediately and the outcome will be watched with interest.

On October 1st the office of the secretary of the National Telephone Exchange association was moved to 20 Cortlandt street, ground floor of the Telephone Building, where all communications may be addressed. Telephone (connected by metallic circuit), "1139 Cortlandt street."

The injunction obtained from Chancellor Pitney by the Passaic, Garfield and Clifton Electric railroad restraining Seba Bogart from further molesting the property and workmen of the railroad company has brought about a speedy completion of the electric line to the Clifton race track. The company at one time offered Bogart $1,000 to settle the matter. Instead of accepting the offer he tore up the tracks and asked $10,000 damages. At last he is obliged to give in to the railway although a litigation may ensue.

A coroner's jury composed mostly of electricians listened for nearly four hours to testimony relating to Lineman Kopp's death. The main witnesses were Charles Phipps, superintendent of construction of the Brush Electric Light company; Dr. S. S. Wheeler of the Board of Electrical Control, and William H. Brown, manager of the United Electric Light & Power company. The testimony showed that a defective insulation had caused a ground and that the lineman, although he was considered the most expert in the company's employ, failed to take the most ordinary precautions against accident. After a deliberation of two hours the jury brought in a verdict that Kopp would not have lost his life had he used the proper care, and further "While said August Kopp did not exercise the proper care, it has appeared in evidence that the defective insulation which existed at various arc lamps

was a necessary factor in causing his death; and that the existence of such defective insulation was countenanced by the Board of Electrical Control. It is the opinion of the jury that the operation of high tension electric circuits in such condition is a dangerous practice."

During a test of the electric search lights of the Yorktown off Montauk Point, last week, the smoke from the guns was found to be a serious hindrance to sighting the target. The test was expected to show what the cruiser could do with a torpedo boat at night and the wooden targets anchored at a distance from the cruiser represented torpedo boats. Immediately following the discharge of the guns a heavy smoke hung about the ship so persistently that the powerful electric search lights could not fathom it readily, and it was also very difficult to gauge the distance of the target.

One of the handsome electric cars running on Fourth and Madison avenues was badly smashed by a Grand street horse car at the corner of the Bowery and Grand street last Wednesday morning. The electric car proceeded to Eighty-sixth street station, from which it was sent to Thirty-second street repair shops. The electric car was standing still when the Grand street car ran into it.

The trial of the new Fall River line steamer, the Plymouth, was successful and the unique double-inclined triple expansion engines worked with marvelous smoothness. C. D. Shaine of the Edison General Electric company was well satisfied with the electrical features of the new steamer. The addition of this boat gives the Fall River line company a trio of the finest and most palatial steamboats, the Pilgrim, Puritan and Plymouth.

W. H. T.

Detroit, Mich.

DETROIT, Oct. 4.—At the opening of the Federal court at Grand Rapids on Thursday last, Judge Severns handed down his opinion in the case of the Western Union Telegraph company against the City of Grand Rapids. The question involved was the right of the city to regulate the placing and maintenance of poles and wires in the streets. The opinion was made verbally, and is to the effect that the city had the right to regulate and control the use of the streets. This was the opinion of the judge at the time of his denying an injunction. But considering the gravity of the question and its importance to all parties concerned, Judge Severns thought it prudent to confer with his associate on the bench, Judge Jackson. To this end a careful statement of the case has been prepared and submitted. Judge Jackson did not fully agree in all points with Judge Severns, so the latter, in view of the rank of the circuit judge, and owing also to the fact that upon a hearing before a full bench the decision would be in accordance with Judge Jackson's views, said he would waive his own doubts in regard to some of the questions involved. Nevertheless it was Judge Severns' opinion that the act of congress relative to the use of the post routes of the country by telegraph companies does not confer any power or right to the companies which is paramount to the local legislature. The right and privilege conferred by that act upon the telegraph companies in its nature is permissive only, and must be exercised in subordination to the local police authority and other regulations of the state, which are of a general character. It was not intended by congress to authorize a corporation of one state to enter another state and there exercise its franchises in insubordination to the policy and control of the state into which it thus carries its business. It makes no difference in whom the fee of the street is, whether vested in the city or abutting property owners. The telegraph companies could not acquire by time any right in the street which would be superior to the local power of control. The authority given to the company by the legislature of the state to enter the highways and streets and construct its lines, is in its nature a license to be exercised and enjoyed in subordination to the original use of the street as a public highway, and the license can be revoked at any time when the public authorities shall be of the opinion that the public convenience requires it; that it is at all times to be enjoyed by the telegraph company subject to police regulations, and that the power delegated by the acts of the legislature to the city of Grand Rapids by its charter, is deemed to vest in it the exercise of that police control, and confers upon the common council the power to determine in what manner this privilege which the telegraph company enjoys, shall be exercised It is not necessary to determine whether the city has a right to exclude the company from all the streets, but it is held that the authority conferred upon the common council is broad enough to authorize the aldermen to use their judgment and discretion when they deem the public convenience requires that the lines shall be taken from one street and put in another. This power the judge likens to that of the common council to require the telegraph company to place its wire underground. Having determined that the council had this power, the question, so far as the court was concerned, was ended, because if the council possesses the power, it is not within the province of the court to regulate the exercise of their discretion unless it may be in case of gross abuse.

The only point upon which Judge Severns said he had any difficulty was the one involved in the extent that the telegraph company had authority conferred by the act of the legislature, and the power conferred by the charter to the council was not to be exercised in subordination to the general statutes of the states authorizing the telegraph company to enter upon the streets and construct its lines.

The trouble grew out of the request of the council that the Western Union company remove its poles from Canal street in order that the street might be widened and asphaltum laid. This the company declined to do. It was then proposed that the Western Union company occupy iron poles conjointly with the Electric Light company, but this arrangement was not feasible. The Western Union company offered to move the poles to the farthest line of the curb, but with no avail. The pole chopping ensued.

C.

Pittsburgh, Pa.

PITTSBURGH, Oct. 4.—The Verner Electric Street Railway company of Allegheny City was chartered a few days ago in Harrisburg, Pa., with a capital of $6,000. When the road is completed it will be a feeder to the Pittsburgh, Allegheny & Manchester railway system. The latter corporation is now rapidly transforming its road into an electric motor system. The power house, a large and magnificent structure, is being erected and it is expected to be far enough advanced to receive the machinery by the first of the new year.

The Derry Electric Light company of Derry, Pa., has been granted a charter at Harrisburg, and the organization will immediately start in the electric lighting business. It is stated that the company will furnish the lighting for the streets in Derry.

The tracks for the Braddock & Turtle Creek Electric road are now being laid and the work on the power house is also being hurried. This is an electric road which is to connect Braddock with Wilmerding, Pa., the town completely built up with Westinghouse interests. The Westinghouse Air Brake company has shops there which are said to be the finest in the world.

Electricity is now being employed in this part of the country in the process of drilling oil wells. This new electrical device, for which a patent has been granted to a Wesley Webber, has the object of entirely supplanting the heavy tools and performing in a scientific manner the work which has hitherto been accomplished in a very crude way. The device is composed of a series of motors, placed in tandem and connected to one ansther, so as to practically form one motor. The reason for using the motor in tandem is to get the power within a six inch diameter, so that the entire mechanism, which looks like the common boiler, can be lowered in the well and the power applied direct at the bottom, which is the true place of resistance in "making a hole." Projecting from this motor tandem is a rod, which resembles a piston rod, working in and out of the cylinder; upon this rod the drill bits are firmly fastened and then the apparatus is lowered into the well in the ordinary manner. The mechanical construction and action of the apparatus is a close resemblance to the street car motor. A number of tests, which have been made with the electric oil driller, were pronounced to be entirely successful.

The electric fire alarm system of this city is being renewed now. Morris Mead, the superintendent of the Bureau of Electricity, expects to have the finest fire alarm office in the country and furnished with the most complete electric fire alarm system.

E. H. H.

THE ELECTRIC MOTOR.

An extensive electric railway system is in course of construction at Savannah, Ga.

The Stynepuxent Beach company, Ocean City, Md., will build an electric railway at that resort.

A stock company, capitalized at $20,000, has been formed at Palestine, Tex., to build an electric road.

Coleman, Bush & Co. of Louisville, Ky., contemplate the construction of an electric street railway to Jacob Park.

The Galveston, Tex., Rapid Transit Belt Line company, lately chartered, has not yet decided on motive power, but prefers electricity. The capital stock is $100,000.

An electric railway, six miles in length, will be constructed at St. Augustine, Fla., by the Electric Belt Line Railway company, recently organized by Heth Canfield, C. D. Blauvelt and George Old.

The Accumulator company of New York will exhibit an Edco car at the railway convention at Buffalo, D. H. Bates, vice-president, representing the company. The Electro Dynamic company of Philadelphia will be represented by W. W. Griscom, president, and E. A. Scott.

THE ELECTRIC LIGHT.

The gas company at Richmond, Va., proposes to put in an electric plant.

The Sumter, S. C., Electric Light company will increase its capacity and improve its station materially.

An electric light plant will be installed at Henrietta, Tex., by a local company engaged in public works.

The Emperor of Austria has decided that the electric light shall be introduced into his palace in Vienna, the Hofburg, where till now wax lights have generally been employed for the purpose of illumination. About 8,000 incandescent lamps will be required to light the building throughout.

Official statistics show that the electric lighting installations in Prague last year comprised 8,365 incandescent lamps and 143 arc lights, distributed among factories, theaters and restaurants. The current was obtained from 47 dynamos. Steam engines and gas engines supplied the motive power, the gas engines being in the proportion of 23 per cent.

The Hawkeye Electric Manufacturing company, Davenport, Ia., has received an order for a 600-light plant for Greenfield, Ia. The city council has decided to engage in electric lighting on its own account. The Richmond, Ind., Electric Light company has ordered a Hawkeye incandescent plant. The Hawkeye company has also completed a plant of 600 lights at Sigourney, Iowa.

Electric light plants are proposed at Hyattsville, Md.; Hinton, W. Va.; Carrollton, Ga.; Darien, Ga.; Lakeland, Fla.; Lake Charles, La.; Catlettsburg, Ky.; Frankfort, Ky.; Peach Orchard, Ky.; Fenton, Mich.; So. Denver, Colo.; Modesto, Cal. Extensions are contemplated at Sumter, S. C., by the Sumter Electric Light company, and at New Orleans, La., by the Louisiana Electric Light company.

The incorporation of the following companies is reported: Derry, Pa., Electric Light company, capital stock $5,000; incorporators, G. F. Huff, A. O. Caven and E. Pitcairn. Orangeburg, S. C., Electric Light & Power company; capital stock, $3,000; Charles Cope, secretary. Titusville, Fla., Electric Light company; capital stock, $10,000; secretary, S. F. Gray; Hazeltine Electric company, St. Louis, Mo.; capital stock, $650,000; incorporators, C. W. Hazeltine, G. W. Parker, D. R. Russell.

THE TELEGRAPH.

Since the adoption of the typewriter by the United Press great speed has been attained in the transmission of press dispatches. On Tuesday night, says the Rochester *Herald*, the report of the senate proceedings, including speeches by Senators Carlisle, Allison, Aldrich, Morgan, and others, and making in all about 2,500 words, was transmitted on the state circuit and received in the office of the *Morning Herald* in 43 minutes. The sender at New York was John G. McCloskey. This is at the rate of about sixty words a minute. The amount handled during an ordinary night of seven hours on the circuit referred to is about 15,000 words. The typewriter service was regularly inaugurated by the United Press on its state wire in May. The speed is constantly increasing as the telegraphers become more accustomed to the use of the machines, and it is expected that it will be possible soon to achieve still better results.

Miscellaneous Notes.

The Franklin Institute announces three lectures of unusual interest for the season of 1890–91. Prof. Elihu Thomson will lecture on "Induction of Electric Currents and Induction Coils." Dr. Louis Bell has selected for his subject "Electricity as the Rival of Steam." "Possibilities of Applied Science" will be treated by Oberlin Smith of Bridgeton, N. J.

The Stilwell & Bierce Manufacturing company of Dayton, Ohio, has brought suit in the United States Court against the S. N. Brown company, which is using a Hoppes live steam purifier. The Stilwell & Bierce Manufacturing company claim that the Hoppes purifier is an infringement of the Stilwell purifier patents. The complainants own all the Stilwell patents for heating and purifying feed water for steam boilers, and manufacture the Stilwell exhaust heater and the Stilwell live steam purifier.

At the meeting of the council of the American Institute of Electrical Engineers September 16, Messrs. E. M. Barton, A. H. Bauer and E. M. Izard of Chicago, were appointed a committee of three to represent the Institute at a meeting of various engineering societies to be held in Chicago October 14, under the auspices of the Western Society of Engineers The object of this meeting is to organize an International Engineering Conference, to be held in conjunction with the Columbian Exposition in 1893.

Personal Mention.

J. C. Rohey, manager of the Decatur Electrical Works, Decatur, Ill., was in town last week.

Col W. P. Hix, one of the most popular and successful of the Edison special agents, is lying ill at the New York hotel, New York. Mr. Hix lately returned from San Francisco, where he had been spending some months.

A. H. Reece, for some time special agent of the Edison General Electric company, with headquarters in Chicago, has been appointed general district agent of the same company, for the Pacific coast district, with headquarters at San Francisco. Mr. Reece represented the Edison company in St. Louis for five years, and goes to his new position equipped with a valuable and extended experience.

Wm. M. Porter, who has had charge of the Edison General Electric company's business in Detroit, has been appointed state agent for Michigan. Mr. Porter received his education in the electric lighting business a number of years ago, serving an extended period in the shops of the Brush Electric Light company of Cleveland. He is somewhat of a pioneer in the electric lighting business, having erected the Brush central station in Detroit at a time when electric lighting was scarcely known in that state. Mr. Porter built the Detroit Brush plant when no insulated wire whatever was used. Bare wire only was then in use and that was carried over the tops of buildings in the most exposed manner possible, and still no accidents occurred.

Business Mention.

The Gaynor Electric company of Louisville, Ky., has received contracts to construct the fire alarm system at San Antonio, Tex.

The Gamewell Fire Alarm Telegraph company, New York, has been awarded the contract for the police signal system at Atlanta, Ga.

The River & Rail Electric Light company of New York has issued a neat price list of storage batteries for physicians' and surgeons' use. The company reports an excellent business.

The Crosby Electric company of New York is pushing its dry batteries, and is securing large orders. These batteries are specially adapted to electric bells, annunciators, telephones, gas lighting, electric clocks, medical, electrical purposes, etc.

The National Electrical Manufacturing company of Eau Claire, Wis., has just issued a pamphlet containing a description of the alternating transformer system of incandescent lighting which it is making. It is accompanied by several strong recommendations from users of this apparatus.

The Lynn Belt Line Street Railway company of Lynn, Mass., is attracting considerable attention on account of its economic operations, made possible by the use of the New Improved Root Water Tube steam boiler, manufactured solely by Abendroth & Root Manufacturing company, 28 Cliff street, New York city. A number of these boilers have been adopted by well-known cable and electric street railway companies, who find them very desirable for street railway plants.

R. T. White will exhibit a full line of railway equipments at the meeting at Buffalo, including cable road, elevated road, the Daisy chair, the Eureka and Eureka construction, also other novelties in the railway line. He has lately received large orders from the west and south, and his work at Peoria, where 3,000 Daisy chairs have lately been introduced, is most satisfactory. In Newark his railway appliances are being used and railway men are invited to inspect his systems.

There are many forms of lamp-guards now in the market, but some of them need a holder while others have so large a mesh as to offer but little protection to the lamp. These two faults have been avoided in the new form designed by George Cutter, which is really an improvement on Hipwell's expanding wire guard. It has five rings placed close enough to guard the lamp from injury, and is so shaped as to fit any 16-candle power lamp very neatly. The Great Western Electric Supply company is manufacturing this device

The Hawkeye Electric Manufacturing company reports many excellent sales of its electric lighting apparatus and electric motors. The patent sliding switch socket controlled by that company is becoming very popular throughout the country. The company lately received large orders from Boston, Brooklyn, New York and other eastern points. The Sioux City Electric Supply company has taken the agency for the Hawkeye apparatus and has a creditable exhibit at the Corn Palace now running in that city. The company has the agency for the Black Hills country and is doing a very thriving business.

At the Exposition now being held in Portland, Ore., a tower, similar in construction and appearance to the one which was called the "Tower of Light" at the Lenox Lyceum last spring, has been erected, and lighted with Edison miniature lamps. This is set in a large bank of flowers. The tower and festoons contain about 3,000 lamps of 4-candle power each. The Edison General Electric company has received a telegram from Portland, Ore., stating that the tower was completed in time to be lighted on the opening night and was a great success, giving entire satisfaction to the management and winning much applause from the public.

The gathering of electricians at Alexander, Barney & Chapin's salesrooms Monday was notable from the fact that they were assembled to assure the members of the new firm of their desire that they might prosper in their new field as they had while engaged by others. An electrical feast had been prepared and the occasion was greatly enjoyed. The menu follows: Oysters, neutral points; soups, crowfoot zinc, carbon, blue vitriol; fish, pikes, poles, nippers. Alexite—best vintage. Entrees, monkey-wrench, pony magnetos, turtle gong; roasts, joints insulated, spring jack, buzzer. Extra dry battery. Dessert, automatic drops, cones, maple balls; coffee, porous cups (no grounds); cigars, electric club.

The report which was circulated in Chicago last week to the effect that the Great Western Electrical Supply company was financially embarrassed was promptly and conclusively denied by George Cutter, the general manager of the company. Fortunately the excellent reputation of the company and the financial standing of the gentlemen interested in the enterprise are such that a story of the character circulated received little attention from those who are well informed on electrical matters. The Great Western Electrical Supply company announces that the policy which it has thus far pursued will be continued and that its system of paying cash for all its purchases enables it to secure advantages otherwise unattainable. Mr. Cutter's excellent judgment in the management of the company has brought the establishment to a position in the front rank of electrical supply houses.

The Ball Engine company report the following shipments for September: One 125-horse power standard, Rochester Street Railway company, Rochester, N. Y.; one 250-horse power compound, Belt Line Electric Railway company, Port Townsend, Wash.; two 250-horse power compound Edison Electric Illuminating company, Brooklyn, N. Y.; one 150-horse power compound, Olean Electric Light company, Olean, N. Y.; one 150-horse power compound, Southern Railway company, St. Louis, Mo.; one 300-horse power compound, Waltham Watch company, Waltham, Mass.; one 100-horse power compound, Essex Street Railway company, Salem, Mass.; one 100-horse power standard, Essex Street Railway company, Salem, Mass.; one 25-horse power standard, Edison General Electric company, Portland Ore.; one 100-horse power compound, Walla Walla Gas & Electric Light company, Walla Walla, Wash.; one 60 horse power standard, American Tool company, Boston, Mass.; one 80-horse power standard, Glenwood Feeble Minded Institute, Glenwood, Ia.; one 100 horse power compound, Mohawk & Ilion Gas company, Ilion, N. Y.; one 150-horse power standard, Central Passenger Railway company, Louisville, Ky.; one 100-horse power standard, Edison General Electric company, Baker City, Ore.; two 25-horse power standard, Edison General Electric company, Portland, Ore.; one 35-horse power standard, Edison General Electric company, Portland, Ore.; one 60-horse power standard, Harlem Opera House, New York, N. Y.; one 80-horse power standard. Johnson & Comstock, Binghamton, N. Y.; one 35-horse power standard, National Needle company, Springfield, Mass.; one 50-horse power standard, J. B. Van Sciver, Camden, N. J.; one 100-horse power standard, Harlan & Hollingsworth company, Wilmington, Del.; one 60-horse power compound, M. J. Shields & Co., Moscow, Idaho; one 60-horse power standard, Haxtum Steam Heating company, Kewanee, Ill.; one 25-horse power standard, University of Virginia, Charlottesville, Va.; one 150-horse power standard, Schuylkil Electric Railway company, Pottsville, Pa.; one 80-horse power standard, Morris Park Club House, Van Nest, N. Y.; one 50-horse power standard, Thomas Maddock & Sons, Trenton, N. J.; one 35-horse power standard, Andrew McLean & Co., Passaic, N. J.

Electrical Patents.

Issued Sept. 30, 1890.

437,183. Electric Meter. Richard N. Dyer, East Orange, N. J.

437,203. Method of Adjusting Watches. George E. Hunter and Frederick H. Corthell, Elgin, Ill.

437,204. Method of Adjusting Watches. George E. Hunter and Frederick H. Corthell, Elgin, Ill.

437,205. Apparatus for Adjusting Watches. George E. Hunter and Frederick H. Corthell, Elgin, Ill.

437,206. Apparatus for Adjusting Watches. George E. Hunter and Frederick H. Corthell, Elgin, Ill

437,210. Electric Street Car. Luther H. Leber, Pittsburg, Pa.

437,226. Electric Illuminated Letter. James A. McEatee. Chicago, Ill.

437,259. Electric Motor Gearing. Joseph J. Sprague, Carthage, Mo.

437,272. Distribution and Regulation of Electric Currents. Franz Wilking, Berlin, and Hermann Muller, Nuremberg, Germany.

437,293. Coin-operated Telephone Attachment. Herbert F. Dugan, San Francisco, Cal.

437,307. Automatic Telegraphy. David Kunhardt, Aachen, Germany.

437,311. Artificial Ground and Compound Metallic Circuit System. Charles E. McCluer, Richmond, Va.

The invention consists in the combination with a system of line wires, including translating devices, of a common return conductor insulated from the earth and connected to the terminals of the line wires and of such low resistance or high conductivity as to offer only a fractional portion of the resistance offered by the wires first mentioned to the passage of a current.

437,324. Electric Cut-out. Elmer E. Bailey, Everett, and George J. Galbraith, Boston, Mass.

437,330. Electric Cable. David Brooks, Jr., Philadelphia, Pa.

437,348. Apparatus for Operating Signals. Samuel L. Powell, Lewistown, Md.

437,352. Electric Hand-switch. Joseph W. Battershall, Attleborough, Mass.

437,358. Electric Railway System. Charles K. Harding, Atlantic, Iowa.

The invention embraces as one of its principal features an insulated continuous main or supply conductor, a series of exposed separate insulated conductor sections arranged parallel with the continuous or supply conductor, traveling contact devices on the vehicle for taking the motor current from the said sections and electro-magnetic contact devices for bringing the said conductor sections separately into electric connection with the continuous or supply conductor.

437,359. Electric Snap-switch. William Hochhausen, Brooklyn, N. Y.

437,360. Dynamo Electric Machine. William Hochhausen, Brooklyn, N. Y.

Claim twenty-eight reads as follows:

"The combination, with the connected journal bearings and armature shaft, of insulating material for insulating the bearing from the field magnet frame."

437,362. Electric Cut-out. William J. Jenks, Nyack, N. Y.

437,363. Lightning Arrester. Harry M. Kalbach, Ashland, Pa.

437,369. Electric Alarm. Arnold Tschira, Freiburg, Germany.

437,387. Magnet Winding Machine. James J. Wood, Brooklyn, N. Y.

437,393. Galvanic Battery. Edward H. Crosby, Boston, Mass.

437,397. Lightning Arrester for Fire Alarm Boxes. Robert Hudie, Allegheny, Pa.

437,412. Rheostat or Rheotome. Marcel Deprez, Paris, France.

437,422. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

The last claim is given:

"The combination, with the main and artificial lines, of an induction equalizer composed of magnet coils in said lines, and an armature or core adjustable with relation to said magnet coils to vary their relative inductive action upon said lines."

437,428. Propelling Device for Electric Cars. Thomas A. Edison, Llewellyn Park, N. J.

437,415. Conduit for Underground Wires. Thomas M. Morton, Baltimore, Md.

437,469. Galvanic Battery. Gustav A. Liebig and Charles Willms, Baltimore, Md.

437,501. Electric Generator. William M. Mordey, Lambeth, England.

437,502 Arc Lamp. John A. Mosher, Abilene, Kan.

Claim six reads:

"In a feed-controlling mechanism for electric lamps, a wheel formed with pockets, combined with a metallic band around the periphery of the wheel and sealing the pockets, substantially as described."

437,510. Telegraph Key. Arthur F. Purdy, Lawrence, Cal.

437,512. System of Electrical Distribution. Frank B. Rae, Chicago, Ill.

The object of the invention is to provide means whereby currents of various electromotive forces may be taken from a single electro generator, which currents may be in the form of continuous currents and entirely independent of each other, and may be utilized for various and different purposes and joined in different circuits, as circumstances may require.

437,513. Electrical Switch. Frank B. Rae, Detroit, Mich.

437,516. Switch Board for Electric Lighting Systems. Robert F. Sawyer, Chicago, Ill.

437,526. Lightning Protector for Oil Tanks. Henry W. Spang, New York, N. Y.

437,533. Support and Insulator for Suspended Conductors. Charles J. Van Depoele, Lynn, Mass.

437,534. Upward Pressure Contact Device for Electric Railways. Charles J. Van Depoele, Lynn, Mass.

437,535. Motor Truck for Electric Railway Cars. Charles J. Van Depoele, Lynn, Mass

437,568. Electric Conductor. Edward Clark, Newburg, Orange County, N. Y.

437,570. Welding Metals Electrically. Charles L. Coffin, Detroit, Mich.

437,571. Process of Electrically Welding Metals. Charles L. Coffin, Detroit, Mich

437,613. Switch for the Moving Contacts of Electric Railways. John W. Murray, Saginaw, Mich.

437,632. Insulated Wire. Charles F. Splitdorf, New York, N. Y.

437,654. Electric Forging Apparatus. George Lauder and James H. Simpson, Pittsburg, Pa.

Claim five reads:

"In apparatus for electrically forging metal, a traveling clamping device consisting of the combination of a box adapted to receive and hold a metallic bar or blank, a movable side, one or more eccentrics set in the box and movable so as to clamp such bar or blank, and an electric circuit."

437,661. Motor Truck for Electrically Propelled Vehicles. Frank B. Rae, Detroit, Mich.

437,662. Automatic Switch for Stationary Motors. Frank B. Rae, Detroit, Mich.

The fifth claim is as follows:

"In an automatic switch device for electric motors, the combination, with a pivoted break switch having extensions, of a pivoted switch lever having an extension engaging the extensions of the break switch, an electro magnet controlling the movement of said switch lever, and a spring for retracting it to its normal position."

437,663. Armature for Dynamo Electric Machines and Motors. Frank B. Rae, Detroit, Mich.

The first claim is given:

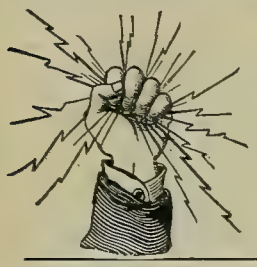
"An armature consisting of a shaft having recesses in which are secured the non-magnetic splines, disks having notches fitting said splines, end plates, also having notches, fitting the splines, and nuts mounted on the shaft and fitting recesses in the end plates, substantially as described."

437,667. Electrical Switch. Lucius T. Stanley, Brooklyn, N. Y., and Henry B. Cutter, Philadelphia, Pa.

437,668. Fire Alarm Signal Box. John Young, Chicago Ill.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

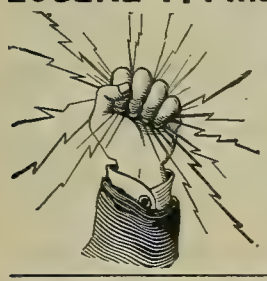
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS. Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

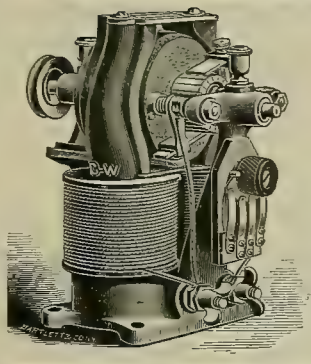
THE TURNER BRASS WORKS
4 LASALLE AVE
MAKE ANYTHING IN BRASS. CHICAGO.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE CROCKER-WHEELER PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base—Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

NO LOSS OF CANDLE POWER.

FOR PARTICULARS WRITE

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

OKONITE

TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

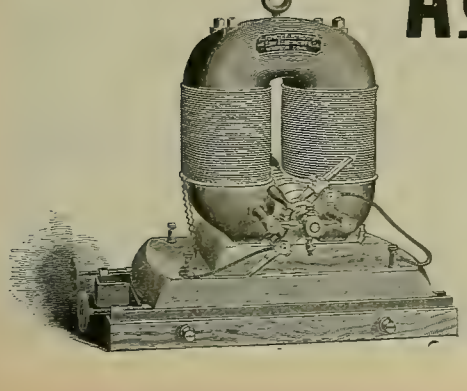
THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

EDDY ELECTRIC MANUFACTURING CO.,

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS



In all Sizes from One-half H. P. Upward.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.

DYNAMO ELECTRIC MACHINES

For Electroplating, Electrotyping, Copper Refining, Etc.

BRANCH OFFICE: NEW YORK, 33 Church St. BOSTON, 111 Arch St. PHILADELPHIA, 506 Commerce St. KANSAS CITY, Rialto Building. NEW ORLEANS, 78 Customhouse St. CHICAGO, 329 Rookery Building.

The EDDY ELECTRIC MFG. CO., - Windsor, Conn.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

Cleverly
1018 CHESTNUT ST.
PHILA

Electric Specialties

—WE MAKE—

Electric Supplies Under Contract.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental **MACHINERY.**

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acide. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

NEW IDEAS DEVELOPED,

Experimental, Electrical and Model Work. Contractors for Light Manufacturing.

E. D. STIFF & CO.,
67 S. Canal St., Chicago.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.,

11 Adams St., Opposite Pullman Building, CHICAGO, ILL.

MANUFACTURERS AND DEALERS IN

Electric Railway Supplies.

Standard and Special Devices for use on all roads IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. **Correspondence Solicited.**

Office and Salesroom, 11 Adams Street.

W. R. MASON, - - General Manager.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

FRANK T. BROWN, Late
PRINCIPAL EXAMINER ELECTRICITY,
U. S. PATENT OFFICE, NOW OF
Butterworth, Hall, Brown & Smith,
Patent Attorneys,
25-26 HONORE BUILDING, - - CHICAGO.
Two complete sets of U. S. Electrical Patents.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE BARD PORCELAIN.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue **1--66** of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

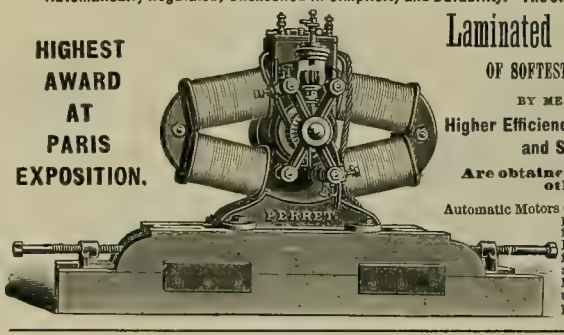
79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets

OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

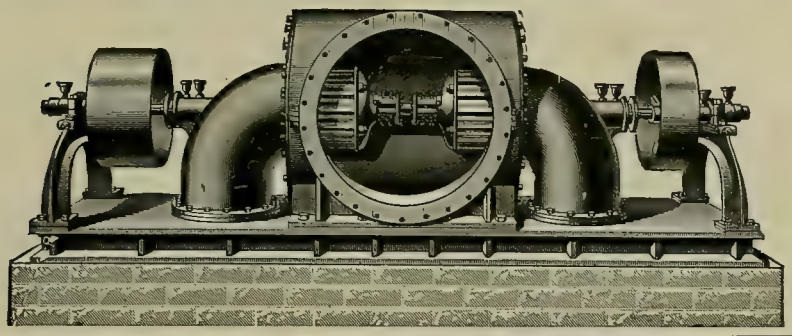
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use. we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

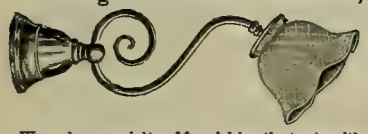
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

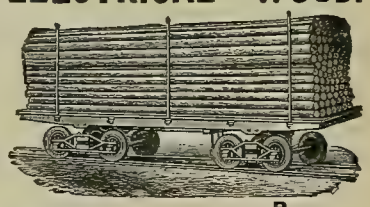
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

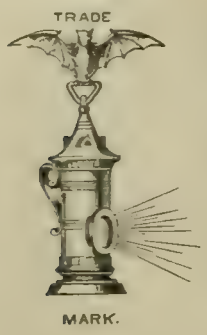
TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.



Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

DOUBLE ARC LAMPS.

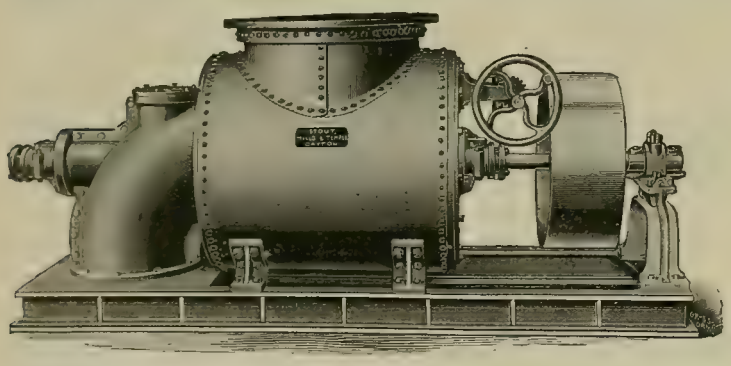
No finely geared clock work. No close fitting sliding solenoid cores.
No steel pinions or pivots to rust and stick. No gearing to clog with dust.
Practically and Theoretically the simplest and best constructed Double Arc Lamp.

The ONLY DOUBLE ARC LAMP MANUFACTURED for both High and Low Tension Currents.

We offer to furnish Companies using high or low tension systems with new double arc lamps, guaranteed to work satisfactorily, and with guarantee against loss on account of suits for alleged infringement of patents.

WESTERN ELECTRIC COMPANY,
CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
21, 23 and 25 Ann St. New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

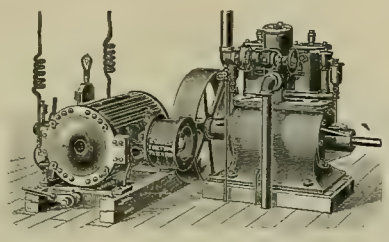
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

LIST OF PARTIES WHO HAVE ADOPTED THIS SYSTEM:

City of Boston, Water Department, Chestnut Hill, Mass.
City of Boston, Sewerage Department, Dorchester, Mass.
Pettee Machine Works, Newton Upper Falls, Mass.
Morgan Engineering Co., Alliance, Ohio.
Fitchburg Steam Engine Co., Fitchburg, Mass.
Portland Steam Packet Co., S. S. Portland.
Metropolitan Steamship Co., S. S. H. M. Whitney.
Chas. L. Seabury, yacht "Aztec."
Shoe and Leather Exchange, Boston, Mass.
Cocheco Manufacturing Co., Dover, N. H.
Hospital Cottages for Children, Baldwinsville, Mass.
Pennsylvania R. R. Co., Shops, Altoona, Pa.
Steamship Naugatuck.
Vanderbilt Building, New York.
William Tod & Co., Youngstown, Ohio.
Am. Waltham Watch Co., Waltham, Mass.



Seamless Rubber Co., New Haven, Conn.

C. F. Hovey & Co., Boston.
P. S. Malcolm, Portland, Oregon.
Chatham Hotel, Chatham, Mass.
Waltham Gas Co., Waltham, Mass.
Union Electric Light Co., Franklin, Mass.
Florence Electric Light Co., Florence, Ala.
Hutchinson Water, Light & Power Co., Hutchinson, Kan.
Walworth Light and Power Co., Boston, Mass.
North Attleboro Steam and Electric Co., Attleboro, Mass.
Jamestown Electric Light and Power Co., Jamestown, N. Y.
Weymouth Light and Power Co., E. Weymouth, Mass.
Leavenworth Electric Light Co., Leavenworth, Kan.
Willimantic Electric Light Co., Willimantic, Conn.
Towanda Electric Light Co., Towanda, Pa.
M. C. Dizer & Co., Weymouth, Mass.
Derby Gas Co., Derby, Conn.

AGGREGATING OVER 3,000 HORSE POWER.

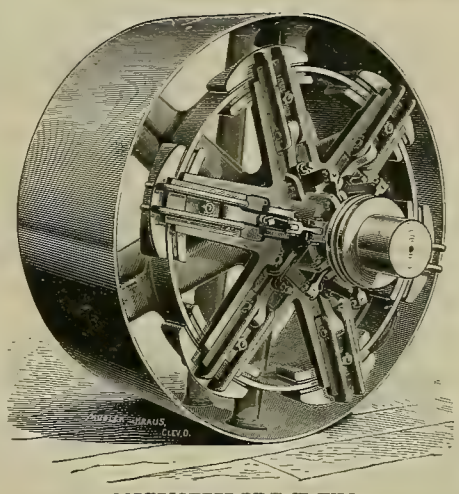
THE EVANS FRICTION CONE CO., 85 Water St., BOSTON. Send for Catalogue D.

DR. GASSNER'S
DRY BATTERY
FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3⅝ in.
17.	"	7½ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.



COPYRIGHTED BY H. W. HILL.

HILL
Clutch Works,
CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

John A. Roebling's Sons Co.,
MANUFACTURERS OF
BARE AND INSULATED WIRES
FOR ALL PURPOSES.
ALSO WESTERN AGENTS FOR
SAFETY INSULATED WIRE AND CABLE COMPANY'S
SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.
FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

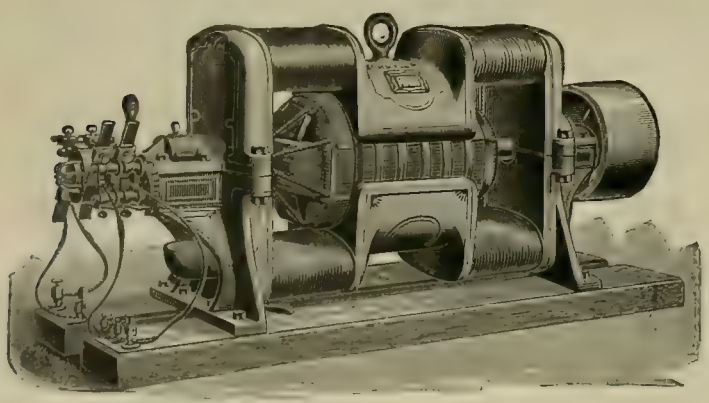
Manufacturers of Electric Light Carbons and Battery Material.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

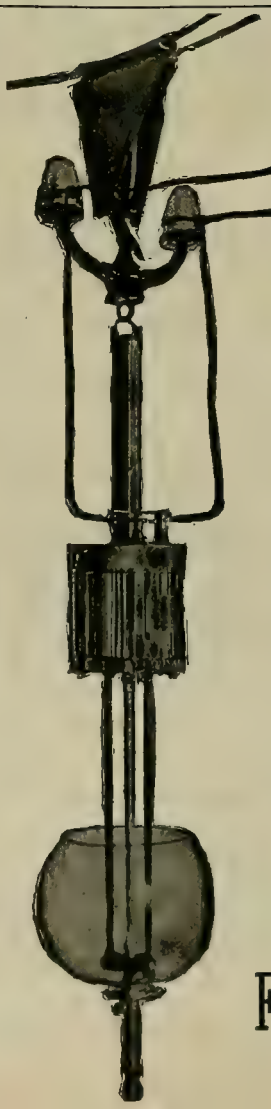
Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

THE FOREST LAMP HANGER.



ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.

OKONITE TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

E-D-I S-O-N

Miniature Incandescent

ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

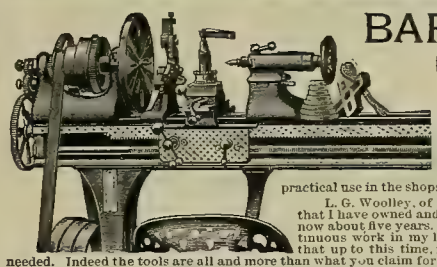
We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.



BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

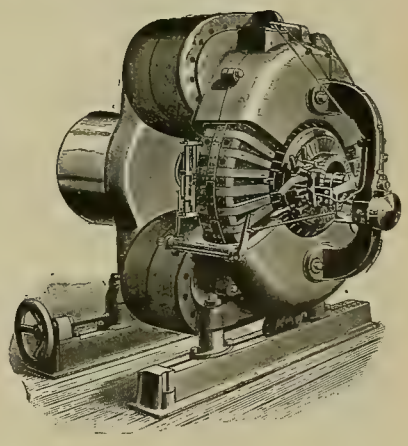
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)

MANUFACTURERS OF

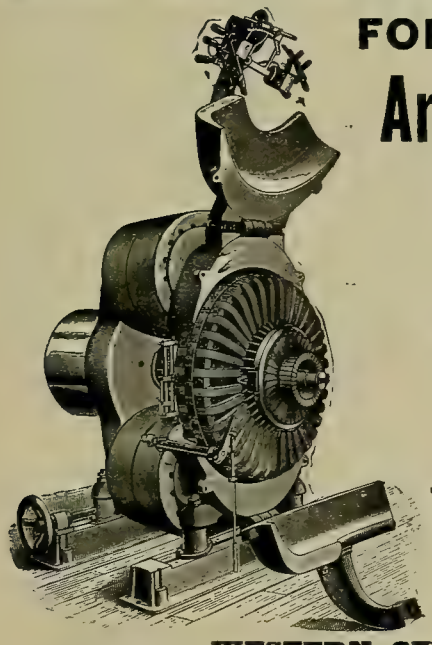
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

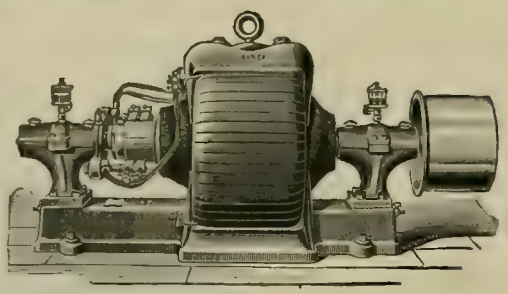
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS

CARS ADAPTED TO ALL SYSTEMS.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP
and 1914 Olive

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2 000	"
" " " "	3d " (Just ready.)	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition (Just ready.)	2,500	Cop'es
Bell Hangers' " "	1st "	2,500	"
" " " "	2d "	1,000	"
Total within Eighteen months		15,000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System.
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three-wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE OF MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues.

SOLE BUILDERS

EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

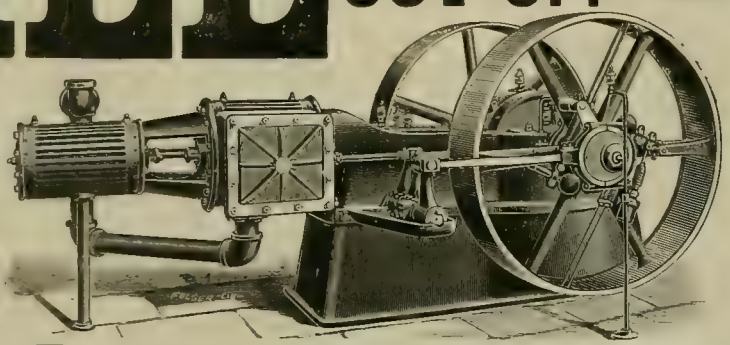
BALL AUTOMATIC CUT OFF ENGINE

Standard.

Cross Compound.

Triple Expansion.

Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER.
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Building, CHICAGO, ILL.

WILLIAM T. BONNER,
618 New York Life Insurance Building, OMAHA, NEB.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

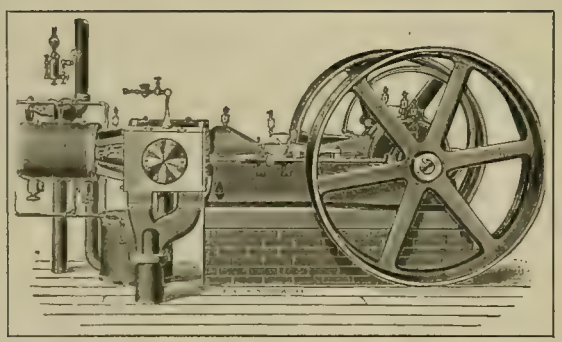
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

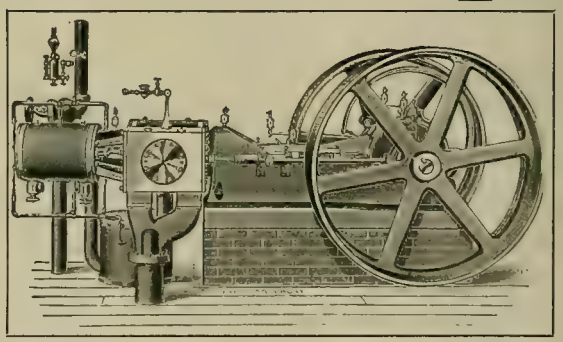
SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

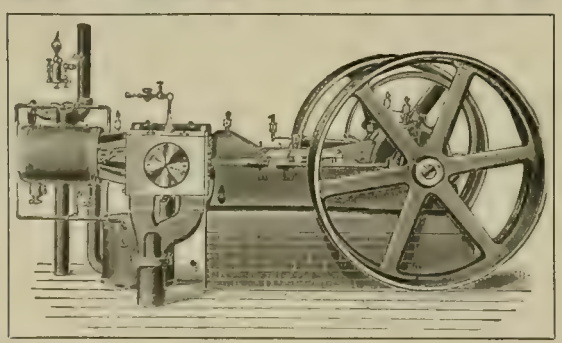
None so Good, None to Equal.



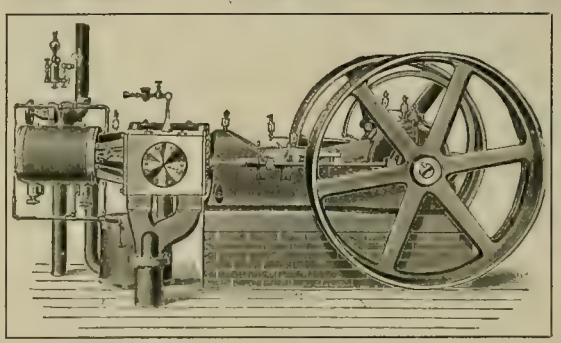
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

BURLINGTON ROUTE.

But One Night Chicago to Denver.

"The Burlington's Number One" daily vestibule express leaves Chicago at 1:00 p. m. and arrives at Denver at 6:30 p. m. the next day. Quicker time than by any other route. Direct connection with this train from Peoria. Additional express trains, making as quick time as those of any other road, from Chicago, St. Louis and Peoria to St. Paul, Minneapolis, Council Bluffs, Omaha, Cheyenne, Denver, Atchison, Kansas City, Houston and all points West, Northwest and Southwest.

WHIPPLE'S
Electric, Gas & Street Railway
FINANCIAL REFERENCE DIRECTORY
FOR 1890.

CONTENTS:

List of all Central Electric Light and Power Stations, with Capital Stock, Officers, Systems used, Capacity and Number of Lights in use, Steam Plants, Day Circuits, Kind of Wire and Belts used and Financial Standing.

List of all Isolated Electric Light Plants, with Number and Kind of Lights.

List of all Gas Companies, with Capital Stock, Officers, Price of Gas and Financial Standing, including all Gas Companies operating Electric Light Plants.

List of all Street Railway Companies, with Capital Stock, Officers, Miles of Track, Gauge, Kind of Rail, Number of Cars and Horses, Motive Power, if Electric, Cable or Steam, and Financial Standing.

List of all Telephone Exchanges and Licensed Companies, with Officers and Financial Standing.

Financial Standing of all Manufacturers, Dealers and Agents in the General Electrical World.

Price of all Public Lighting Contracts, with Number and Kind of Lights, Hours Burned, etc.

Rules and Requirements of all the Boards of Fire Underwriters, Insurance Companies, etc.

HANDSOMELY PRINTED AND BOUND.

Sent express paid on receipt of $5; with Monthly Corrections, $6; with Confidential Rate Sheet, $10.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.

THE
Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS
Hazelton Tripod Boiler Co.,
170 TWENTY-SECOND ST.,
CHICAGO, ILL.

Binders
FOR THE Western Electrician
$1.00.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

GEORGE P. BARTON,
LAW OFFICE,
225 DEARBORN STREET,
CHICAGO, ILL.

Patent and Trademark Cases

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

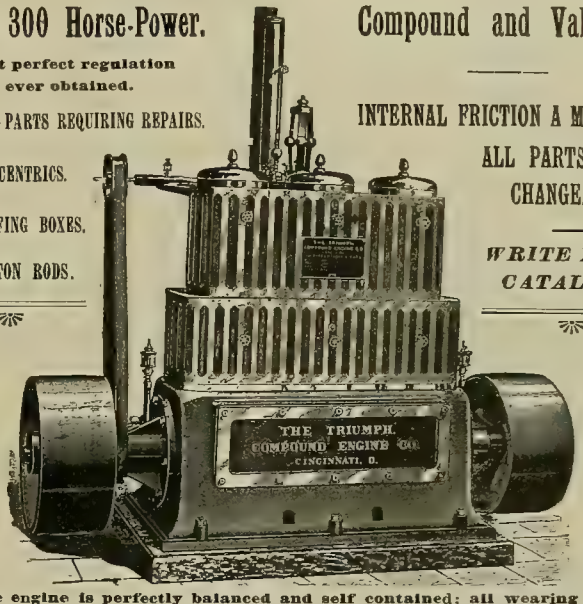
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

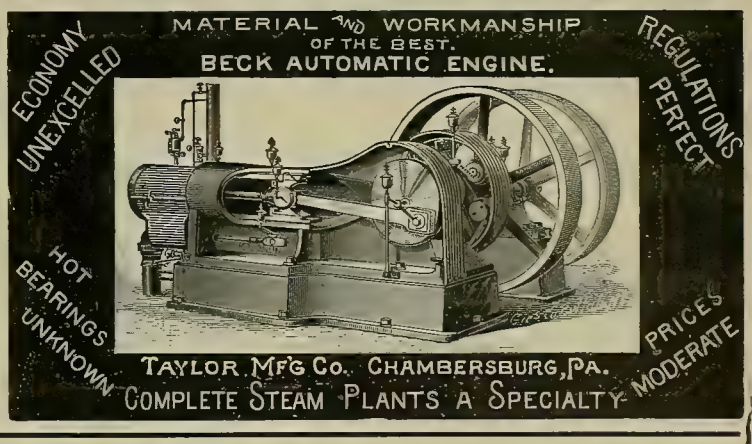
SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

Chicago Electric Club.

Will hold its next regular meeting at the Club Rooms, Monday Night, October 20, 1890.



DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill.

THE

DAVENPORT & ROCK ISLAND STREET RY. CO.

(OWNED BY C. B. HOLMES AND ASSOCIATES OF CHICAGO)

Has Contracted for the Equipment of Thirty-two Miles of Street Railway and Fifty Motor Cars with the

THOMSON-HOUSTON ELECTRIC CO.

THIS COMPANY NOW HAS

NINETY-FIVE ELECTRIC RAILWAYS IN OPERATION

AND THIRTY-ONE IN PROCESS OF CONSTRUCTION.

THE THOMSON-HOUSTON ELECTRIC RAILWAY SYSTEM

IS OPERATING SUCCESSFULLY IN THE FOLLOWING LEADING CITIES OF THE UNITED STATES:

BOSTON, BROOKLYN, ALBANY, SYRACUSE, TOLEDO, CLEVELAND, MILWAUKEE, INDIANAPOLIS, ST. LOUIS, KANSAS CITY, ATLANTA, PUEBLO, DENVER, OMAHA, ST. PAUL, MINNEAPOLIS AND CINCINNATI.

INCREASED FACTORY FACILITIES NOW ENABLE US TO FILL ORDERS PROMPTLY

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

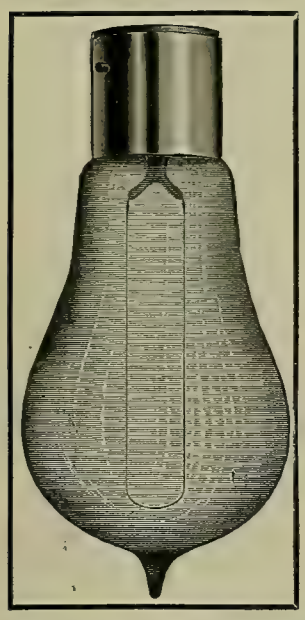
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 408 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

THE

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.

GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

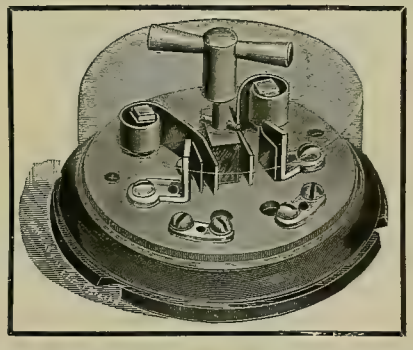
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

WE CALL SPECIAL ATTENTION TO

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

FOR

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

WESTERN AGENTS

HABIRSHAW WIRES, CABLES AND CORES.

A HIGH GRADE OF RUBBER INSULATION.

[CONTINUED FROM LAST WEEK.]

RECAPITULATION.

Habirshaw Insulation is the best and only thoroughly Reliable Rubber Insulation made. For full particulars see our advertisements in the following numbers of this paper:

AUGUST 30.—Johns-Hopkins University test and testimonials from well-known contractors and experts.

SEPTEMBER 6.—List of places where Habirshaw Insulation has been used.

SEPTEMBER 13.—Illustration of some of the cores referred to in our list of Sept. 6.

SEPTEMBER 20.—How some "rubber" insulations look under chemical analysis. What our claim of superiority is based on.

SEPTEMBER 27.—Report of test made of all of the different rubber insulations.

OCTOBER 4.—Pure Para Rubber Stock used in Habirshaw Insulation *versus* old rubber boots and shoes used in other insulations.

MORAL.

FOR IMPORTANT WORK USE ONLY

HABIRSHAW INSULATION.

IN CASES OF THIS KIND THE BEST IS BY LONG ODDS THE CHEAPEST.

The Habirshaw insulation fulfills all requirements in places demanding the "BEST," and in that field finds no successful competitors.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS,
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

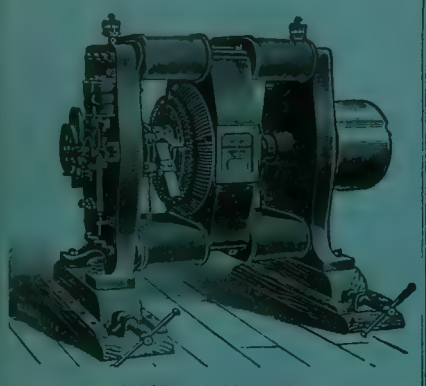
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



WOOD ARC DYNAMO.

MAIN OFFICE:

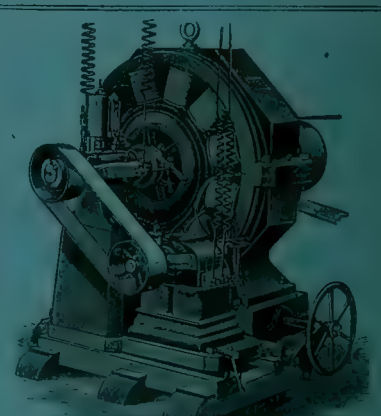
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK,	115 Broadway.
CHICAGO,	185 Dearborn St.
PHILADELPHIA,	907 Filbert St.
PITTSBURGH,	533 Wood St.
DETROIT, MICH.,	57 Gratiot Ave.
SAN FRANCISCO,	35 New Montgomery St.
TORONTO, CAN.,	138 King St. W.
DALLAS, TEX.,	McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.

THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

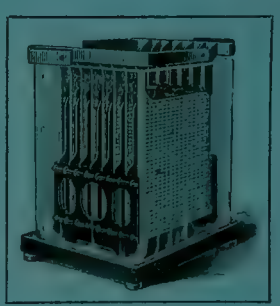
Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF

FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR CO.,

44 Broadway, NEW YORK.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 Carler Street, Philadelphia, Pa.
CHICAGO AGENCY:—239 La Salle St. SAN FRANCISCO:—220 Sutter St.
BOSTON:—HOLTZER-CABOT ELECTRIC CO, 111 Arch Street.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, OCTOBER 18, 1890. No. 16

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. { PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin' ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4⅞-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, { 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

THE EDISON-EICKEMEYER ARMATURE.

THE EDISON DYNAMO

SEE PAGE 8.

CENTRAL DISTRICT OFFICE, RIALTO BUILDING, CHICAGO.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment.
Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	285
Waterhouse	222	.....	222
Heisler	.....	500	[illegible]
Remington	159	300	459
Sperry	130	.....	130
Excelsior	90	.....	90
Hochhausen	[illegible]	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc.	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,067
Edison	.....	13,853
American	1,537	[illegible]
United States	632	6,141
Schuyler	1,066	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	[illegible]	.....
Excelsior	205	30
Hochhausen	[illegible]	.....
Weston	[illegible]	.....
Fuller	10	.....
Reliance	[illegible]	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	[illegible]	[illegible]
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	28
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%

	Arc.		Incandescent.	
	T. H. System.	All other Systems	T. H. System.	All other Systems.
Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Increase	5,843	4,402	36,229	40,652
Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co.....—
Abendroth & Root Mfg. Co.. xviii
Alexander, Barney & Chapin.. xiv
Allis, E. P. & Co..... xxvi
American Electrical Works.. xvii
Ansonia Brass & Copper Co.. i
Automatic Switch Co..... vii
Baggot, E..... xviii
Bain Foree..... xviii
Ball Engine Co..... xxvii
Barnes, W. F. & Jno..... xxi i
Barton, Geo. P..... —
Baxter Electric Motor Co..... xxxii
Bernstein Electric Co..... xxiii
Bleckert & Nelson..... xix
Brown, Frank T..... xvii
Brooks Underground Tel. Co.. xvii
Brush Electric Co..... xxxi
Bunnell & Co., J. H..... xvi
Butler Hard Rubber Co..... xxii
C. B & Q. R. R..... xviii
C. & C. Electric Motor Co... xxiv
Central Electric Co..... xiii
Cleverly Electrical Works... xvii
Colburn & Co., I. W..... xviii
Columbia Incandescent Lamp Co xix
Connecticut Motor Co..... xxi
Consolidated Electric Storage Co..... —
Continental Dynamo Co..... iv
Crocker-Wheeler Motor Co... xvii
Crosby Electric Co..... iv
Curtis Regulator Co..... —
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xx
Eastern Electric Cable Co. xvii
Eddy, Henry C..... .. xvi
Edison Mfg. Co..... xxiv
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Wire Dept..... i
Edison Lamp Co..... —
Electric Construction & Sup. Co iv
Electric Merchandise Co..... xviii
Electrician Publishing Comp'y xxv
Electrical Supply Co..... xxx
Elektron Mfg. Co..... xviii
Empire City Electric Co..... xx
Empire China Works..... xviii
English, Morse & Co..... xix
Eureka Tempered Copper Co.. xix
Evans Friction Cone Co..... xxi
Excelsior Electric Co..... ... xxiii
Fibrone Mfg. Co..... xvii
Fletcher & Fletcher Elec ric Co xviii
Forest City Electric Works.... —
Fort Wayne Electric Co..... xxxii
Gibson Gas Fixture Co..... xx
Globe Carbon Co..... xix
Great Western Electric Sup. Co. v
Greeley & Co., E. S..... —
Harmount, G. A..... vii
Hawkeye Electric Mfg. Co.... iv
Hazelton Tripod Boiler Co... xxvii
Heisler Electric Light Co..... xxvi
Hill Clutch Works..... —
Holmes, Booth & Haydens..... xix
Holmes & Co., C. H..... xix
Holtzer-Cabot Electric Co..... i
Humphrey, H. H..... —
Illinois Electric Material Co.... xvi
India Rubber & Gutta Percha Co. i
Interior Conduit & Insulation Co. xvi
Ireson, Chas. L.. i
Jewell Belting Co..... xvii
Jones Bros. Electric Co..... vii
Knapp Electrical Works..... xxix
Laminar Fibre Goods Co..... xix
Law Telephone Co..... xvii
Leclanche Battery Co..... —
Leffel & Co., James..... xviii
Magnolia Anti-Friction Metal Co t
Mason, James H..... ... xxvii
Milliken & Co..... x
Monitor Electric Co..... xvii
Munsell & Co., Eug..... xvii
Munson Belting Co., Chas..... xvi
National Carbon Co..... iv
National Conduit Mfg. Co.... xxii
National Electric Mfg. Co..... xii
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T..... —
N. Y. Belting & Packing Co... xvi
Okonite Co..... lx, xvii
Ostrander & Co., W. R. xx
Page Belting Co..... ...xviii
Paiste, H. T..... xvi
Partrick & Carter..... xxii
Phillips Electrical Works, E. F xvii
Phoenix Glass Co..... xxxii
Pond Engineering Co..... vii
Powell Co, Wm..... xxvii
Pumpelly Storage Battery Co. vii
Queen & Co..... xv i
River & Rail Elec. Light Co.. xi
Roeblings' Sons Co., Jno. A... xxi
Sawyer-Man Electric Co..... xiv
Schoverling, A..... —
Schuyler Electric Co..... x
Shultz Belting Co..... xviii
Southern Electrical Supply Co. xxiii
Sperry Electric Co..... xx
Standard Electrical Works ... xvii
Standard Paint Co..... xvi
Standard Underground Cable Co. i
Standard Carbon Co..... xxii
Stanley & Hall..... xvi
Stephenson & Co., Jno xxiv
Stiff, E. D. & Co.... ..... —
Stilwell & Bierce Mfg. Co. xviii, xix
St. Louis Electrical Supply Co. xxiii
Sunbeam Incandescent Lamp Co. xvii
Taussig, S..... xvi, xviii
Taylor Mfg. Co..... xxvii
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxviii
Triumph Compound Engine Co..... xxvii
Tripp Mfg. Co..... xxvii
Turner Brass Works..... xvi
Union Hardware Co..... xvi
United Electric Traction Co.... vii
United States Electric Lighting Co..... —
Van Nuis C. S..... i
Wanted..... xvi
Western Electric Co..... xx
Western Power Construction Co. xxvi
Westinghouse Electric Co..... xv
Weston Electrical Instrument Co..... —
White, R. T..... iv
Wollensak, Jno. S..... xxiii
Woodbridge & Turner..... xix

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S..
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magnetic.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See insulated wire.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Brooks Underground Telegraph Co.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.
National Conduit Mfg. Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brooks Underground Telegraph Co.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
National Conduit Mfg. Cor
Northwest Thomson-Houston Co.
Pond Engineering Co.
River & Rail Electric Light Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Const
White, R. T.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
River & Rail Electric Light Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Co.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works
Standard Underground Cable Co.
Western Electric Co.

Jewelry, Watches, &c.
Giles, Bro. & Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Contd.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car
Edison General Electric Co.
Sprague Electric Railway & Motor Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
Tripp Mfg. Co.
United Electric Traction Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co, James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

R. T. WHITE,

PATENTED MATERIAL FOR

STREET RAILWAY ROAD-BEDS

Also Cable, Electric and Elevated Railways,

12 PEARL STREET, Rooms 6 and 7, BOSTON, MASS.

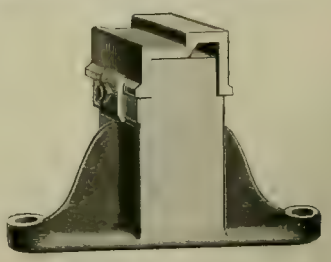
NEW YORK OFFICE, 52 Wall Street, Room 41.

CORRESPONDENCE SOLICITED.

DAISY CHAIR

For T Girder or Rail, having a T Form of Base.

Patented January 28, 1890—No. 420.135.



EUREKA CHAIR

For Channel Iron Form of Rail.

GIVES A CLEAR AND STEADY LIGHT.

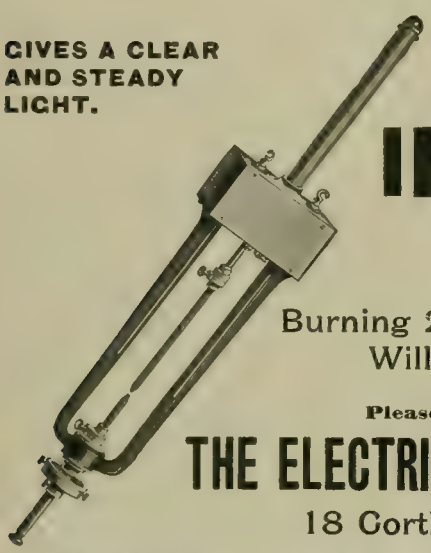
THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.



We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

87 and 89 South Fifth Avenue, - - NEW YORK.

THE HAWKEYE

ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station

AND

ISOLATED PLANTS,

ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps,*** Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190-192 Fifth Avenue, CHICAGO.

DESIGNERS
—OF—
Electric Railway Specialties.

MAKERS
—OF—
Choice Electric Supplies.

DEALERS
—IN—
Standard Electrical Goods.

POLES

Of Extra Strength in all Sizes and Styles.

PLAIN WOOD POLES:

GET OUR PRICES.

OCTAGONAL WOOD POLES.

NEAT AND LOW PRICED.

POLES

ANGLE-IRON POLES

Superior to pipe poles at about half the cost.

Our 28-foot pole will stand a strain of 3,000 pounds without deflection.

LATTICED CORNER POLES.

Extra strong and stiff. Will stand all strains met in practice without appreciable deflection.

BRACKETS

Of angle iron. Stronger and neater than those made of piping. Maintain their shape perfectly.

Try us on

BRACKETS AND POLES.

IF YOU WANT MATERIALS

That have the greatest strength,
That give the highest practical insulation,
That pay best in the end:

TRY US FOR YOUR SUPPLIES.

TREBLE CURVE INSULATOR.

Gives the Greatest Strength and the Highest Insulation. Try it and you will use no other.

RESISTS ABRASION AND GIVES THE HIGHEST LINE INSULATION.

SIMPLEX WIRE.

THE WIRE THAT PAYS BEST IN THE LONG RUN.

Try it for mains and you will always use it.

For lines in mines or among trees it is unequaled.

SEND FOR A SAMPLE.

ALL-COPPER RAILBONDS.

SEND FOR A SAMPLE.

Have practically no resistance. Are quickly and cheaply applied. Will not oxidize.

WATCH FOR NEW ADDITIONS TO OUR

Electric Railway Specialties.

We insist on having only the very best, and that at figures which will command your orders.

ALL OF OUR

SPECIALTIES

WEAR WELL.

Prove it for yourself by trying them.

Our place at 190-192 FIFTH AVENUE is the

HEADQUARTERS

For Electric Railway Supplies

In any quantity,
For any system,
And to meet any circumstance.

WHAT'S THE MATTER

WITH YOUR DYNAMO?

IS THE ARMATURE BURNED OUT?

SEND IT TO THE REPAIR DEPARTMENT OF THE

NORTHWEST THOMSON-HOUSTON ELECTRIC COMPANY,

401 FIRST ST., SOUTH, MINNEAPOLIS, MINN.

REMEMBER, We Repair Everything ELECTRICAL,

It Matters Not What System You Use.

If anything is out of order, send to us and we will repair and return quicker and in better order than any one else in the Northwest.

GIVE US A CALL.

We Always Please Our Customers.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,
BALTIMORE, MD., U. S. A.
Sole Manufacturers of the
WHITTINGHAM
AUTOMATIC SWITCH.
The only reliable protector to the Armature of an Electric Motor.
Applicable to Constant Potential Motors of all sizes and patterns.
SEND FOR CATALOGUE.

POND ENGINEERING CO.,
ST. LOUIS, CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.
ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.
COMPLETE STEAM PLANTS CONTRACTED FOR.
ERECTED READY FOR SERVICE.
SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.
Send to the Nearest Office for Latest Catalogue.

UNITED
Electric Traction Co.
ELECTRIC RAILWAYS.
STREET OR TRUNK LINES.
ELEVATED OR UNDERGROUND.
Central Stations for Power Distribution.
STATIONARY MOTORS.
STORAGE BATTERIES.
Executive Offices: 115 BROADWAY, NEW YORK.
AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.
FACTORY: JERSEY CITY, N. J.

TRADE GONDA MARK.
PARIS
HIGHEST AWARD!
THE ONLY
GOLD MEDAL
FOR
ELECTRIC BATTERIES
EXPOSITION
1889
The Standard Open-Circuit Batteries of the World
THE LECLANCHE BATTERY CO.,
149 West 18th Street, - - NEW YORK.

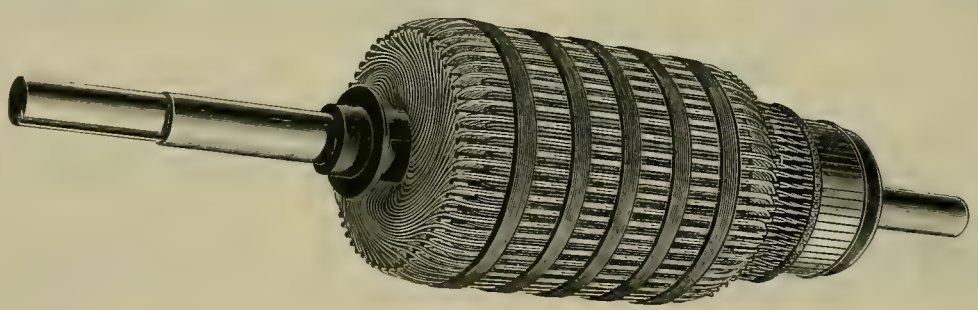
ARMATURES REPAIRED and REWOUND
COMMUTATORS TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

THE EDISON MOTOR.

BALANCED GEARING,
COMMUTATED FIELD COILS,
WROUGHT IRON CORES.

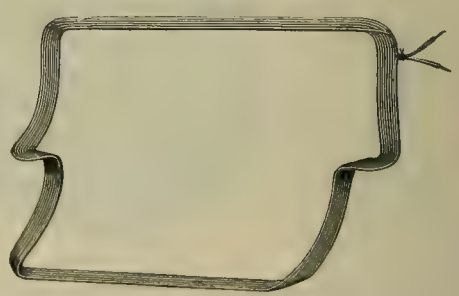
NOISELESS GEARING,
MECHANICAL PERFECTION.

The Edison-Eickemeyer Indestructible Armature.



Independent Armature Coils.

SINGLE LAYER WINDINGS.
SYMMETRY OF DESIGN.



STANDARD ARMATURE COIL.

IN TWO YEARS OF LIGHTING SERVICE NO ARMATURE HAS EVER BURNED OUT.

EDISON GENERAL ELECTRIC COMPANY,

Edison Building, Broad Street, NEW YORK.

Every Delegate

—TO THE—

STREET RAILWAY ASSOCIATION

OKONITE TRADE MARK.

Convention at Buffalo who is interested in the use of Electricity as a Motive Power will find it to their profit to look into the following

OKONITE TRADE MARK.

FACTS:

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES have the indorsement of the best electrical experts and electricians in the world.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not deteriorate, but improve with age.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not crack when exposed to severe changes in temperature.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not deteriorate when placed in lime or mortar.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are not affected when immersed in sulphuric acid.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will stand a greater amount of kinking and tortion than any other wire in the market.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are immersed in water for three days (72 hours), and then carefully tested with Thompson's Reflecting Galvanometer.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are tested in addition to the Galvanometer, with a dynamo current of 2,000 volts.

IT IS A FACT that the OKONITE INSULATED WIRES AND CABLES were awarded the GOLD MEDAL at the Paris Exposition, 1889.

IT IS A FACT that the OKONITE INSULATED WIRES AND CABLES are giving better satisfaction, are more carefully made, and are not only the best, but cheaper in the end, than any other wires on the market.

THE OKONITE COMPANY, 13 Park Row, New York, will furnish INSULATED WIRE OR CABLE of any size or number of conductors for use as SUBMARINE, UNDERGROUND or AERIAL CABLES, FEED WIRES, WIRING of CARS, or for any other purpose where first-class insulation is required.

THE OKONITE CO.

13 Park Row, New York.

WILLARD L. CANDEE and H. DURANT CHEEVER, Business Managers. F. CAZENOVE JONES, Superintendent of Factories.

BRANCHES:—Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, Kansas City and San Francisco.

THE MILLIKEN PATENT Electric Railway Pole.

MANUFACTURED BY

MILLIKEN BROS.,

NO. 55 LIBERTY STREET, NEW YORK.

Standard Side, Center & "Pull Off" Poles.

Special Poles of any Required Length, or to stand any Strain, made to order.

OVER 6,000 SOLD IN THE LAST THREE MONTHS.

In use in Newark, Jersey City, Paterson, Troy, Buffalo, Pittsburgh, Hamilton, O., and many other cities.

WESTERN AGENCY,

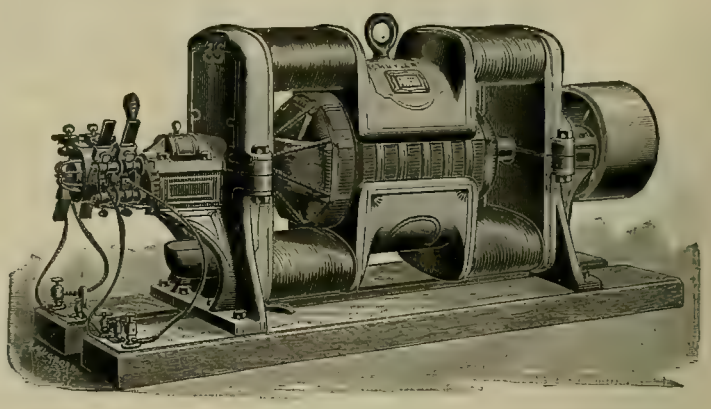
MILLIKEN & CO., 59 Dearborn St., CHICAGO.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature. proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

SYNOVIAL OILS

Are admittedly the best lubricants on the market to-day. We make a specialty of supplying electric light stations and electric railways with Synovial oils and greases.

Heaviest Gravity Made. Uniform Quality. No Gum or Acids.

Will stand filtering indefinitely. We are supplying the largest companies east and west. Synovial oils have held the Government contract for supplying the electric light plant at the Chicago postoffice for five consecutive years against all comers. This contract has been renewed for the current year as the following letter will show:

Office of CUSTODIAN U. S. CUSTOM HOUSE,

S. TAUSSIG, Agent. Chicago, September 3d, 1890.

Dear Sir:—Your proposal of June 7th for supplying this building with

1,000 gallons of Engine Oil, and 1,200 gallons of Cylinder Oil,

has been accepted by department letters of June 21st and August 30th, 1890. You will be notified from time to time relative to the delivery of same.

Respectfully, F. HITCHCOCK, Custodian.

DYNAMO OIL.

CYLINDER OIL.

TRADE SYNOVIAL MARK

ENGINE OIL.

GREASES.

Managers of Electric light and power stations who desire the best and most economical lubricant known should send for samples or order goods on approval.

Manufactured exclusively by SMITH & NICHOLS, 143 Front St., NEW YORK.

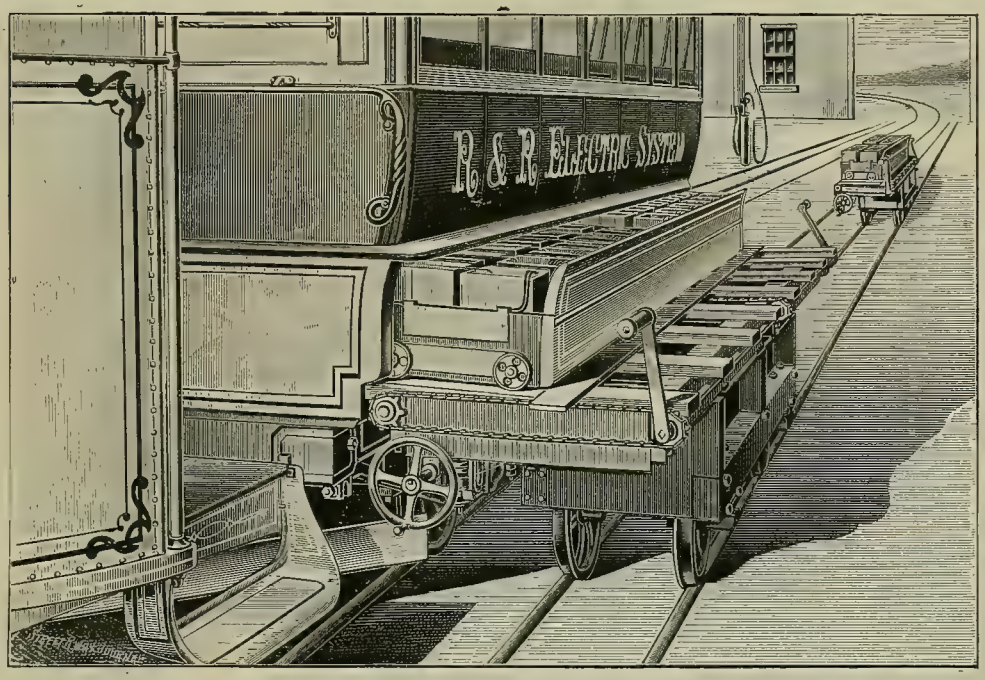
WESTERN DEPOT: S. TAUSSIG, 45 River Street, CHICAGO, ILL.

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



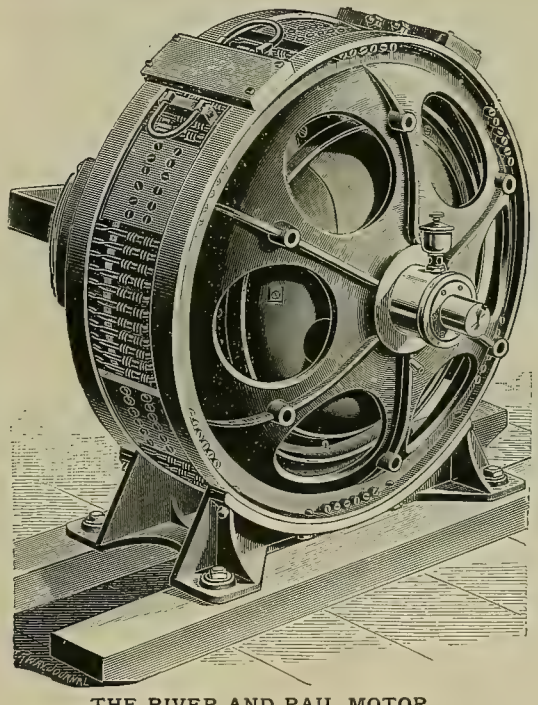
Cars are Lighted by Batteries That Propel The Motor.

METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

THE MAIN Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

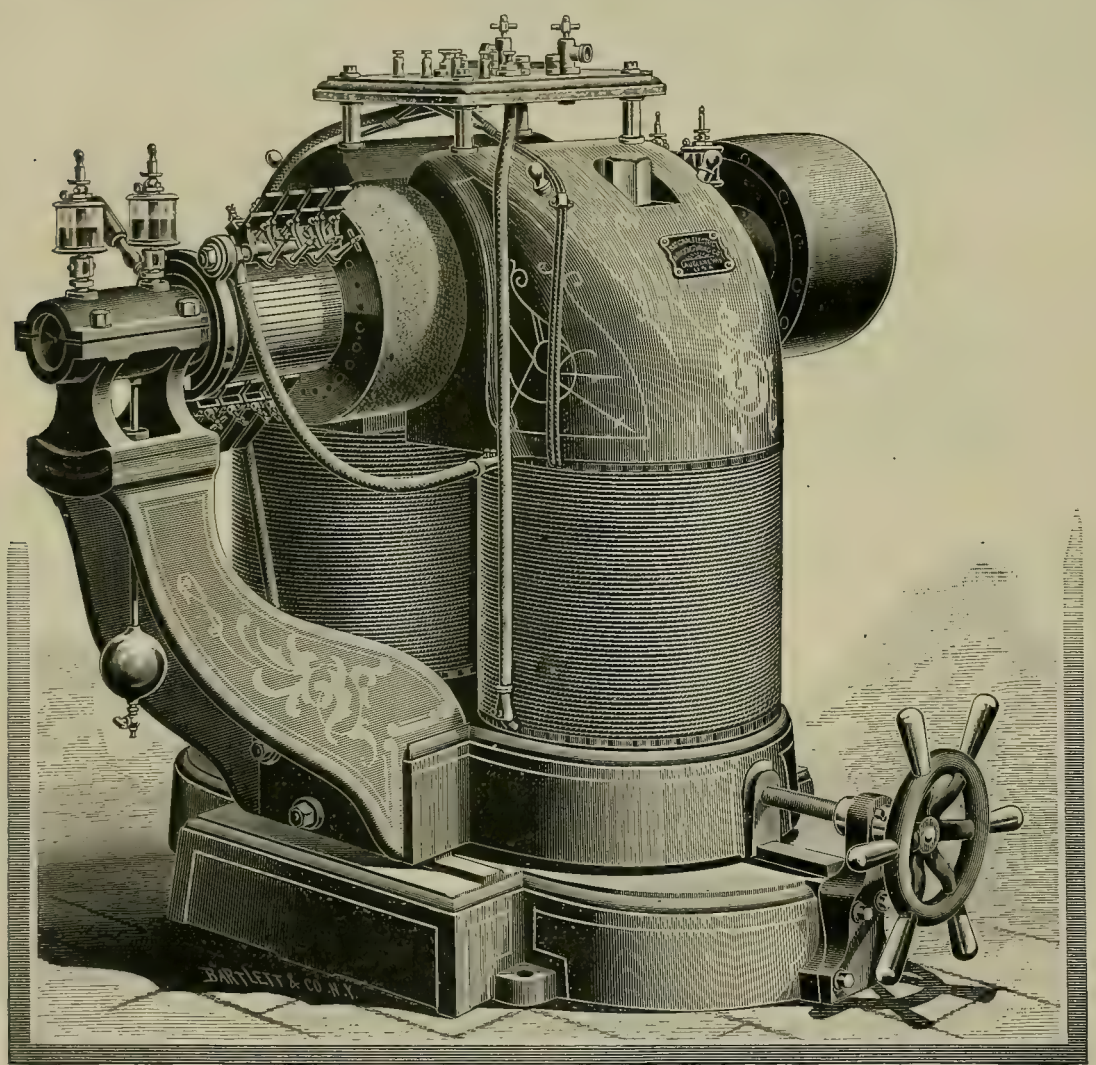
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMO CAPACITY 500 16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Ag'ts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building. St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

ELECTRIC RAILWAY SUPPLIES.

BARE TROLLEY WIRE,

INSULATED FEEDER WIRE,

JORDAN'S TROLLEY WIRE INSULATOR AND SUPPORTER.

Absolutely Safe and Reliable. No Soldering.

Connected by Private Wire with Postal-Telegraph Cable Co.

OKONITE TRADE MARK.

General Western Agents for **Okonite** AND **Candee Wire.**

The Central Spark Arrester.

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting into the globe.

THE HOT WIRE

LIGHTNING ARRESTER.

No Magnet or Self-Induction.

Furnishes Absolute Protection,

And is Automatic in its Action.

Our Price on these Instruments is very Low.

THE PERRY WIRE PEELER.

This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs,
Cleveland Switches, Paiste Switches,
Branch Blocks,
And all kinds of Electrical Supplies.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

BRYANT,
PERKINS,
CLEVELAND,

TRADE A.B.C. MARK

HILL,
PAISTE,
STAR,

SINGLE POLE DOUBLE POLE

S-W-I-T-C-H-E-S

AT MANUFACTURERS' PRICES,
WHOLESALE AND RETAIL.

Alexander, Barney & Chapin,

TELEPHONE BUILDING,

20 CORTLANDT STREET, NEW YORK.

CORRESPONDENCE SOLICITED.

SAWYER-MAN LAMPS,

Any Candle Power,
To Fit Any Socket.

NEW SERIES LAMP AND SOCKET FOR

ARC CIRCUITS.

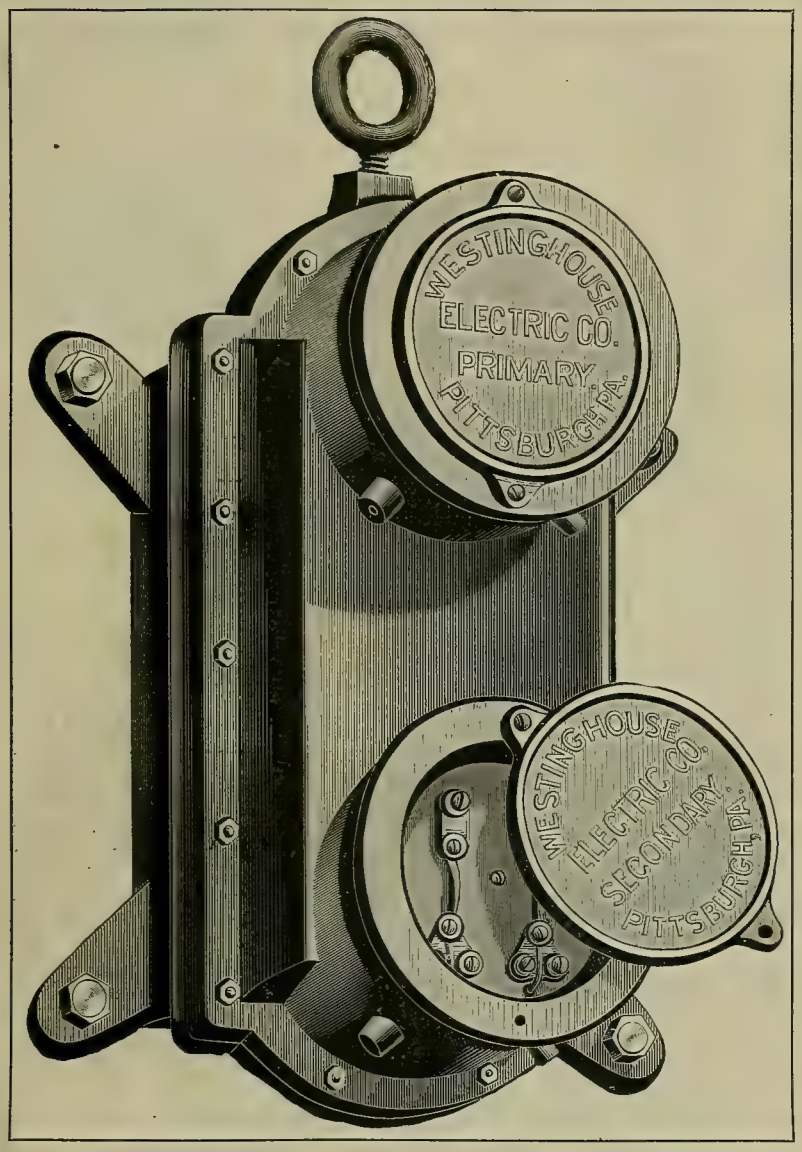
SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.

CONVERTER EFFICIENCIES

It Will Pay You to Throw Out Your Present Converters and Substitute Our Make.



COMPARISON OF CONVERTERS.

	Total Efficiency.	Converter Capacity Tested.
Thomson-Houston,	87.50 Per cent.	25.
Ft. Wayne Jenney,	87.	25.
National,	88.	20.
WESTINGHOUSE,	95.	20.

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

Incandescent Alternating Current Dynamos, Converters, Meters, Motors.

325 Central Stations and 600,000 Lamps.

Alternating Current Arc Lighting Apparatus.

Lamps burn 40 hours without renewal of carbon.

Arc Lighting revolutionized.

Send for Special Circular.

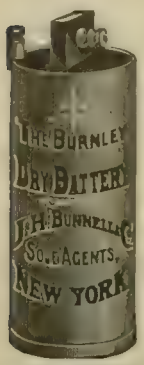
55 PLANTS, AND 5000 LAMPS SOLD WITHIN A FEW MONTHS.

CORRESPONDENCE SOLICITED.

WESTINGHOUSE ELECTRIC & MFG. COMPANY,

PITTSBURGH, PA., U. S. A.

BOSTON, NEW YORK, CHICAGO, CINCINNATI. ST. LOUIS,
CHARLOTTE, N. C., SAN FRANCISCO, PORTLAND.



BURNLEY DRY BATTERY

PATENTED January, 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:--Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

BUSINESS CHANCE.

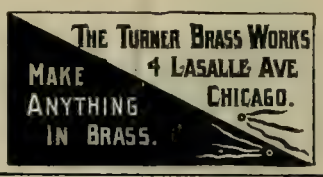
WANTED.

To place, at a bargain for buyer, within 30 days, a Steam Engine and Boiler plant. No real estate.

Address,

"CODAC,"

Care of WESTERN ELECTRICIAN.



HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

DUST-PROOF BELLS.

None Genuine Without the Washer

STANLEY & HALL,

(Formerly HAZAZER & STANLEY,)

32 and 34 Frankfort St.,

NEW YORK.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
ST. LOUIS, 616 Locust St.

"CANVAS JACKET" LINE WIRE

MOISTURE & FIREPROOF.

ILLINOIS ELECTRIC MATERIAL CO.,

POLES

"BISHOP" RUBBER CABLES.

COVERED WIRES AND

"The Rookery," CHICAGO, ILL.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

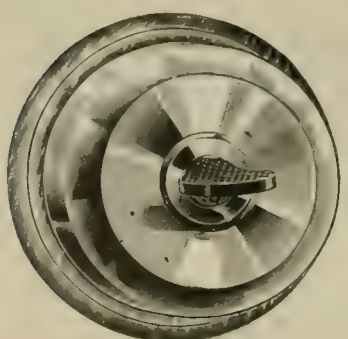
CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH



FOR INCANDESCENT WORK

Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,

12th and Market Sts.,

Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

GET THE BEST!

P. and B.

INSULATING COMPOUNDS,
ARMATURE VARNISH,
INSULATING TAPE,
INSULATING PAPERS,
MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, OCTOBER 18, 1890. No. 16

The Westinghouse Electric Railway Motor.

Ever since the Westinghouse Electric & Manufacturing company made the announcement of its intention to commence the manufacture of electric street car motors, those directly concerned in the progress of electrical achievements have been interested in the apparatus brought out by the company. From the accompanying cut, Fig. 1, it is at once discernible that the motor employed by the company is of solid mechanical construction, which is of especial importance in a street car motor on account of the unusual wear and tear to which it is constantly subjected. Otherwise the motor does not seem to have any radically new features; in fact, one is inclined to assume that the company's intention was not principally to manufacture a motor totally different from those already in use, but rather to design an apparatus the chief characteristics of which should be simplicity, strength, and above all, durability.

The motor is series wound etc., and designed for a constant potential 500 volt direct current circuit. Armature and fields are in series with a set of "diverter" coils, which are used when the cars start, and also to vary the speed. For its foundation the motor has a continuous iron frame, upon which all the bearings are placed; in fact its chief object is to hold all the mechanical parts of the motor together and keep them in the same position in which they were arranged when the motor was put together in the company's works.

The field magnets are supported by this frame and they are constructed upon hinges in such a manner that an armature may be taken out and a new one substituted in a short space of time. If, for example, the motor was on the truck as well as the body of the car, and the removal of the armature was desired, it would only require the opening of the bottom of the car and the unhinging of the field magnets. The armature could then be taken out in a few seconds. To make this process of removing the armature still more easy, the company manufactures a small portable hoisting device, which fits into the oil pockets of the frame and enables one man to remove any part of the motor.

The construction of the field coils has been very carefully conducted. Indeed, the experience which the Westinghouse company has gained in winding and insulating high tension apparatus proves here to be of the utmost advantage, and it has been exercised in making the coils waterproof. They can easily be changed by slipping them over the magnet cores, and they are held immovable by brass rings.

The durability of any motor depends chiefly upon the construction of the armature. In the Westinghouse motor the shaft is made very heavy, is constructed of steel and the armature is built up to prevent any loosening of its details. The armature shaft is of varying diameter, being thicker in the center and tapering toward each end.

The commutator is constructed of a special composition metal made by the company, and is insulated so as to prevent burning out. All the details of the commutator are held together rigidly and are fastened to the armature shaft in a manner which obviates jarring or breaking of the armature wires.

The brush holder bracket is fastened rigidly to the frame and a wooden bar carries the brush holder arms. This method has been adopted to prevent vibration or shifting of the brushes.

The gears in the motor are heavier than ordinarily employed. The face of the gear wheel is wider, to give more wearing service.

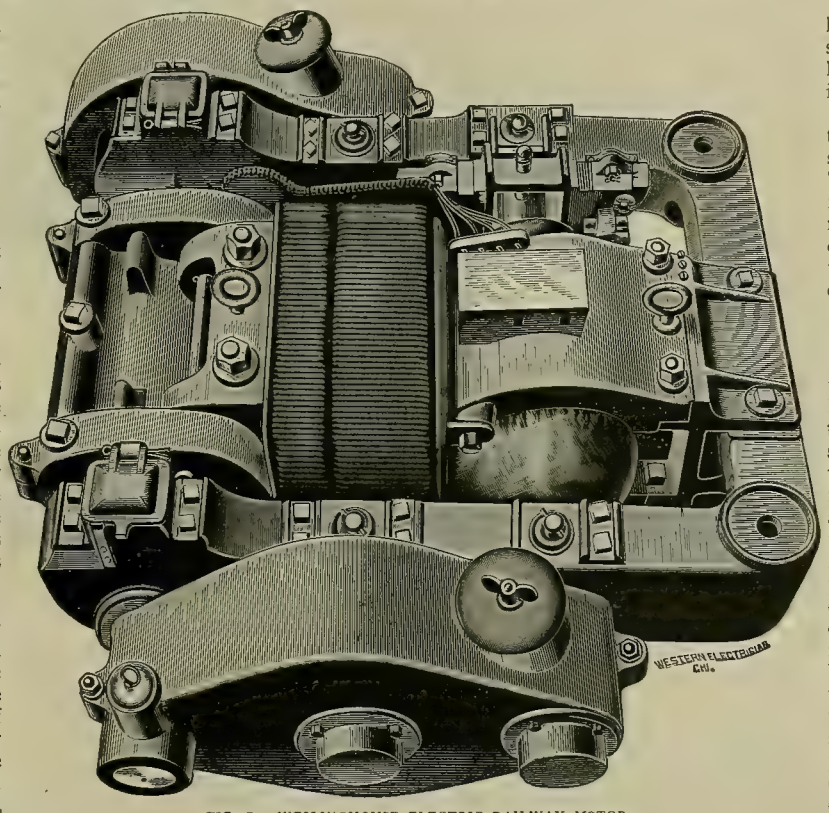


FIG. 1. WESTINGHOUSE ELECTRIC RAILWAY MOTOR.

The armature pinion and the countershaft pinion are made of steel. The axle wheel and the countershaft wheel, however, are of cast iron. The armature pinion, the countershaft pinion and the wheels are all bored taper fashion and their shafts are turned correspondingly. These parts are keyed together. A powerful spring is used behind two nuts to keep the wheels in place. The advantage of this method will be readily appreciated by those who realize that there is considerable heating in the pinions which expand more than the shafts and thus become loose. The purpose of this taper hole and shaft is that should the pinion expand more than the shaft, the spring will force the pinion tighter on the shaft and the loss of any motion between the latter and the wheel will be obviated.

All motor parts are held together by through-going bolts and spring washers are utilized to prevent the loosening of the nuts on account of constant jarring and shaking. The motor is supported upon the truck by two springs, which diminish the strain on the crossbeams. In Fig. 1 the gear wheels are not shown. They are surrounded by an iron box which is used principally to deaden the noise caused by wheels. The box surrounding the gears is filled with a peculiar lubricating material which reduces the friction of the gears and renders their movements, it is stated, practically noiseless while adding at the same time to their durability.

Fig. 2 gives a plan view of the truck.

To prevent accumulation of dust in the several parts of the motor, a sheet iron pan has been placed beneath the bottom of the motor and a sail cloth curtain surrounds the side of the apparatus. The ordinary overhead trolley wire system is used in connection with the motor.

In Pittsburg, Pa., the motors have now been operated on the streets since July 3, and they have become extremely popular in that city.

In Lansing, Mich., the operation of the motors is declared successful in every particular. The company has now contracts for fifty roads and the equipment for them is being turned out at the Pittsburg and Newark works as rapidly as the capacity of the shops permits.

Electric Poles and Wires.

The multiplicity of wires and poles in the city of Rochester, N. Y., due to the numerous electric light, telegraph, telephone, signal alarm, police and fire service and electric railroads, has resulted in a vigorous protest and a demand for the removal of the poles and wires in some cases. It is hardly possible that the people of Rochester will resort to extreme measures. They have excellent service both in arc and incandescent lighting; they have been free from fatalities owing to the excellent construction work and the precautions observed; their telegraph and telephone service meets all the requirements, and with the introduction of electricity on their street railroads their happiness should be complete. It is well both for the companies and the city that the poles and wires should be kept in good condition and made as little obnoxious as possible, but it can hardly be expected that the same service will be given at the present rates with the wires underground. The companies cannot afford to do it, and as they are not in the business for their health, they will not do it when it means pecuniary loss.

It has been suggested that the poles of the Bell Telephone company be utilized to carry the wires of the other companies. This would rid the streets of many poles now standing.

Street Railway Convention.

The Street Railway Convention at Buffalo, N. Y., Oct. 15, 16 and 17, promises to be a meeting of no little importance to street railway men in general, and particularly to electric railway managers. All the electric railway manufacturers will be represented. The headquarters of the WESTERN ELECTRICIAN will be at Parlor F, Iroquois hotel.

C. B. Holmes and Electric Railways.

The decision of the syndicate which controls the Davenport & Rock Island street railway to equip the road with an electric railway system at a cost of $350,000, was conclusive proof of the belief of the gentlemen who furnished the capital in the efficiency of electric traction. A significant fact in connection with the decision of the road is that C. B. Holmes, who is at the head of the syndicate, is particularly identified with the cable system. The Chicago City railway, of which he is the executive officer, is operated by as efficient a system of cable as can be found in the country. That the service on the several lines of the company is excellent, cannot be gainsaid. Still the brains of that company, Mr. Holmes, favors electric traction. A representative of the WESTERN ELECTRICIAN recently asked Mr. Holmes for his ideas on electric propulsion.

"You know," said he, "that we have decided to equip the Davenport and Rock Island road with an electric system, and we are also trying the Short system on the south end of our Broadway line in St. Louis. The latter works well and I have no doubt the same will be true in Rock Island and Davenport. These facts show my belief in electric railways."

"Do you believe that the day of the cable is passed?" was asked.

"By no means," was the response. "I think, on the contrary, that we have seen merely the beginning of cable roads."

"Where do you draw the line between roads that should be equipped with an electric system and the cable?"

"Where the volume of travel is extraordinarily heavy, in my opinion the cable should be used. Where the traffic is relatively light the electric motor will prove more advantageous. Take the case of our State street line for example. We carry 200,000 passengers a day on that line. In this case the cable is to be preferred. Why? Because it is more economical. Electric motors have no particular advantage over steam locomotives, considering them simply as means for drawing cars. Now, if we were given full permission to use steam on State street, it would not answer. The cars would not start quickly enough. We have to have something that will start right off. Then again on a road like State street the expense of running with the cable is not over two cents per car mile. With the electric motor it could not be reduced below four cents—a very substantial difference you see. In smaller cities, however, as I have already said, where the volume of travel is comparatively light, the use of the electric motor will prove economical and advantageous."

"Have you had presented to you any plan for the use of the cable conduit for the underground system of an electric railway?"

"Yes, but none of them has seemed feasible to me. I haven't much faith in underground systems for electric railways. They have proved failures wherever they have been tried, so far as I know."

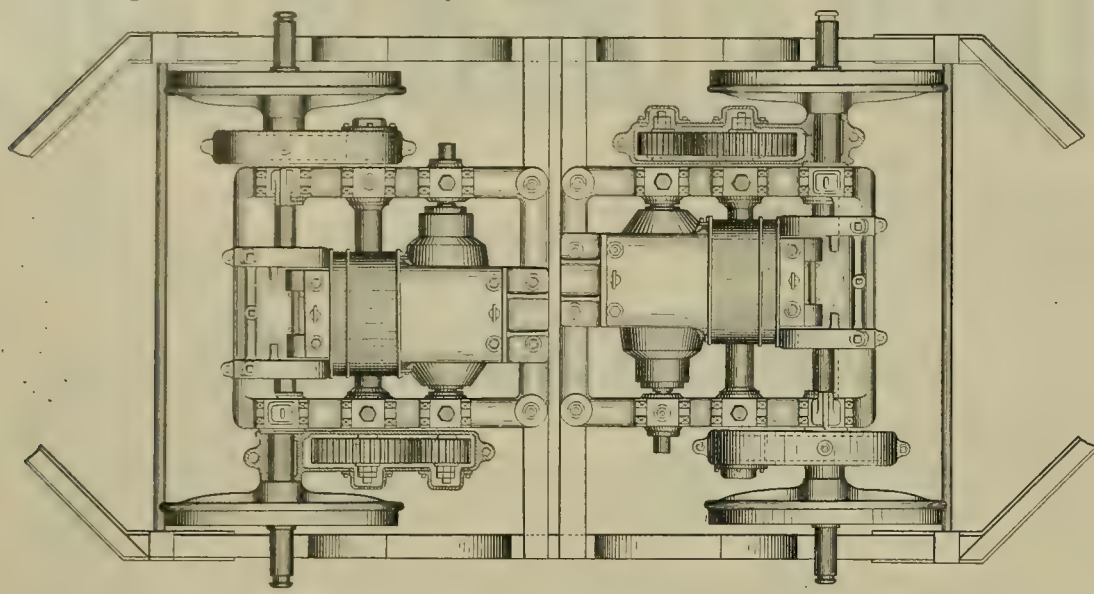


FIG. 2. WESTINGHOUSE ELECTRIC RAILWAY MOTOR—PLAN OF MOTOR AND TRUCK

Maguire Street Car Truck.

The accompanying cut represents the Maguire truck for electric cars. The extended spring base enables it to carry a long-car, it is stated, on a sixteen foot wheel base and makes an easy riding car without the excessive longitudinal rocking common to many six-foot wheel base cars. As the springs are all located outside the wheels there is no central point on which the car can rock. The attachment of the truck to the car is elastic in every direction. The truck is strong and simple in construction. The side of the truck being composed of only four pieces it is little liable to get out of repair. An axle and wheels can be moved by taking off four nuts, and by removing eight nuts the car and truck frame can be lifted from the axle and wheels. The journal boxes, it is stated, will run a year with one oiling and are both dust proof and water proof. The trucks are constructed almost entirely of wrought iron. They are manufactured by the Maguire Manufacturing company of Chicago.

MAGUIRE ELECTRIC CAR TRUCK.

The North Avenue Electric Railway company of Baltimore, Md., has commenced work on the extension of its system. An electric road will be constructed at the Baltimore Sugar refinery. The Thomson-Houston system will be employed.

Electric Light Litigation.

A hearing was had in Chicago last week in the case of the Brush Electric company of Cleveland against the Fort Wayne, Ind., Electric company. This is one of the cases growing out of the double carbon arc lamp patent which has attracted so much attention of late. The case was heard by Judges Gresham and Blodgett. Testimony similar to that given in the complainant's double carbon lamp suits was presented and decision was reserved by the court.

Stevens Positive Gravity Switch.

The accompanying illustrations show the new switch introduced by the Electric Merchandise company, Chicago. It is intended for use on overhead electric railway lines and has been approved by many prominent electrical engineers. It has been in practical operation on several lines. Fig. 1 shows the switch as it appears on the line, while Fig. 2 shows the openings through which the trolley wheel passes. It will be noticed that the switch is level with the trolley wire, having no depressions to wear the wheel. This feature is considered a positive advantage. Another advantage claimed for this device is that the speed of the car or the direction in which it is traveling will not interfere with the satisfactory operation of the switch. The wheel itself opens a space in the switch which, after the car is allowed to pass, closes immediately and is ready for the car following or one coming from another direction. The switch is made for both right and left turn-outs.

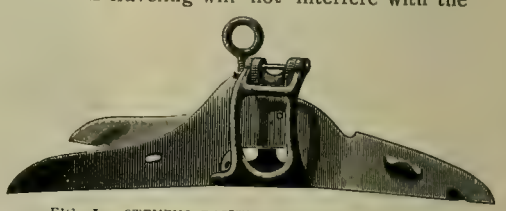


FIG. 1. STEVENS POSITIVE GRAVITY SWITCH.

FIG. 2. STEVENS POSITIVE GRAVITY SWITCH.

The device is extremely simple. It is only eighteen inches long, which is a commendable feature.

Telephone and Electric Railway Companies.

One of the greatest obstacles the promoters of electric railways in large cities have had to contend with was the opposition of the telephone companies. These corporations have in many cases carried the controversy into courts, thereby causing much delay in the introduction of the electric system on the street railways. The disturbances experienced in telephone work due to the operation of electric street railways can generally be avoided by the establishment of complete metallic circuits for the telephone. The telephone companies desired the electric railway companies to reimburse them for the expense of changing their systems, but the electric railway companies claimed that the telephone system, if properly constructed, would not be affected by the introduction of electric railways. Both telephone and railway companies claimed the right to use the street, the telephone companies because they had their poles planted before the introduction of electricity in the propulsion of street cars, while the latter contended that the streets being highways and the railway companies being common carriers and having

franchises the change from horses to electricity would not affect their prior claim to the right to use the street. After much contention there now seems to be a desire on the part of both railway and telephone companies to avoid further litigation and settle their differences amicably. This course is being pursued in Milwaukee, Minneapolis and St. Paul and many other Western cities. There is but one electric railway in Chicago and thus far there has been no serious trouble, the telephone company changing the route of its wires where necessary. In Joliet the telephone company found considerable trouble when the electric railway was introduced, but this was overcome by means of a common return. At present the only road that is giving trouble to the telephone company is at Elgin, and it is expected that an agreement will soon be reached there.

OVERHEAD ELECTRICAL RAILWAY CONSTRUCTION IN INDIANAPOLIS.

Overhead Electric Railway Construction in Indianapolis.

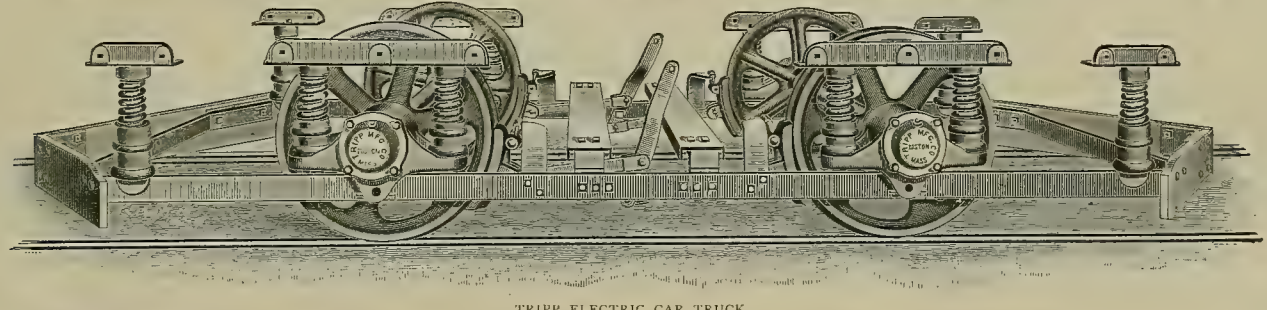
The accompanying engraving gives a view on the Citizens' Electric railway in Indianapolis. The cut is interesting, as showing the latest overhead construction of the Thomson-Houston Electric company. The iron poles which are used are located in the center of the street, between the tracks, and it will be seen they are by no means objectionable in appearance. The method of locating the feeder wires is also shown in the cut. Strung at the center, almost directly over the pole proper, these last mentioned conductors in nowise detract from the symmetry and neatness of the overhead work.

Tripp Electric Car Truck.

The Tripp electric truck is illustrated in the accompanying cut. The engraving represents the standard truck for fourteen, sixteen or eighteen foot cars, made with or without extension springs, which are designed to prevent oscillation of the car body.

A bottom truss is required for the largest car, running from end to end of the equalizing bar, and bolted to it by four vertical supports. The equalizing bar is perfectly straight, which is a departure truck in construction. The trucks can be easily removed from the car body, and to remove wheels is only the work of a few minutes.

The trucks are equipped with anti-friction journal bearings, and are dust-proof. They are made by the Tripp Manufacturing company of Boston.



TRIPP ELECTRIC CAR TRUCK.

The Tennessee Industrial Land company has authorized W. Englewood to receive bids for the construction of an electrical railroad to belt its property at Dayton, Tenn.

Telephone Rates in Washington.

The Bell Telephone company has been victorious in its first contest with the government regarding the rates to be paid for instruments used in the public service. The lowest annual rent in the District of Columbia is at present $60 a year. An amendment added to the General Deficiency bill by the Senate proposed to reduce the rate to $30, and provided that if the telephone company should decline to accept that rate, the privilege of using the streets, alleys and reservations in Washington for the laying of wires should be denied it. The fight on the company was begun in the Senate by Senator Morgan, who presented the amendment providing for a reduction in the rates, and he was assisted in his opposition by Senator Plumb, who thought it an outrage that the government and the public should be compelled to pay $60 a year for the use of an instrument which, he said, does not cost more than $3 or $4 to make. Hearings were given the officers of the telephone company by the House committee and they had ample opportunity to show the expense of maintaining the service and give their reasons why the proposed reduction should not be made. The House committee thereupon non-concurred to the amendment of the Senate and the conference indorsed its action.

Electric Railways in Minneapolis and St. Paul.

The street railway system of the Minneapolis street railway company is the most extensive yet equipped with electrically propelling machinery. The number of miles in Minneapolis alone almost equals the total number of miles of electric railway lines in all other cities combined. The statement is unquestionably true if the lines in St. Paul are included with those of Minneapolis. The systems in the two cities should be considered as one, as a car from any point in either city may reach any point in the other city by a continuous unbroken trip under a trolley wire.

The map shows the lines in the cities which are to be equipped with electricity.

A brief description of the generating plants may not be without interest. In the Minneapolis station the boilers are of the Babcock & Wilcox make, and their capacity aggregate 3,000-horse power. Oil is used as fuel. Three Allis-Corliss triple expansion condensing engines are to be used; one is now in place, and is operating that portion of the system which is equipped. Work is rapidly progressing toward placing the other two engines in position. These are 1,000-h. p. each, but may be easily worked up to 1,200 each if occasion should require. They were built by E. P. Allis & Co., Milwaukee. The engines are to be bolted to a shaft in the basement by a double leather belt, six feet one inch wide, and 152 feet long. The shaft is provided with Hill clutch pulleys for each dynamo, and a loose clutch of same make for each engine will make it possible to drive the shaft with any one engine, or all engines as may be desired. The dynamos, of which there are to be fifteen, five of which are now in place and in operation, are located on the first floor with the engine, and are belted up through the floor from the shaft below.

The Edison compound dynamos which are used are of 150,000 watts' capacity each. Two 15-horse power Sprague motors are used on each car. The twenty-six-foot cars used were built by the Leclede company, St. Louis, and are very handsome in design. The novelty of this particular system lies in the fact that there is not a wire in sight except the overhead trolley wire. The feeders, mains and track feeders are contained in a conduit under ground. The sub-feeders connect from the trolley wire through the hollow iron supporting poles.

The conduit is located between the tracks and is built as follows: Two-inch plank, first treated with fernoline, is used for constructing a long box or trough of desired size, a number of paper tubes, of the Interior Conduit company's make are laid in the box, and thoroughly joined together in continuous lengths. The tubes are raised a short distance from the bottom of the wood box by placing at short intervals, crossways, made of short pieces of the tubing. The tubes are separated from each other and prevented from touching the side of the box by the same means. When this operation has been completed from one manhole to another, the box is entirely filled with an insulating compound. The top, of 2-inch pine, is then nailed on. This upper surface of the box is about eight inches below the paving stones.

The manholes are located 400 feet apart. They are made by building two wooden boxes, one within the other; the longest is 36"x36"x36"

inside measurement and the smaller 30"x30"x30" outside measurement. The space between the two boxes is thoroughly filled with compound. Both boxes are provided with cast iron caps into which fit the cast iron covers. The iron cover is tightly sealed with the compound to prevent leaking of water into the manhole. After the conduit has thus been completed, bare copper wires are drawn into the tubes. A continuous unbroken main, except for fuses, is laid throughout the entire system. Numerous feeders join it at intervals, and equalize the pressure.

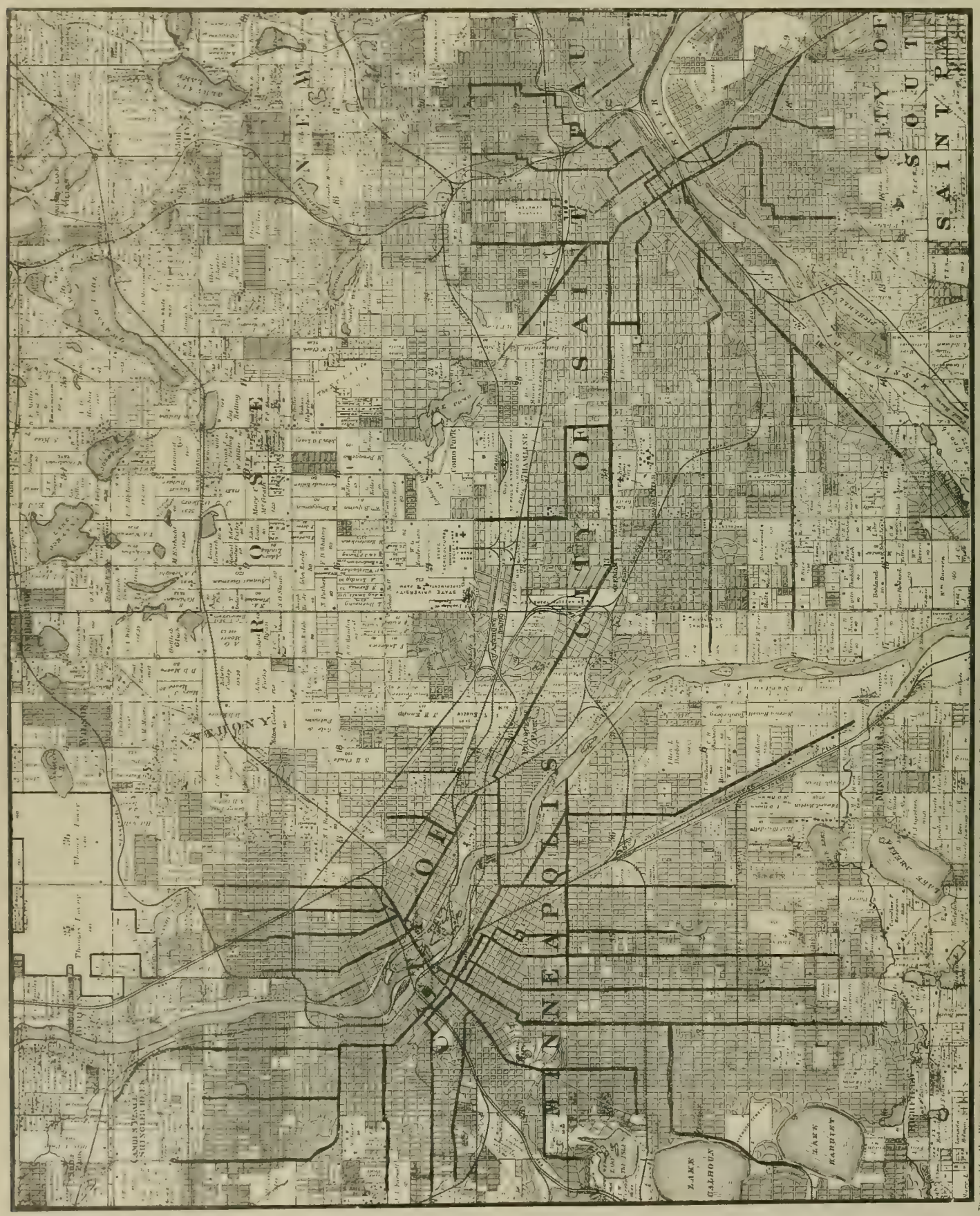
Iron poles between the tracks, are used entirely, sub-feeders come out of the conduit from the main up through these hollow iron poles and are connected to the trolley wires through fuse wires at intervals of 400 feet or at every manhole.

When the Minneapolis system is equipped it will include more than one hundred and forty miles of track, and two hundred electric cars will be in operation. There are now about forty cars in operation and about one-fourth of the road has been completed on which they are running regularly. The system has been in operation since the first of September without a single stop due to any imperfection.

St. Paul system will differ from Minneapolis in two very important features A combination of underground lead cables and overhead construction will be used, and side poles will be employed instead of center poles.

The same make of boilers and engines will be used in St. Paul as those employed in Minneapolis. Their capacity will be 7,000-horse power There will be ninety miles of track and one hundred and forty electric cars in operation when completed. It is expected that this portion of the system will be operation before snow flies.

The details of construction of both the systems were worked out by Clift Wise, mechanical engineer in charge, and Foree Bain, advising electrical engineer of Chicago.



ELECTRIC RAILWAY SYSTEMS IN MINNEAPOLIS AND ST. PAUL.—BLACK LINES INDICATE PROPOSED ROUTES.
Prepared for the WESTERN ELECTRICIAN by Foree Bain, Consulting Electrical Engineer, Minneapolis Street Railway Company.

Devold Power Transmission.

By Gustave Monrath.

Economy in industrial work is a topic which is engaging more and more the attention of our oldest engineers, and numerous inventions are leading us step by step nearer to the point "where nothing shall be wasted." Saving is especially essential in the transformation of power. In our day where mechanical power has embraced every branch of industry, where the distribution of energy is effected from large central plants through a complicated network to the smallest sewing machine, and to the great steam hammer, the question of transmission with the least possible waste, has become of paramount importance.

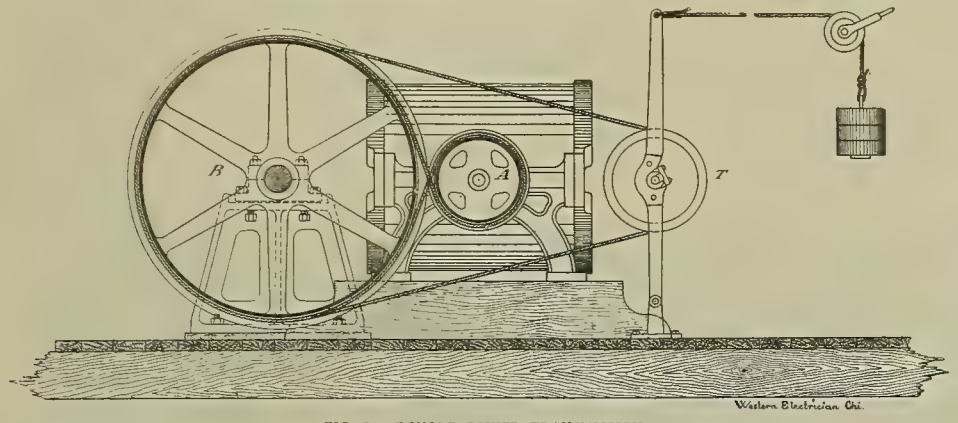


FIG. 1. DEVOLD POWER TRANSMISSION.

In large electric power plants the question of economical operation has stimulated the ingenuity of electrical engineers and the result is a large number of skillful inventions for transforming steam power into electricity, with the greatest possible reduction of friction, and consequently with the least possible loss.

The accompanying cuts show an ingenious scheme recently invented for transmitting power from engine to dynamo. The system which promises considerable saving is the invention of John Devold of Chicago.

The invention consists of a combination of rope and friction transmission so arranged as to reduce friction in the bearings of both dynamo and main shaft to a minimum. Both pulleys have two or more grooves for the rope, and a 2 or 3-inch projecting friction flange on each side. The dynamo, Fig. 1, is placed with its pulley *A* against the driving pulley *B* on the main shaft, as in the case of ordinary friction transmission; but the pulleys, although in contact, do not press hard against each other. A rope is thrown two or three times over both pulleys in the direction shown in Fig. 1, and back to a rope tightener *T*, some few feet behind the dynamo. When the rope is straightened the friction of the rope and the friction of the two pulleys, increased by the pulling rope, will transmit the power, and as the pull of the rope and the press of the flanges are working in opposite directions the loss of energy is materially reduced. In Fig. 2 is shown the arrangement of ropes on the pulleys.

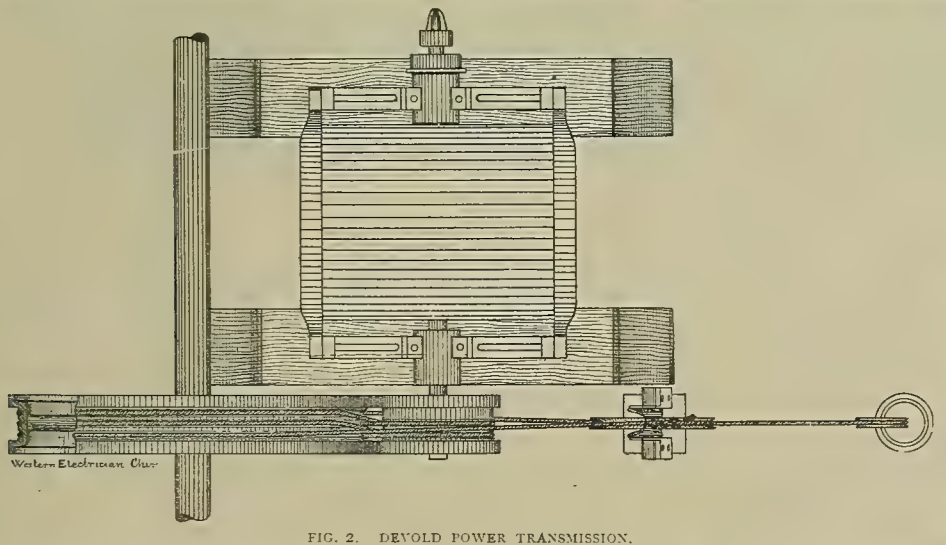


FIG. 2. DEVOLD POWER TRANSMISSION.

To show the merits of the system we will compare its operation with that of common belt transmission, leaving out of consideration the weight of armature and stiffness of rope or belt, which are equal in both cases.

A 50-arc light Thomson-Houston dynamo requires about 50-horse power. The belt speed at 800 revolutions with 18-inch pulley is 3768 feet per minute, consequently

$50 \times 33{,}000 = p. 3768$ or $= p. = 438$.

From the laws of mechanics, Fig. 3, we know that $T = p + t$ where T = tension on tight side, t = tension on slack, and p = total power to be transmitted; p in this case is = to 438 lbs.

Assuming the arc of contact, $\times = 0.8\ \pi$, and the coefficient of friction between belt and pulley = 0.24, we have Fig. 4 t = 1.22 p = 435 lbs., T = 2.22 p = 972 lbs., t + T = 435 + 972 = 1,506 lbs. Fig. 4 represents the armature shaft of the dynamo. We will then have $1506 \times 10 = \times 37.25$, $\times = 404$ and $1506 + 404 = 1910$.

The coefficient of friction for lubricated bearings is 0.05. The waste of power due to friction in the bearings is:

For *A* $1910 \times 0.05 \times 419 = 40015$ foot-pounds.

For *B* $404 \times 0.05 \times 419 = 8464$ foot-pounds.

If the main shaft is 5 inches in diameter with 280 revolutions, the waste of power in both bearings will be $1506 \times 0.05 \times 367 = 27635$ foot-pounds, and the total amount of energy lost through friction $(40015 + 8464) + 27635 = 76114$ foot-pounds = 2-3 *horse power*.

By using the Devold system, in the first place we have no friction whatever in the dynamo except that which is due to the weight of the armature. The main shaft can be reduced from 5 inches in diameter to 4 inches because the bending momentum has been reduced to a minimum, as there is no belt pull.

Taking the same dynamo, Fig. 5, we have with a 52 inch driving pulley and pressure flange = 56 inches, $56 \times 280 = \times 800 \times = 19.6$ = diameter of pressure flange for small pulley.

If the full power was to be transmitted simply by friction between the flanges, the pressure would be:

$N \times 0.40 \times 3.14 \times 56 \times 280 = 50.33000$, from which equation we find N = 84.

If we suppose the rope to transmit one-fifth of the total power, *i. e.*, 10-horse power, we have Fig 6 p = 88 pounds.

Assuming in this case the arc of contact to be $\times = \frac{3}{5}\ \pi$, and the coefficient of friction = 0.24 we have t = 0.5 p = 44 pounds and T = 1.5 p = 132 pounds.

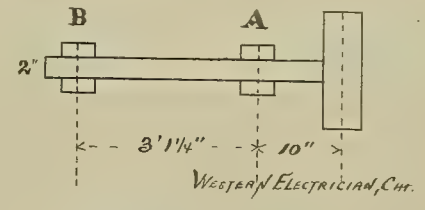


FIG. 4. DEVOLD POWER TRANSMISSION.

The pressure between the pulleys due to t + T is by the graphostatic law = 118 pounds, which is 118 — 84 = 34 pounds in excess of what is needed.

If we choose two strands of rope the strain in the slack rope will be $\frac{44}{2} = 22$ pounds. Giving the tightener a diameter of 18 inches and the journals 1¼ inches, we have for friction in the boxes $44 \times 0.05 \times 266 = 585$ foot-pounds.

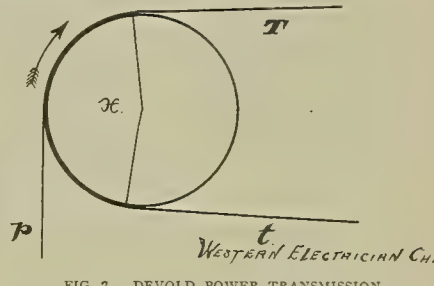


FIG. 3. DEVOLD POWER TRANSMISSION.

With 4 inch main shaft we have for friction: $44 \times 0.05 \times 292 = 642$ foot-pounds. The total in friction will then be 585 + 642 = 1227 foot-pounds or 0.037 *horse power*.

The strain of the rope with two strands is $\frac{132}{2}$ = 66 pounds, which is 1.32% of the breaking strain.

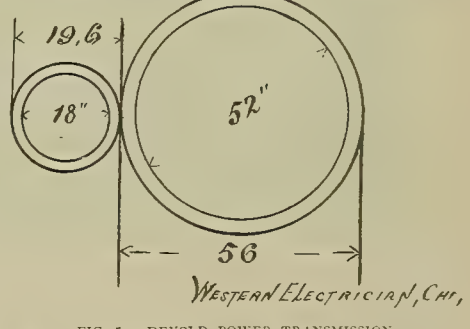


FIG. 5. DEVOLD POWER TRANSMISSION.

One more point to be noticed is the counteraction of the rope pull against the weight of the armature; the tight side of the rope T, Fig. 6, having an angle of 130° to the center of gravity, will tend to lift the armature, and the danger of overheated boxes, one of the most serious troubles in operating large dynamos, is thereby considerably reduced.

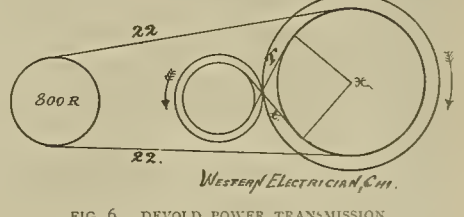


FIG. 6. DEVOLD POWER TRANSMISSION

While the system seems to be an advance in transmission, one point may be objected to—the increased floor space which it requires. It will not be possible to operate as many dynamos from the same main shaft as with belt transmission. The same objection holds true in reference to friction transmission generally.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
P. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

The Westinghouse Electric Railway Motor. Illustrated.... 203, 204
Electric Poles and Wires.... 203
Street Railway Convention.... 203
C. B. Holmes and Electric Railways.... 204
Maguire Street Car Truck. Illustrated.... 204
Electric Light Litigation.... 204
Stevens Positive Gravity Switch. Illustrated.... 204
Telephone and Electric Railway Companies.... 204, 205
Tripp Electric Truck. Illustrated.... 205
Overhead Electric Railway Construction in Indianapolis, Illustrated.... 205
Telephone Rates in Washington.... 205
Electric Railways in Minneapolis and St. Paul. With Map. 205, 206
Devold Power Transmission. By Gustave Monrath. Illustrated 207
Editorial.... 208
Electric Welding at the Minneapolis Exposition. Illustrated.... 209
Electric Traction in the United States from an English Standpoint.... 209
The Electric Railway.... 209, 210, 211
Reckenzaun Improved Meter. Illustrated.... 211
Turbine Water Wheel. Illustrated.... 211
Columbian Street Lamp Post. Illustrated.... 211
Storage Battery Traction. By William Bracken.... 212
The Thomson-Houston Electric Company's Statistics.... 212
Death of William Sprague, Jr.... 212
Improvement in Street Car Construction.... 212
The Subscribers' Telephone Company, Chicago.... 212, 213

DEPARTMENTS.

Correspondence.... 213, 214, 215
The Electric Motor.... 215
The Electric Light.... 215
Electrical Patents.... 216

THE next issue of the WESTERN ELECTRICIAN will contain a report of the annual convention of the American Street Railway association now in session at Buffalo. The meeting promises to be one of great interest both to street car men and to those engaged in the installation of electric railways.

THE present issue of the WESTERN ELECTRICIAN is printed before the regular day of publication in order that copies may reach delegates to the convention of the American Street Railway association at Buffalo. Matter of unusual interest to members of the organization will be found in this issue.

THE best evidence of the success of electric railways is furnished by a cable railway syndicate which formerly opposed the introduction of the electric system. This combination, known as the Holmes syndicate, has recently been purchasing street railway systems throughout the country and transferring them into electric roads. The electric railway has proven successful and the advocates of the cable system wisely accept it without further controversy which could only result disastrously to their own interests.

THE necessity of employing competent telegraph operators was impressed on the B. & O. Railroad company recently when a terrible accident resulting in loss of life and property was due to the carelessness of a boy employed as an operator at Pleasant Valley, near Zanesville, O. The press dispatches contain this story from Janesville: "Orders were given east and west bound freights to pass at Black Hand, but Operator Keelty at that place failed to deliver the order to the east-bound train. Later he saw his mistake and telegraphed the operator here that there would be a wreck pretty soon and left his post. He is a mere boy." The explanation of many tragedies is told in these few lines. Railroad companies do not appear to realize the necessity of employing competent and trustworthy men as telegraph operators in small stations, yet human lives are intrusted to these men, and often, as in this case, human lives are sacrificed. It often happens, too, that the operator is not so much to blame as the corporation that employs him. He has very little time to devote to his duties as a telegrapher—those of flagman, switchman, baggage master and ticket agent taking precedence over telegraphy. He forms the impression that his duties as operator are of a secondary character. There have been frequent warnings of the danger of following such a course, but all to no avail.

IN his address at Ottumwa, Ia., a few days ago President Harrison made a brief allusion to the progress which has been made in the electrical world. After speaking of the prosperity of industries in general, the president said: "The progress in the mechanical arts that men not older than I have witnessed, the applications of new agencies to the use of men within the years of my own notice and recollection, read like a fairy tale. Let us not think that we have reached the limit of this development. There are yet uses of the agencies already known to be developed and applied. There are yet agencies, perhaps, in the great storehouse of nature that have not been harnessed for the use of man. The telegraph, the telephone and the phonograph have all come within the memory of many who stand about me to-day. The application of steam to ocean travel is within the memory of many here. The development of our railroad system has all come within your memory and mine. The railroad was but a feeble agency in commerce when my early recollection begins, and now this great state is covered with railroads like a network. Every farm is within easy reach of a shipping station and every man can speak to his neighbor any day of the week, though that neighbor live on the oppositie side of the globe. Out of all this what yet is to come? Who can tell?"

ELECTRIC street railway engineers will be interested in an ingenious combination of rope and friction gearing, the invention of a Chicago man, described in this issue. The inventor employes grooved pulleys as in the ordinary rope system, and provides them with friction flanges. The faces of the flanges are kept in contact by the pull of the rope. The rope, it may be stated, runs crossed or in other words on a "half turn." A tightener pulley is employed to take up the slack. By this arrangement the friction of the rope is aided very materially by the friction of the flanges of the pulleys.

At first glance the reader will, doubtless, become impressed with the idea that the combination is impracticable. The fact that the ropes must necesarily run at "half turn," or nearly so, will lead to this conclusion. It must be noted, however, that the grooves of the pulleys are cut a sufficient distance apart to prevent any rubbing between the traveling ropes. Another feature which, perhaps, will be criticized is that the ropes on account of the distance between the grooves must run to the pulley at an angle. This practice, which is of course unavoidable, would seem at first to be an objection. The inventor, however, claims that by running the ropes in deep grooves there will be no "mounting" the flanges. The system is worth a careful study.

ELSEWHERE in this issue is presented an article devoted to a brief description of most of the prominent systems of electric traction now exploited in the United States. It is thought that the information will be of especial value for purposes of reference to the members of the American Street Railway association now in session at Buffalo. A glance at the figures contained in the article indicates in a very striking manner the vast amount of work already accomplished. The electric railway, barely considered by street railway men two years ago as a system worthy of a careful attention, is now to be found in successful operation in all sections of the country. The multiplication of electric railways is a hackneyed theme but their rapid extension is none the less wonderful on that account. All the companies which are engaged in the installation of systems of electric traction are full of work for there are still a vast number of cars propelled by animal power. It is only a question of a short time when the better motor power will be substituted. To the organizations of street car men is due in no small measure the general adoption of electric systems in so short a period. It has been asserted on a great many occasions that street car companies were ultra-conversative but they have certainly not shown such a characteristic in their attitude toward electric propulsion. In street car conventions electric railways were carefully considered as soon as their practical operation was demonstrated. The endorsement given to the new system by these organizations has smoothed the way for many an electric company. The result is that to-day street car conventions to a great extent partake of the nature of meetings of an electrical association.

IN another column is presented a brief interview with C. B. Holmes, in which he speaks of the relative merits of the cable and electric railway systems. Mr. Holmes is at the head of the most successful cable railway in Chicago, and he is recognized as one of the ablest street railway men in the country. Mr. Holmes' name has been identified with a cable system for years and his advocacy of that means of moving street cars is well known. During the last few months he has experienced at least a partial conversion to electric systems. While we entertain the highest respect for Mr. Holmes' opinions we think his views will undergo, as time passes, a still greater modification, and that eventually he will put himself on record unconditionally in favor of electric railways. At present Mr. Holmes states that in his opinion a proper plan of street railway equipment would be that which would give to heavy traffic roads a cable system, and to light traffic roads an electric system. The fact that the West End Railway company of Boston has met with such success with electric cars on lines where travel is the heaviest would seem to show that Mr. Holmes' belief that the cable is essential under such conditions is not well founded. His idea as to the relative economy of the cable and electric motor does not seem to be substantiated by figures. Under the most favorable conditions we did not suppose that the cost of the cable was as low as two cents per car miles as Mr. Holmes says. Ordinarily it is given as considerably more than twice that figure even when traffic is extremely heavy. His figure of four cents per mile for electric roads is greatly in excess of the figures usually given. Taking up the first table which happens to be at hand we find that for two small roads the operating expenses are 2.7 and 2.8 cents per car mile. One of the primary advantages referred to by electric railway companies is the rapidity of starting the cars. We had supposed this to be a characteristic of the electric car rather than of the grip car. Certainly we have heard no complaints of the electric motor on this score. Mr. Holmes' opinion therefore that for this reason electric cars would have difficulty in transporting crowds when cars come after each other in quick succession is one which we think could be disproved by a practical demonstration.

Electric Welding at the Minneapolis Exposition.

Electric welding has not yet ceased to be a novelty and attraction to the general public and it is one of the most interesting studies occupying the attention of electrical engineers to-day. The general interest manifested in this department was demonstrated at the Minneapolis Exposition where the welding apparatus was one of the chief attractions. To electrical engineers and mechanics it was particularly interesting, and as it was the first display that has ever been made in the west its features were closely studied by critical eyes.

In the accompanying cut an excellent view of the exhibit is presented. The apparatus occupies a prominent position on the second floor of the main building. The plant consists of an alternating machine of the Thomson-Houston pattern and four Thomson welding machines for tires, axles, three-inch iron pipe and small metals. The boards arranged about the space contain specimens of the work performed by the machines displayed. Many of these are very interesting, showing the novel uses to which electric welding may be applied. The plant was installed by the Northwest Thomson-Houston Electric company of St. Paul. This is the most interesting part of that company's exhibit. The cut is reproduced from the *Electrical Northwest*.

ELECTRIC WELDING AT THE MINNEAPOLIS EXPOSITION.

Electric Traction in the United States from an English Standpoint.

The London *Electrical Review* has the following apropos of the annual meeting of the American Street Railway association: It is anticipated that electric traction will form an important topic of discussion during the forthcoming meetings of the several American Street Railway associations. Until three years ago these societies not only occupied themselves exclusively with matters concerning horses, stables, manure and horse cars, but when the subject of electric haulage was mooted the introducers of the novel "fad" were looked upon with suspicion and skepticism. Times have changed with astonishing rapidity. Many of the advocates of the horse have been converted to modern ideas, others have dropped avowed opposition and are now watching events. None can upset the remarkable fact that out of 8,652 miles of tramways in the United States. 1,753 miles, or nearly 20 per cent., are now worked with electric cars. We expect, therefore, to hear of many practical results from practical men who view the present situation entirely from the financial point of view; thus we may contrast the utterances of the old-fashioned tramway man with those of the modern electrical engineer, and draw useful conclusions.

The London *Electrician* speaks as follows of the electric traction work in America:

But if the distribution of electricity for light and power has become a comparatively prosaic routine performance, we are not left entirely without compensation, for again our progressive cousins are showing us the way, to their honor and our advantage. The conditions in this country are not over favorable to electrical experiments of any description. What better could happen, therefore, than that the many knotty problems connected with electric traction should be partially solved for us across the Atlantic? In a few years it will doubtless have been satisfactorily settled for us by practical experience whether we should employ two small motors or a single large machine; and an efficient slow-speed motor geared direct to the axle will probably have been evolved. With such points disposed of, and the city and South London line and the Liverpool overhead railway in fair running order, it is possible, provided that a satisfactory closed or open conduit system has been devised, that we may buckle to and move forward in the matter of electrical propulsion.

Storage Battery Car at Dubuque, Ia.

W. W. Griscom, president of the Electro Dynamic company, Philadelphia, and William Hood, Chicago representative of the Accumulator company of New York, held a conference at Dubuque, Ia., last week, with representatives of the street railway company of that city. It has been decided to equip the entire system with storage battery cars, and 15 cars have already been ordered. The Dubuque *Ledger* says: "The experimental car which has been in the service in this city for the past three months, has given the best of satisfaction to both Mr. Rhomberg and the public, and since it began running it has required but little if any attention other than what would naturally be given it in daily service. Mr. Rhomberg stated last evening that six of the fifteen new cars ordered from the Accumulator company would be here during the month of December next, and the balance about the middle of May. The erection of a two-story brick power house will be begun at once, near the present street car depot, and the work will be pushed forward without delay. It will be supplied with machinery from the Accumulator company's works, all in the latest and most approved style."

The Electric Railway.

A glance over the report of the proceedings of the last convention of the New York State Street Railway association held recently at Rochester, N. Y., would seem to indicate that in discussions as to the most improved methods of propulsion, the electric motor is not only occupying almost exclusively the attention of street car men, but has, during the last year, taken its place in advance of all its competitors. Not many would have ventured five years ago, to prophecy that a body of men like those who met at Rochester would have found it advantageous to devote their time almost exclusively to the discussion of electrical systems of car propulsion. Such however, was the case. It was a noteworthy fact that the deliberations of this body were more in the nature of a consideration of the efficiencies of the various systems rather than a debate as to the advantages or disadvantages of electric motive power as compared with the cable or any other non-electrical system. The adjective "phenomenal" is often applied relative to the rapid development and introduction of the electric systems of street car propulsion in this country and without doubt electric railway men in the United States have had many occasions for rejoicing during the last year. The introduction of electricity on the Boston street railway lines and the adoption of electricity at Minneapolis and St. Paul after it had been decided to put in the cable, together with the substitution of electricity for horses on all the Milwaukee lines, were certainly events of no little moment, but by far the greatest achievement has been made in New York where Jay Gould is reported as announcing his intention to substitute electricity on the elevated roads. Mr. Gould says the "L" road management is conducting experiments which will eventually result in the adoption of some particular system. Mr. Gould and General Manager Hain both favor storage batteries but it is feared that at present the accumulator system will not prove commercially successful.

In addition to this, the fact that C. B. Holmes of cable railway fame, has been investing heavily in electric street railway equipment, must not be overlooked. It is not to be wondered at, then, that the electrical equipment companies display a certain amount of enthusiasm. Their business is sometimes referred to as being "in its infancy," but those in the field at present, with factories running on over time, appreciate to the greatest degree that while the ordinary mite of humanity grows first into boyhood, the so-called "infant," electricity, has already advanced to a sturdy manhood. The records of a number of the equipment companies substantiate the above statement. The Edison General Electric company now exploiting the Sprague system, well known as the one introduced on the historical Richmond, Va., road, reports that it has in the neighborhood of 125 roads inoperation, or in process of construction. A number of the Sprague roads are outside of the United States. As the development of the application of electrical power to the propulsion of street cars has gone forward, one problem after another has been satisfactorily solved, until to-day the Edison company claims to have a system as near perfection as mechanical skill and inventive genius can develop.

The special features of the Edison system may be mentioned: The trolley wire or working conductor is carried over the center of the track upon span wires running from pole to pole across the street, or upon brackets attached to poles set on one side only. No change in the size of this wire is required with an increase in the number of cars running on the line. The main current is carried by a conductor running parallel to the line wire, and supported on poles at the side of the street. From this feeder wire tap wires are run at intervals of 500 feet to the trolley wire. By the use of this parallel conductor and by means of special cut-outs for line sections, it is claimed there is absolute certainty, even in case of an accident upon any portion of the line of the current always being furnished to the cars, except immediately at the point of breakage. The main conductor wires are carried upon poles, and the span wires are thus not subjected to strain. The flexible suspension of the car motor is another feature. By this arrangement a spring contact can be maintained between the pinions and gears, and smoothness and easy riding can be accomplished. This prevents the stripping of the gearing by sudden strains upon the car. In the Edison system no resistance box is used. A controlling switch throws sections of the field coils into different combinations, series, multiple, etc., and thus governs the speed of the motor. The latest improvement in this motor is the adoption of the Eickemeyer armature. By the Eickemeyer method of winding the company claims to secure increased reliability, and also interchangeability of the coils.

The Thomson-Houston Electric company has equipped street railway plants with its electrical system in all parts of the United States from Maine to California, and from Minnesota to Texas. This company has at the present time about 150 roads in operation or in process of construction in the United States and has also installed its electrical railway system in many of the foreign countries. In all cases, it is claimed the apparatus is operating with wonderful satisfaction. The Thomson-Houston company considers the electric railway problem more of a mechanical than an electrical one. It uses no commuted fields claiming that it is better to spend a little more money for coal, and avoid wear and tear. The motors are plain series wound and a rheostat is used to control the speed. Generally speaking, this company uses the trolley wire as a conductor, and only feeds where it is necessary on account of special grades or excessive work.

The Short Electric Railway company of Cleveland, O., has during the few months of its existence, taken a prominent position in the field of electrical industry. Its works are associated with the works of the Brush Electric company in Cleveland. At the beginning of its operations this company installed a series system but this method of distribution has since been abandoned. It is now exploiting a parallel system somewhat similar to that of the Thomson-Houston and Sprague; that is, in connection with the distribution of current and the style of overhead construction. The Short motor has an individuality as to mechanical and electrical construction. The field magnets, which are four in number, are series wound in one coil on each magnet, and the coils on the armature are entirely separate from each other. If one of the coils should happen to burn out it does not touch any other coil on the armature. An armature of large diameter is used and is run at a slow speed. When the car is running at the rate of twelve miles an hour, the armature revolves at about one thousand revolutions per minute. Large pinions, 6½ inches, are used, which are made of the best machine steel. The large gears are made of cast steel, and have wooden webs between the rim and the hub. These webs are put there for the purpose of deadening the noise, and also to serve for insulating the motor from the ground, the ground connection being made directly from the motor to the car axle by flexible cable connections. The motor is insulated by heavy wooden beams. This construction is used in order to deaden the noise and to get perfect insulation from the ground to the armature.

The Detroit Electrical Works have recently commenced active work on a number of electric railways. The Rae system, which the company exploits, has as its special feature a single motor of large power attached to a rigid frame support, a disposition which, it is claimed, secures perfect alignment and freedom from noise. The peculiar construction permits the use of large wearing parts, and slow speed of armature shaft. The company has installed its system on nine roads which operate 71 cars An interesting installation which the company has recently made is the Calumet electric railway which is of peculiar importance inasmuch as it is the first practical street railway ever operated by electricity in the limits of Chicago.

One of the latest competitors in the electric railway field is the Westinghouse company. The Westinghouse system is operated at a constant potential of 500 volts. The overhead wire is used, and while there are no radical departures from existing methods of electric propulsion, this company claims great improvements in the details of mechanical construction and workmanship. The Westinghouse motor is described in detail in another column. It may be mentioned that these motors and the Westinghouse generator are designed to be operated on any existing lines in connection with machines already installed.

Electric traction with storage batteries was first attempted at the Paris Exposition of 1881. Two cars were run from the Place Concordat to Palais de l'Industrie. This was shortly after Faure and Julien had begun to introduce the storage battery in Europe. In the early part of 1885, A. H. Bauer made some experiments with a storage battery car in Baltimore, Md., with varying degrees of success. In October, 1886, storage battery traction was brought prominently before the attention of engineers in this country by a Julien car which was put in service on Eighth avenue, New York City. That car was afterward transferred to the Fourth and Madison avenue line and was by degrees followed up by more cars, until in 1889 the largest installation of storage battery cars that had ever been attempted was made. Ten cars were put in actual service on the Fourth and Madison avenue line in New York City, and have continued in service up to the present time with the exception of an intermission brought about by adverse litigation. Mr. Wharton has now five or six cars in actual service on Lehigh avenue, Philadelphia. That line is run exclusively by the aid of storage batteries. Another company is running four cars at Beverly, Mass., and have been doing so for over a year and with considerable success.

The Electric Traction & Manufacturing company have in New Orleans two storage battery cars in actual service and has ten additional cars which it expects to place in service by the first of November, while a number of additional cars are being constructed for New Orleans.

Two Julien cars are in passenger service at Indianapolis, Ind., it is understood, with great success.

A storage battery car equipped by the Daft Electric company, now the United Electric Traction company, is and has been for several months past in service in Toledo, and with great success. It has carried as many as 1,100 passengers in one day.

One or two cars have for some time been in service on the Metropolitan Street railway in Washington, D. C.

Leo Daft's system and his electrical work on the New York elevated roads are well known. As one of the pioneers in electric street car propulsion and in addition to the special work on the New York elevated road, Mr. Daft has developed a system which is now being exploited by the United Electric Traction company of New York. The new motor and truck recently brought out by this concern deserves more than a passing mention. The United Electric Traction company claims that it has been found from practical experience that suspending the motor directly from the axle and not attaching it to the frame of the truck or car body reduces the noise to a minimum. This fundamental idea has been skillfully worked out in a truck which the company has recently placed on the market. The motor, which is of the consequent pole type, is hung to the rear axle of the four wheel truck and the forward end of the motor hangs by a special flexible ring bearing to the forward axle. Laminated field magnets are employed and the armature is of large diameter. This machine was designed to be adapted to either the overhead system or accumulator work.

The River & Rail Electric Light company of New York is exploiting the Main storage battery for street car work. It has a peculiar form of motor which differs materially from those ordinarily employed in street car work. The armature is stationary and the fields and brushes revolve. The car machinery permits the coupling of both axles to a single motor without hard running action The storage battery used by the company has no applied oxides of lead. It is formed by the action of the current alone in accordance with the Plante principle.

The Pumpelly company, Chicago, has made a number of experiments in street railway work with storage batteries, and believes that it has succeeded in putting on the market a battery which is capable of doing street car work successfully. It operated in Detroit, some time ago, a storage battery car, equipped with 96 150 ampere-hour cells, and a Rae motor. The device for controlling the cells was so arranged that the car started with four series of cells in multiple. The next position of the switch, place the cells with two series in multiple, and the next, all the cells in series. This gave a gradual dischage of the cells. By this arrangement, the cells are not called upon for a heavy rate of current, and three different speeds can be obtained without inserting resistance in the circuit. The plates of the cell are separated by cellulose fiber, and this is so placed in the cell as to form a support to the entire surface of each plate. This seems to lengthen the life of the battery considerably, and the electrolyte by this means is kept from splashing. This car operated successfully on heavy loads, and made about 40 miles with each charge. The rate of speed attained was about 15 miles. The car was stopped and started on curves. The Pumpelly cell has also been used in connection with the Patton electric car. This Patton motor system has lately been attracting considerable attention at Pullman, Ill., where an experimental car has been exhibited.

The system of street car propulsion adopted by the Accumulator company of New York, is known as the "Edco system," in which the energy is supplied from accumulators placed under the seats of the car, the motors being geared to the axle, with dust-tight covering, and gearing running in oil, thus securing the minimum of noise, and of course, the loss of the smallest quantity of power in friction. One or two motors per car are used, according to the size of the car. The motors and gearing are

supplied by the Electro Dynamic company of Philadelphia.

One of the 16-foot cars of the Accumulator company has been in daily successful use since August 12th upon the track of the Dubuque, Iowa, street railway. The charging current required is about 26 amperes at 225 volts. The daily run has been about 75 miles within 12 hours, including stops, and when heavy loads were carried it required about the same number of hours for charging as for running. The car has two 12-horse power motors, and the cells being arranged in crates can either be shifted in and out at the sides, the panels being swung for the purpose, or through the ends of the cars on skids or rollers. The car carried on an average of 200 pay passengers daily, and on two occasions over 1,000. No difficulty was experienced in maintaining 5 miles an hour up a 4½ per cent. grade, or 10 or 12 miles on a level. The track has a 60 lb. rail well laid, and is generally level with only a few grades of from 3 to 5 per cent., none being longer than 400 feet.

The Union Electric Car company has also been running two cars equipped with the Stevens gearing and batteries, made by the Accumulator company, upon the Beverly & Danversport, Mass., road, 3½ miles long, for regular business since October, 1889. This track is very hilly, and the requirements severe, but it is said the performance of the two cars has been uniformly satisfactory.

Reckenzaun's Improved Meter.

The features claimed for this new Reckenzaun meter illustrated in the cuts are sensitiveness and an absolutely accurate measurement of the electricity consumed.

The device consists essentially of two solenoids actuating iron cores *A* and *B*, which are connected with a lever *L*. This lever is pivoted at *O* upon a standard and carries at its furthermost end a friction roller *R* which is supported from the forked end of the lever by means of two small links *P*, pivoted at their upper ends to the fork of the lever and at their lower ends to a collar, mounted loosely around a sleeve on the roller *R*. The object of this mode of suspension is to allow complete freedom of motion to the roller up and down the vertical spindle *S*, which is connected at its upper end to the registering or indicating mechanism. Since the end of the lever describes an arc while the path of the friction-roller is in a vertical straight line, this highly flexible mode of suspension is

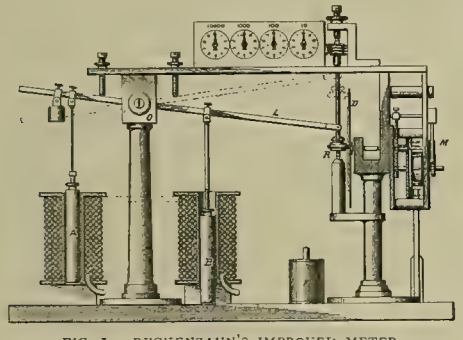


FIG 1. RECKENZAUN'S IMPROVED METER.

of great importance in eliminating friction. The lever *L* is balanced by a counter-weight as shown in such a manner that the roller *R* will just drop down toward the center of a disk *D* when no current is passing through the solenoid. As soon as a small current is allowed to circulate through the solenoids the core *B* will be sucked up to a slight degree corresponding to the strength of the current. Core *A* simultaneously drops down as a result principally by gravity.

The highest portion of the lever is shown by dotted lines in Fig. 1. This would correspond to the greatest current the instrument is intended to indicate and in this position the friction roller will be near the circumference of the disk *D*, and will therefore transmit its greatest velocity. The disk *D* is revolved at a constant speed by the clockwork shown to the right in Fig. 1. In order that the roller *R* may rise and fall readily with any variation of current a portion of the face of the disk is cut away, Fig. 2.

It may be stated in order that the action of the meter may be more easily understood that the distance through which an iron core travels within a solenoid is not absolutely proportional to the current flowing within the coil. In this meter, however, it is quite essential that the radial displacement of the roller *R* relatively to the disk *D* should be proportional, because the consumption of electricity has to be recorded by the velocity with which roller *R* revolves and communicates its motion to dials similar to a

FIG. 2. RECKENZAUN'S IMPROVED METER.

gas-meter. Thus the function of the second solenoid and core *A* is to compensate for the varying attractions upon *B*, and also to equalize any "magnetic lag" which might be appreciable and involve slight errors. Both solenoids are energized by the same current, and the tendency of core *B* being sucked up a greater distance than that corresponding with the increased quantity of current is counteracted by the core *A*, whose gravitation effect is reduced simultaneously, since there is also here the natural tendency of the core being held level with its solenoid. The core *A* will keep dropping down so long as its weight is greater than the effect of the solenoid trying to hold it up; but as the current is increased there will be a point when *A* will actually be held up by the solenoid, and all tension on its suspension cord or chain *C* des-

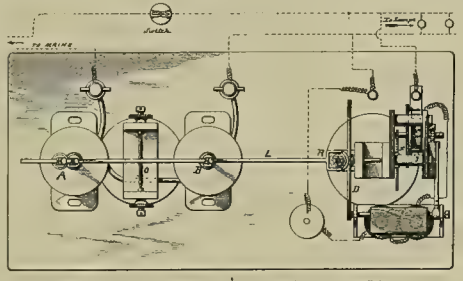
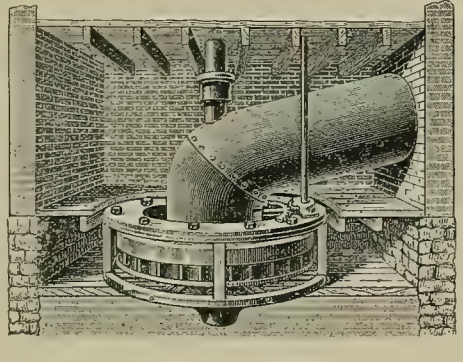


FIG. 3. RE KENZAUN'S IMPROVED METER.

troyed. After this occurs the core *B* has alone to do the work of raising the lever, and for this reason core *B* is suspended by a rigid rod *G*. A plan of the meter is shown in Fig 3.

Turbine Water Wheel.

In the cut is shown a turbine wheel which is stated to be of inexpensive construction, and one which is not likely to get out of order under ordinary circumstances. More and more interest is being taken in the utilization of water power, and many street car companies in small cities in the west are considering the question of using the power of falls of water for operating generators for electric railway systems. In this wheel

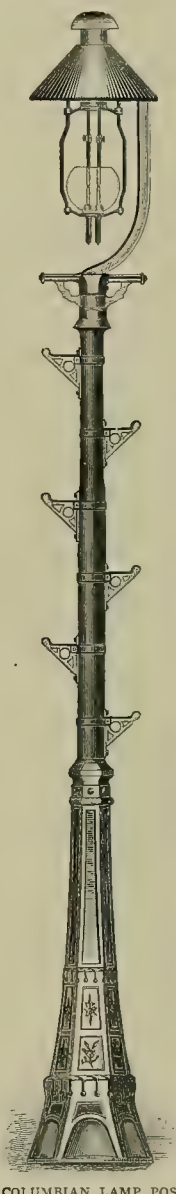


TURBINE WATER WHEEL.

the principle of outward horizontal discharge is combined with an upward discharge, and to this end the water is conducted into the inner or central portion of the wheel, whence it flows between fixed partitions and intermediate regulating gates, by which it is directed against the buckets of the wheel immediately outside of the guides. The mode of regulating the flow of water on to the buckets of the wheel is simple, avoiding all interfering mechanism and giving the way clear to the water from the penstock into the wheel case, whence it flows out between the partitions and the regulating gates onto the buckets of the wheel. The latter is supported by a central pivot which carries both the wheel case and the penstock, which is attached to it. The wheel is manufactured by the Patrick Water Wheel company of Montreal, Canada. The cut is reproduced from the *Scientific American*.

Columbian Street Lamp Post.

The accompanying cut represents a side elevation of a new street lamp post for arc lamps, designed and manufactured by the Western Electric company, Chicago. In electric lighting systems for street illumination a demand has arisen for posts that shall present a symmetrical and pleasing appearance. An effort has been made in this case to meet these requirements. The lower part or base, which is of cast iron, has



COLUMBIAN LAMP POST.

a broad circular footing which, when bolted to the walk, gives the post great stability. Above the footing the base assumes a hexagonal section, and rises in graceful curved faces, paneled and ornamented in a tasteful manner. One of the panels is hinged so that it may be opened to give access to the switch. The wooden portion of the post extends downward through the cast iron base to the sidewalk, and above the base is provided with neat malleable iron steps, while at its upper extremity is carried a single side arm lamp support with switch board and hood of the pattern adopted by the Western Electric company.

Storage Battery Traction.

BY WILLIAM BRACKEN.

One of the chief obstacles in the way of storage battery traction is the uncertainty arising from conflicting litigation as to the ownership of storage battery patents. Considerable allowance for delay must also be attributed to the fact that storage battery traction is more difficult to attain than any other practical system of traction. It has taken longer time, from the very nature of things, to overcome the difficulties encountered in storage battery traction than those to be met with in the overhead system. There now seems to be left but one question as to the final outcome of torage battery traction and its relative position with other systems. That question is its relative economy. The Julien people claim that it is more economical than horse traction and we must infer from the large amount of time and money that they have given to exploiting the system, that they have good grounds for their belief. The only element entering into the question of economy is that of the duration of the battery. The battery, as is pretty generally known, is composed of about an equal number of positive and negative plates. The negative plates as now manufactured will last indefinitely. It is fair to say that they will last ten years It was once thought that they would not last over two or three years; the only question, therefore, is the life of the positive plates. If they can be made to last six months, it is claimed that storage battery traction is as cheap as horse traction where ten or twenty cars are in service, and cheaper than horse traction where the number of cars in service exceeds twenty. All the mechanical difficulties here tofore encountered in storage battery traction have been substantially overcome. They have been overcome as fully as the mechanical difficulties of the overhead system. The car goes and is as reliable in service as a steam car or an overhead car—probably more so. It shifts its batteries in a sufficiently short period of time to admit of that method of traction, no matter what the headway may be on the most crowded line and the batteries can be shifted economically and can be stored within a small space by means of a battery rack. The motors, gears and switches are substantially the same as those used in the overhead system and are of course, equally reliable. The sole question then is as to the life of the positive plates or one-half the battery. They cost at present for a car about $600; they can be furnished for a much less figure than this when used in large quantities They ought to last for one year; that would mean $2 a day or 2 cents a car mile for 100 days' run. And let me say here what may seem very strange, that they will last as long, if not longer, running 100 miles a day as if they should run 50 miles a day. One gratifying point about a storage battery is that the more continuous the service, the better its condition remains. There is nothing more harmful to a storage battery than disuse. Almost all the difficulties that the Julien people encounter on Fourth and Madison avenues, arising from storage batteries, are met with, it is stated, on Monday and are to be attributed to the fact that the batteries have been idle, as the cars do not run on Sundays.

From what can be learned, 3 cents a car mile for storage batteries is a conservative estimate. This leaves from six to seven cents a car mile for steam power and the maintenance of the motors and gears. Conservative estimates by electricial engineers place the cost of motive power for these items as follows: Electrical energy delivered at the terminals of the battery or generated on the overhead system, 2 cents a car mile; maintenance of motors and gears, 2 cents a car mile; maintenance of batteries, 3 cents per car mile; sundries, 1 cent a car mile. This is 8 cents per car mile by the storage battery system.

The cost of motive power in horse traction in large cities is 10 cents per car mile; thus there is 2 cents per mile in favor of storage battery traction. Add to this the superior service obtained, and the advantages are unquestioned I think the overhead system gains nothing over storage battery traction in the economy of power. The cars on the Fourth and Madison avenue line take less than one electrical horse power per mile. I do not think the over head system is run on very much less then two-horse-power per mile, which would make a difference of 2 cents per car mile in favor of the storage battery or in other words, enough saving to maintain the storage battery. I have as yet no accurate data as to the energy per car mile utilized by the overhead system. Theoretically, there must be considerable waste of energy, and we must accept the theory to be correct, until it is practically disproved.

The great success, however, of the overhead system as compared with cable and horse, and the increased income of railways using that system, have made the managers indifferent to the cost of motive power, for it makes very little difference whether a system costs one or two cents a car mile, more or less, so long as the surplus earnings are unprecedentedly ahead of the cost of maintenance.

Thomson-Houston Electric Company Statistics.

The attention of the Thompson-Houston Electric company was first directed to electric railways in the spring of 1888. A railway department was then organized, and the patents of the Van Depoele company were purchased, and the services of Mr. Van Depoele were secured A combination of two systems led to many changes in the Van Depole system. It was decided that it was best to place the motor underneath the cars and the direct gearing in order that the motors should be entirely free from the car body. With this end in view the company began the work of developing its present system and in the spring of 1888 commenced the equipment of its first road at Crescent Beach, Mass. This was one mile in length, and was first opened to the public July 5th. It was successful from the start. The equipment of this road resulted in a contract with the Lynn & Boston Railroad company for a line to Lynn. Following upon this was the construction of the double bracket center pole system at Washington, D. C. This road, 3 miles long and equipped with 15 cars, started Oct. 17, 1888 and was the only line of its kind the company had undertaken. Then followed the building of the roads at Omaha, Neb., 26 miles and 30 cars, started Oct 29, 1888; Wichita, Kan., 5 miles. 15 cars, Nov. 13, 1888; Cambridge division of the West End street railway, Boston, Mass.; Syracuse, N. Y., 4 miles, 10 cars, Nov. 29, 1888; Danville, Va., 2 miles, 6 cars, Nov. 25, 1888; and the equipment of some of the Van Depoele roads with the new type of truck. On January, 1889 the company had 12 roads in operation, comprising 45.97 miles of track and 62 cars; April 1, 18 roads, 99.97 miles, 104 cars in operation, and 23 roads, 134 cars, and 89.56 miles of road under contract May 15, 1889, 21 roads, 133 cars, 117.97 miles in operation, and 24 roads, 133 cars, 93.66 miles under contract. July 1, 1889, 23 roads, 164 cars, 136.50 miles in operation, and 32 roads 191 cars, 164.25 miles under contract. Aug 1, 1889, 27 roads, 206 cars, 160.25 miles in operation, and 36 roads, 485 cars, 402.50 miles under contract. Sept. 1, 1886, 37 roads, 304 cars, 208 75 miles n operation, and 29 roads, 451 cars, 372.96 miles under contract. Oct. 15, 1889 43 roads, 334 cars. 235.15 miles in operation and 32 roads, 549 cars. 465.17 miles under contract. Nov. 15, 1889, 47 roads, 490 cars, 313 75 miles in operation, and 33 roads, 494 cars, 430.56 miles under contract. Dec. 15, 1889, 49 roads 528 cars, 335.75 miles in operation and 34 roads, 511 cars, 451.06 miles under contract. April 1, 1890, 61 roads, 665 cars, 463.56 miles in operation and 39 roads, 431 cars, 385.20 miles under contract. June 30, 1890, 77 roads. 920 cars, 556.26 miles in operation, and 36 roads, 336 cars, 297.26 miles under contract, July 31, 1890 80 roads, 1069 cars 571.84 miles in operation, and 43 roads, 408 cars 325.93 miles under contract. Aug. 31, 1890, 82 roads 1131 1131 cars, 585.34 miles in operation and 49 roads, 529 cars, 322.96 miles under contract. Sept. 30, 1890, 95 roads. 1392 cars, 707 07 miles in operation and 31 roads, 460 cars, 341.99 miles under contract.

Death of William Sprague, Jr.

William Sprague, Jr., only son of ex-Governor and Kate Chase Sprague, of Providence, R. I., committed suicide at Seattle, Wash., last week. He had only lately settled in that city, and was at the time occupying an excellent position. Domestic troubles were undoubtedly the cause of the rash act. Young Sprague was only 23 years of age, but he had had considerable trouble. Shortly after he finished his education at Heidelburg, Germany, reverses of fortune visited his family and he was obliged to shift for himself. He was of a high strung temperament and keenly felt the contrast in the position he occupied and that he had hoped to fill. Before going to Seattle he was engaged in a Chicago electrical house, occupying a subordinate position, and consequently receiving only a small salary. Many instances are now recalled where young Sprague showed his high spirit, and the occasion of his withdrawal from that situation was his refusal to perform some menial service. He had many friends in Chicago who admired his excellent qualities and ability.

The Edco Accumulator Car at Dubuque, Iowa.

A portable engine and boiler purchased from the Porter Manufacturing company, constitutes the steam plant for the Accumulator road at Dubuque, Iowa. The engine and boiler are rated at 15 horse power by the makers, but are said to be not more than 12-horse power at the best. The engine is of the common slide valve type, giving steam up to about ⅝ of the stroke. Cold water is used to feed the boiler, and bituminous Iowa coal is employed as fuel. This coal is inferior to Pennsylvania coal, and gives a great deal of dirt, and the flues have to be cleaned twice a day. It required from 700 to 1,000 pounds of coal a day, according to loads on car, for a seventy-five-mile run of car. The price of coal is $2.50 per ton of 2,000 pounds. One man attends to the firing of the boiler, running the engine and dynamo, and the charging of the cells. This man is inexperienced in electrical matters, but understands the management of a boiler and engine. The generating plant worked without a hitch from the start. The charging current varied from 23 to 25 amperes at a pressure of about 225 volts.

When heavy loads are carried the length of time for charging about equals the time required to make a run. When, however, the street car travel is light the charging can be done in about three-fifths to three-quarters of the time.

The car may be described as follows: The body is sixteen feet long, and is equipped with two 12-horse power motors made by the Electro Dynamic company. The car has an opening along the side, so that the cells can be shifted in and out. Shifts are made three times a day, and always after a twenty-five mile run. This leaves a margin of 50 to 75 per cent of the charge in the cells. The car is equipped with 96 "23M" cells divided into twelve crates of eight cells each. Half of the crates are placed underneath the seats on one side, and the other six on the other side of the car. Tables of twice the length of car body are placed on each side of the track. Of course these shifting devices are rather crude, but in spite of this a shift has been made in three and one-half minutes. Ordinarily it required from five to eight minutes to perform the same operation. The equipment arrived in Dubuque on Aug. 2, and one week was required in which to set up the generating plant and to charge the cells. The trial trip took place on Aug. 9.

Since Aug. 12 the car has been in operation regularly every day, with the exception of a few days when it was necessary to wait for brushes. The car carried on an average of 200 passengers a day, and on two occasions over 1,000 in a single day. There was no difficulty experienced in going up a 4½ per cent grade with 100 passengers at a rate of five miles an hour.

For the sake of experiment on three days one motor was dispensed with, and the car run with one motor and sixty-four cells. It was found that on a comparatively level track one motor did the work as well as two, and with as many passengers, but on a grade while pulling a load it was hard to start the car.

The roadbed is substantially built with sixty-pound Johnson girder rails throughout; it is comparatively level. The few grades are as follows: The Fifteenth street grade, 3 per cent, is 400 feet long; the Second street grade, 5 per cent, is 150 feet long; the Main street grade. 4½ per cent, is 300 feet long; Rhomberg avenue grade, 4 per cent, is 400 feet long There are also a number of bad switches and curves, and the rails, as a general thing, are very dirty.

Improvement in Street Car Construction.

"The application of electricity to street railway propulsion has led to many radical changes in the building of car trucks, "said a representative of the Pullman company. "You will notice that the cars which are being turned out for electric railways are far superior to those which they succeed. They are far more substantial than the old horse cars, more commodious and better adapted to the wants of the people. Then, too, they are handsomely finished and are inviting. All these little details are now the subject of as much thought as the tracks were formerly. Americans to-day will not put up with old style, stuffy street cars, such as the old bob-tails were. That is only one feature of the improved electric car. There are many others — prominent among them the change in construction. The old horse car could not stand the service imposed upon the electric car of to-day. The increased rate of speed, quick turning of curves, sudden stopping and starting to which the electric car is adapted would wreck a horse car in very short time. The whole plan of construction is changed. Horse cars have been changed into electric cars where there were particularly favorable circumstances and the rate of speed was not materially increased; but it is out of the question to secure rapid transit on a road equipped with old style horse cars.

"Another consideration is the effect the new method has had in car building. I have already alluded to the changes or rather improvements in the construction and embellishment of street cars since the introduction of electricity in street car work. Now let me add that the electric system has greatly boomed the car building business. New roads have been established where it was impossible to operate horse car lines and the limited traffic would not warrant a cable system. It seems as if one of the first things a small Western settlement requires nowadays, is an electric railway. In the larger towns and in small cities where the enterprising element has looked in vain for rapid transit heretofore electricity has been welcomed as a boon. Its application to larger cities such as Boston has opened a new field, one that is far more extensive than the warmest friend of the electric system had heretofore hoped. The world is only beginning to realize what a great blessing electricity is to the world. The builder of electric cars, I can assure you, appreciates it fully."

The Subscribers' Telephone Company, Chicago.

The ordinance of the Subscribers' Telephone company, Chicago, was considered at a meeting of the city council last week, but no definite action was taken as all the sections had not been examined when the council adjourned. Thus far the new company has persistently refused to say what telephone it will use, and this position has led many of the aldermen to believe that it would be useless to pass the ordinance as the company would be unable to operate under it. One of the aldermen openly denounced the new project in the council chamber, and announced that he had been informed by one of the gentlemen interested that the company had no telephone. The policy adopted by the company of refusing to divulge the plans has not increased the confidence of the aldermen in the project. They argue that they have no right to dispose of a valuable franchise unless they know what the company, to which it is granted, proposes to do and what the prospects are for the success of the scheme; also how the public is to be benefited.

The new company refuses to enlighten the public on these points, and it is probable "the public," represented in the city council of Chicago, may feel some hesitancy in granting so valuable a franchise without further light.

The action of the council thus far is not reassuring for the friends of the ordinance, and if the aldermen continue as they have begun it is hardly possible the framers of the ordinance will know it when they get it through the council. It was loaded down with amendments last week, every one of which showed the distrust which the aldermen felt toward the measure. The daily papers which indorsed the company less than a month ago now show their suspicion, and one of them intimates that the company may have no intention of establishing a telephone service. It points out that under the form of the ordinance it might operate a district messenger service or local telegraph system. The ordinance does not require it to furnish telephones. The company is authorized to lay wires and cables for conveying sounds and signals, and although telephones are mentioned in the ordinance the company is not obliged to give telephone service.

One of the friends of the new company announced last week that it would agree to withdraw from the field provided the old company would agree to reduce its telephone charges to $87 per year. Such a proposition, of course, would not be seriously considered by the Bell company.

CORRESPONDENCE.

New York Notes.

NEW YORK, Oct. 11.—The inadequate transportation facilities of the Manhattan Elevated Railway company have been admitted by Jay Gould, but he maintains that the company is doing all in its power at present to promote the efficiency of the service. He says: "We have adopted every practicable measure to insure safety and efficient service on the elevated roads. As fast as other improvements suggest themselves they will be made. Experiments with electricity as a motive power are progressing, and it seems a question of comparatively short time when it will be adopted on the elevated roads."

It is reported that the Western Union has withdrawn its objections to the government postal telegraph scheme. An official of the Postal Telegraph-Cable company to-day said that he was convinced that there was a demand and room for just such a postal telegraph system as recommended, and that it would in no way interfere with or reduce the present commercial telegraph business. It would be something just between the postal service and the telegraphic service which would not interfere with either, but expedite business which heretofore had been intrusted to the postal service without the aid of electricity.

The Court of Appeals has handed down a decision affirming the conviction of Shibuya Jugiro of murder in the first degree, and as soon as the court of Oyer and Terminer opens again he will be brought down from Sing Sing, where he has been in solitary confinement, and will be resentenced to die by electricity.

The Court of Appeals has also affirmed the conviction of Joseph Wood for the murder of Charles Ruffin, a negro laborer, on May 19.

Dr. Carlos F. McDonald has made his report to Gov. Hill on the electrical execution of Kemmler. He says that despite minor defects in arrangement and operation of apparatus the first execution by electricity was a successful experiment. He considers execution by electricity infinitely preferable to hanging. The report recommends that there be but one plant for execution of criminals by electricity, located in the central part of the state, in a building specially constructed for that purpose, and that the voltage be not less than 1,500 nor more than 2,000. Dr. McDonald argues that in Kemmler's case death was instantaneous. He says: "Had the first contact of the current been maintained for full twenty seconds, as first suggested, in all probability there would have been no reflex muscular movement after it was broken, and no unfavorable criticism at the result could have truthfully been made. In the excitement and confusion of the moment occasioned by the suspicion on the part of some that death was not complete, the second application of the current was maintained too long—nearly one and one half minutes If there was a spark of unconscious vitality remaining in Kemmler's body after the first contact was broken—there certainly was no conscious life—it was absolutely extinguished the instant the second and last contact was made. That the man was dead, however, long before the burning of the sponge and desiccation occurred, there is no reason to doubt."

The prosperity of the Western Union company may be appreciated when the report of the fiscal year 1890 shows an increase of net earnings over the previous year of about $1 000,000. The net earnings of this year are $7,312,725, and after paying interest and dividends the surplus for the year will amount to $1,441,582, the aggregate dividend being $4 956,000. The total expenses was $15,074,303; capital stock, $86,199,852, and net earnings $7,312,725 At the last meeting of directors the old board was re-elected with the exception that Charles F Mayer, president of the Baltimore & Ohio railroad, was chosen to succeed John Jacob Astor. W. H. T.

Pittsburg, Pa.

PITTSBURG, Oct. 11.—Pittsburg has for the last three days been honored by a visit from the English iron and steel men, the German Eisenhuetten Verein, and a large number of mechanical and mining engineers of Europe generally. Yesterday and to-day they have been holding several meetings at Carnegie Hall; they were feted at the Duquesne club last night, and they were also entertained in a very interesting manner at the different industrial establishments for which the Smoky City has become famous at home and abroad.

A good many of the English and German engineers expressed a desire to visit the works of the Westinghouse Electric & Manufacturing company, as well as those of the Westinghouse Air Brake company, and other Westinghouse interests. At the request of the committee of entertainments, the general manager of the Westinghouse Electric company placed a number of gentlemen at the head of the visiting delegation in order to guide them through the electrical and other workshops. The buildings on Garrison Alley were first visited. Everything was viewed, inspected and investigated with a critical eye by the foreigners. They expressed satisfaction with everything they saw. The bustle and stir in the street railway motor department elicited especial comment, and as the visitors had already heard that the company had just brought out a new electric motor for street car propulsion, they were exceedingly anxious to have the details of the motor explained.

From the machine shop they were taken to the department where the Westinghouse alternating current flat carbon arc lamps are made and here again many complimentary remarks were made by the visitors.

Then the laboratory, the detail department and the various other branches of the works were seen, but as the gentlemen incidentally heard that an electrical display of the company was now at the Pittsburg exposition, they all expressed a desire to examine it. Here they spent almost an entire afternoon. The Tesla motor and its various applications in small manufacturing plants proved a great attraction. The mining engineers were anxious to witness the operation of this motor in the coal mines. Accordingly a large delegation of the visitors were taken charge of this morning by John S. Scully, the owner of the Willock mine, and conveyed to that place by a special train from the Baltimore & Ohio station. E. H. H.

Topeka, Kan.

TOPEKA, Kan., Oct. 11.—The council has passed the ordinance granting the Rapid Transit Railway company the right to operate its electric cars on Kansas avenue from Eighth to Second streets. With the passage of this ordinance the Rapid Transit company secures right of way on Kansas avenue from Eighth street north, across the Kansas avenue bridge and to Gordon street. The ordinance provides that all tracks on Kansas avenue between Eighth avenue and the north line of the city shall be constructed in such location as the city engineer may determine, subject to the approval of the mayor and council, but shall interfere as little as possible with any part of the street not already occupied for street car purposes. The company is granted the right to use as much of the right of way and such portion of the track of the Topeka City Railway company as the city engineer may deem necessary in the construction and operation of the railway, and the Topeka Rapid Transit Railway company shall have the right to operate its cars upon that road upon payment of a reasonable compensation to the Topeka City Railway company.

The company is to pay into the city treasury $8,000 for repairing and strengthening the Kansas River bridge, and the city agrees to repair and strengthen the bridge so that the company may safely operate its line across the same within 120 days.

The council passed the Rapid Transit company's ordinance. Councilman Ettlinger called up the City Street railway ordinance granting the City Street Railway company the right to operate its lines with electricity and prescribing the manner of doing so. In the course of an informal talk upon the ordinance it was stated that it was satisfactory to the Topeka City Railway company or that it would be accepted, but it was put upon its passage and went through without a dissenting vote.

The ordinance provides that the poles shall be set and the work done under the direction of the city engineer, that the poles shall not be less than 125 feet apart, and that the wires shall be not less than eighteen feet from the ground, and that the council may have the power to order them raised or lowered whenever they deem it proper, that the cars of the company shall be drawn over the present Kansas avenue bridge by horse power, that the company shall place electric lights on the tops of the poles and operate them free of charge during the time the cars are operated at night; that the company shall build its electrical plant within six months, and that the company shall pay one-third of the cost of repairing the Kansas avenue bridge.

On motion of Councilman Hawes, the ordinance granting the City Railway company right of way over the Sixth street viaduct was taken up and was passed unanimously. By the terms of the ordinance the company pays $2,500 for the franchise, and agrees to pave and maintain the paving of the viaduct. The company is required to build its track on the viaduct within ninety days.

H. C. Corwin & Co. have received word from James Anthony and C. B. Holmes, who are at the head of the water power project, that they have almost completed their purchase of machinery for the dam and the contracts for electrical machinery are all let. They expect to be back in Topeka this week at the latest, and the work will thea be begun in earnest.

The Secretary of State has issued a charter to the Leavenworth electric street railways. The main line of this road is to run from Fort Leavenworth through the city of Leavenworth and to the National Soldiers' Home and Kansas penitentiary, with branches. Estimated length fifteen miles. The directors are S. F. Neely, John Hannon, Robert Garrett, Leavenworth; Henry L. Newman, St. Louis; B. E. Senning, Chicago: Wm. B. Knight, Delbert J. Haff, Kansas City, Mo. Capital stock. $500,000. M.

Waco, Tex.

WACO, Oct. 11.—The city council at a special meeting recently granted a franchise to the Citizens' Electric Street Railway company on North Eighteenth street. The same franchise was some months ago granted to the Dummy Railway company. The meeting was in progress till late in the afternoon and meanwhile, the respective corporations were getting ready for a contest for the street named. Both parties moved material to the scene and last night the Citizens' Railway company forces commenced constructing a double track from Washington street northward. Meanwhile, the dummy forces provided with new steel rail spikes and cross ties commenced a few rods north of the point of beginning of the Electric people, and they, too, began work laying a single track, building northward, as were the Electric people. Before midnight the Citizens' Railway company were victors, having shut out the Dummy company. The Citizens' company is backed by St. Louis capital. The Dummy people claim the city law damaged them by granting the franchise to the Citizens' company, and say they will sue for $14,000. For a time it looked as if a pitched battle would result. R.

Louisville, Ky.

LOUISVILLE, Oct. 8.—The threatened strike on all the local street railway lines was averted by mutual concessions, and the service was not interrupted.

The work of laying track for the Belt Line Terminal at New Albany, Ind., began last Monday.

Mrs. Frances Atkinson of Nashville, Tenn., has brought suit against the United Electric Railway company for $10,000 damages alleged to have been sustained through a shock received in a collision.

The Thomson-Houston Electric Light company has brought suit in the Chancery court here to secure from the Barbourville Land & Improvement company of Barbourville the sum of $5,000 alleged to be due in a note given in payment for an electric light plant.

The Edison General Electric company will put in an electric light plant for the handsome new building of the Courier Journal Job Printing company here. The same company is also putting in 1,000 incandescent lights for the Standard Oil company at Whiting, Ind., and expects to install 40 additional arc lights for West Indianapolis.

Paducah, Ky., had a strike on its electric line last week. The railroad men promptly and quietly disposed of it by discharging the strikers and starting out new men.

At the meeting of the Jeffersonville, Ind., general council last week, the Postal Telegraph Cable company was unanimously granted the right to erect within the corporate

mits poles on which to string wires. The route named is Front street, west side of Missouri avenue to Spring street, then north to the city limits. The work is to be done under the supervision of City Engineer Johnson so that the poles will not in any way obstruct the public streets.

The New Albany Electric Light company has contracted with a Meadville, Pa., firm for two boilers and one engine to be used in furnishing the power for an additional dynamo. The company will furnish arc and incandescent lamps, and will have power to furnish 150 arc lights in addition to the fifty now in use. When the arrangements are completed the city will abandon gas in business districts. The new plan will be in operation by January 1.

The New Albany Structural Iron Works is having an electric light plant put in the new mill on West Seventh street in order to enable it to keep its shop in operation night and day. J. W. L.

LOUISVILLE, Oct. 11.—It was rumored Monday that there was a deal between the Jeffersonville, Ind., Electric Light company and the Jeffersonville Gas company, whereby the latter company will pass under the control of the former. The price agreed upon, it is said, is about $25,000, and the whole city is to be illuminated by electricity.

The C. C. Mengel, Jr., & Bro. company of this city, has just placed an order for 270 incandescent lights with the Edison General Electric company's branch house here. The lights will be used in the lumber yards, mills and offices of the company. Most of the local lumber men have electric light plants. J. W. L.

Milwaukee, Wis.

MILWAUKEE, Oct 11.—The street electric light question is nearly settled. The Badger Illuminating company which was the lowest bidder, and the only company which proposed to furnish lights for the whole city, decided to stop the call for new bids if possible, and a week ago used a writ of certiorari on the city officials. The company claimed that the action of the city in calling for new bids was illegal, and the writ commanded the municipal officials to produce all the documents in the case on Nov. 1, 1890, for review in the circuit court. The card was a strong one and the Badger people played it well. It brought the city to time. It was realized the litigation might be a long one, as the case was likely to be appealed to the Supreme Court, no matter how the Circuit Court decided it, which would probably leave the city in darkness, the contract between the city and the Badger Illuminating company expiring December 15 next. Manager Wall and the city attorney held a consultation, the result of which was a decision that the city should avail itself of the provision of the charter which authorizes the common council to make a contract with the owners or licensees of patents without advertising for bids. The company is the sole licensee for Milwaukee of the Thomson-Houston system. The Board of Public Works recommended that the common council make a contract with the company under this provision. The matter will be decided probably in the Badger company's favor at the next meeting of the common council.

Henry C. Payne, Villard's representative in Milwaukee authorizes the announcement that plans and specifications are being prepared in New York for transforming the Milwaukee City and Cream City street railways into electric systems. The cost of the new equipment will be in the neighborhood of $2,000,000. The Sprague system, of course, will be used. It will be early next summer before the work is completed. Poles and rails for the electric line are already being delivered, however, and it will not be long before the work is commenced.

The Milwaukee Edison Electric Light company expected to have its incandescent plant ready for operation by October 1, but work has been delayed considerably and it will be January 1 before the company will be able to furnish contracts with light. Nearly all its mains are laid, and the building is rapidly reaching completion. The company will have a branch plant on the South Side and in time it may establish a branch on the West Side.

It will probably be May 1 before the Cream City and Milwaukee City street car lines, both of which are controlled by Henry Villard, will be converted into an electric system. The lines are the largest in the city. It was intended to introduce electricity on both lines by January 1, but the common council has extended the time until May On that date, it is expected, Milwaukee will have nothing but electric street car lines. All the old lines will have been converted into electric systems and all the new lines will be electric roads. Milwaukee is fast losing its steam railroad offices, the sale of the Milwaukee & Northern railroad to the St. Paul Railway company, leaving but one road, the Milwaukee, Lake Shore & Western, with all its general offices in the city, but it is going to have as good electric street car lines, and perhaps more of them in proportion to the population, than any other city in the country.

Still another ambitious railway enterprise, a larger undertaking than any of its predecessors, has come to the surface. It is nothing less than the construction of a line running from the city to Fox Point, a place on the lake shore, about ten miles north of the city limits. Arrangements are being made for a large purchase of land on Fox Point. The scheme includes the platting of several hundred acres for residence purposes, the creation of a fine summer hotel, and the building of a suburban railroad—probably an electric line.

The legal fight over right of way which Villard and Pfister are waging will probably be determined soon now. The test case has been argued during the last two Saturdays and it is expected that the lawyers will cease talking this afternoon. Judge Johnson will probably render a decision within the next week. C.

Minneapolis, Minn.

MINNEAPOLIS, Minn, Oct. 8, 1890.—Rapid work is being done in both Minneapolis and St. Paul on the new electric street railway system, and in both cities the principal lines will be in operation by the 1st of December. The First avenue line, leading from the heart of Minneapolis to the western suburbs, is nearly completed and the wires are strung on the center posts about half the distance. This line will be extended in the spring to Lakes Calhoun and Harriet and will on its completion succeed to the immense summer business of the old steam motor line. Iron posts are now being set for the Chicago avenue line. Work is advancing on all the lines in both cities, and the suburban line on University avenue will begin operations within sixty days. The company agreed, as a consideration that every line in both cities should be running by electricity next year.

The Duluth Street Railway company, which is controlled by the corporation of which Thomas Lowry of Minneapolis is the head, is changing some of its lines from horse to electrical power and will eventually use only the latter. The gentlemen interested in these companies are so thoroughly convinced of the superiority of electrical power for street railway service, that they abandoned the cable system aftes having laid considerable cable track in both Minneapolis and St. Paul.

The Bonsfield Woodenware company is the latest important factory to secure its own electric lighting system, and at an early day its extensive plant will be fully equipped. Every sawmill in the city, fifteen in number, is now equipped with electrical lighting apparatus, and nearly every woodworking factory is similarly provided. This feature of the business has been of no small importance this year in Minnesota and Wisconsin, where lumber manufacture and auxiliary industries are heavy. Establishments of this kind have no danger greater than fire, and as night work in the summer is necessary to most of them, they are therefore equipped with electric lighting apparatus to reduce the danger from fire.

The agitation of the question of municipal lighting which stirred up the common council a short time ago seems to have subsided, and the inference is drawn that the proposition then made to have the city undertake its own lighting has been abandoned as impracticable. There was at one time considerable sentiment favorable to the plan, which was due to difficulties between the city and a lighting company. It is probable that the matter will not be discussed again for some time at least, as there is a very conspicuous disinclination on the part of business men now in the council to do anything of the kind. It is probable that an ordinance will be passed, however, requiring a guard-wire to be placed over the trolley wires on the new lines as a precaution against danger from contact with other wires.

There is probably no place in the country where public interest in the development of electricity is more acute at the present time than in Minneapolis. The magnificent electrical display at the Exposition, the recent convention of the Association of Edison Illuminating companies in this city and the construction of the hundred and fifty miles of electric street railway system now progressing in the Twin cities, have been fruitful stimulants to the popular interest. Much good will undoubtedly result.

The Northern Car company of this city has recently taken several contracts for street cars for electric propulsion and is now finishing important contracts for the Cleveland, O., and the Tacoma, Wash., street railway companies. A new foundry has been added and extensive improvements are in progress at their plant in Parker, a northern suburb. They are also building thirty cars for the new Minneapolis electric railway. N. O. F.

MINNEAPOLIS, Minn., Oct. 11.—New difficulties seem to have interfered with the commencement of operations on the projected electric street railway from the city limits to Robinsdale, the principal northern suburb of Minneapolis. Work was to have been commenced last Tuesday at the Robinsdale end of the track, but some cause has necessitated another postponement. The company which is to undertake this enterprise was incorporated early in the year, and its officers and directors are some of the wealthiest financiers in the city Among them are T. B. Walker, president of the Business Men's Union; A. B. Robbins of the Northwestern Elevator company, and President Moan of the Northern Car company, whose plant is situated near the Robinsdale terminus of the projected line. The intention of the projectors is to construct a line from Robinsdale to the city limits at the intersection of the Crystal Lake road, where connection will be made with the Thirty-second avenue extension of the Minneapolis street railway for all points in this city and St. Paul. Some difficulty has been experienced in reaching an agreement with the Minneapolis Street Railway company, and it is probable that the present delay is owing to this matter. The Robinsdale company intended at the inception of its enterprise to apply to the city for a franchise permitting it to construct its line into the business center. This met with such strong objection from the Minneapolis Street Railway company that negotiations were begun for adjustment without the arbitration of the city council. The Lowry system will doubtless eventually be extended to the point on Thirty-second avenue where the city limits cross, thus giving the Robinsdale company the connection needed. This cannot be accomplished this fall, however, as all the men that can be secured are now employed in the construction of the new city lines.

The new company which has recently absorbed the Brush plant at Eau Claire, Wis., has bought up the almost unlimited water power of the Dells and proposes to make extensive departures in electrical railway construction in that city and its environments. The new Eau Claire company has announced its intention of extending the line of its Eau Claire railway to Chippewa Falls, a distance of about ten miles passing through Badger Mills and other villages. Altoona, another adjoining town, will also be connected with the system. In connection with these enterprises, two extensive parks are to be established by friendly interests, and a series of public improvements instituted which are intended to back up the enterprise. The construction of all the new lines contemplated will necessitate the purchase of a good deal of extra equipment and give somebody contracts worth looking after.

The John R. Davis Lumber company of Phillips, Wis., is about to undertake an enterprise somewhat too large to be called an auxiliary to its manufacturing business at that point. The plant of the company, as well as its surrounding yards, is lighted by a system of arc electric lighting owned and operated by the company, but it proposes to add to this an incandescent plant with a capacity of 500 lights for the use of the city. It would not be surprising if the John R. Davis company should be the first to undertake electric traction as a substitute for steam in logging railways. It owns its logging railroad and uses two powerful locomotives in bringing timber to the mill at Phillips.

The St. Paul Telephone company has received its first installment of 6,000 feet of cable and commenced the work of laying it in the conduits, the start being made at Fifth and Cedar streets Another consignment of 30,000 feet of cable is expected daily, and P. G. Reynolds, superintendent of construction, says that Dec. 1 will witness the completion of all the work laid out for this year.

The Duluth Street Railway company announces that a new extension is to be made to its new electric system. The line will be on Twenty fourth avenue and extend through the fine residence property of the West End. Manager Chase has stated that the date of its construction hinges entirely upon the ability of the company to secure material, some of which has been already bought. Walcott's Park and Brookdale property owners have subscribed $2,500 toward the project.

Clift. Wise, whose trip to the East last winter on behalf of the Minneapolis Street Railway company resulted in the adoption of the electric system in both of the Twin Cities, has become so interested in electricity that he has resigned his position here to join an Eastern electrical company. When Mr. Wise went East last winter the local company was beginning cable construction, but the result of his investigations on his trip so interested Messrs. Lowry and Goodrich that they made a study of electrical railway construction and operation, which induced them to change their plans.

The new Third avenue power house of the Minneapolis Street railway is finished and the connection with the Fourth avenue line has been transferred to it from the Thomson-Houston people. The First avenue line is now in running shape and has been successfully operated sev-

eral days. The Chicago avenue line will be ready within a week or two, and the Hennepin & Lyndale line will be completed simultaneously. All the new lines will use the "loop" at the Union depot this winter, connecting with horse cars at the steel arch bridge for the east side. Motors are arriving daily, and the progress of work is more rapid than it has been at any time heretofore. The interurban line will probably not be in running shape until Dec. 1.

The city council of Stevens Point, Wis., has voted to hold a special election to decide upon the matter of purchasing an electric lighting plant for that city. An estimate was placed before the council from the Thomson-Houston company for a $10,000 plant and it is upon this basis that the election will be held. F.

Nashville, Tenn.

NASHVILLE, Oct. 4.—The Electric Street Railway company of this city has adopted a system of transfer tickets similar to that now in use on the South Side cable system of Chicago.

The Capitol Electric company has been extending and improving its lighting service, both on its municipal contract and its arc and incandescent lights for commercial uses. The day circuit established by this company a month or two ago has proven quite popular. At first the citizens were a little afraid to risk their money and business on motors that they did not fully understand, but the dozen or so they put up to run fans, elevators and other light machinery have given such satisfactory results as to secure for them public confidence and popularity. The Cumberland Publishing House, a large and wealthy concern, has decided to discard steam and use electric motors to run its printing presses and other machinery. Ground has been broken for the erection of a new building for this publishing house, to cost $50,000, and it will be thoroughly equipped with every electrical appliance of established utility that may be needed in the business.

The local telephone exchange has greatly improved its service within the past two months after a good deal of litigation, in which the courts have settled a great many important questions concerning the legal rights of the several electrical companies. Electricity, as an industrial factor, was but recently introduced in this section, and as there were neither laws nor precedents bearing on the matter, the conflicting interests of the electrical companies presented some exceedingly difficult and knotty questions that gave the town the unenviable (and really undeserved) name of the "City of Injunctions." Happily most of these legal questions have been settled and new companies may enter into business now with a well-defined knowledge of their legal rights and status beforehand. Experience and practice have also done much to improve the service of all the electric companies. The poles carrying wire for the various purposes and currents of widely differing power have been better arranged as to their heights and location, and less interference is experienced The telephone people have put up return wires on all streets carrying wires of high potential, and the service they render, though not perfect, is reasonably satisfactory, and their list of subscribers increases every month. Their service with distant points in Cumberland Valley in this state and Kentucky, notably to points on the Upper Cumberland river, locally known as "The Town Board," is subject to frequent interruptions. Their wires for the most part follow the country roads through forests or along the river banks, and can be reached only by private conveyance or by steamboats. Falling timber often breaks the wires and, in the absence of live game, the insulators on the poles are a favorite target for juvenile sharpshooters of African descent who infest the region.

The Commercial Club, the business exchanges, the newspapers and the private citizens of the city never lose an opportunity to say a word in praise of its electric plants, and visitors all receive a favorable impression of this feature of the city's progress. D. M. B.

THE ELECTRIC MOTOR.

The Bristol, Tenn., Street Railway company will build three miles of electric railway.

The Excelsior Manufacturing company is contemplating the construction of an electrical railroad at Washington, Ga.

J. C. Burney, J. S. Baxter and T. J. Carling have secured control of the Ocmulgee Street Railway company and will establish an electric road at Macon, Ga,

The South Side Rapid Transit company has been incorporated at Austin, Tex., by A. Von Rosenberg, H. J Doughty, W. M. Harris and others, to build an electrica railroad four miles long. The capital stock is $100,000.

G. A. Edward Kohler, Chicago, representative of the Eddy Electric Manufacturing company, closed a contract last week with Andrew Cummings of Thomson's restaurant, Chicago, for a 20-horse power Eddy motor. This machine will drive an Excelsior dynamo furnishing current to the arc lamps in the restaurant. Mr. Kohler has just installed a one horse power Eddy motor in the United States Dental College for laboratory work.

The Chesapeake & Columbia Investment company organized by T. N. Smith, N. H. Shea, Dr. W. P. C. Hazen and others of Washington, D. C., contemplates building an electrical railroad on its property near Bay Ridge, Md.

There is considerable activity in electric street railway work in Houston, Tex. The Houston City and Bayou City Street railways will be equipped with electrical apparatus and will be operated by the Houston Street Railway company; which has amended its charter, increasing capital stock from $400,000 to $800,000. W. H Bailey and associates have petitioned the council for a franchise to construct an electric street railway, and L. W. Hill, W. C Wagley, W. H. Crank and others, have also applied for a similar franchise.

The Fidalgo City & Anacortes, Wash. Railway company is pushing to completion its electric road, which is eleven miles in length. The company consists of Joshua Price of Tacoma, Julius S. Porter of Fidalgo City, H. C. Culver of Walla Walla and C. B. Holman of Seattle. The Thomson-Houston system will be used. The cars will be finished in the latest designs of car building, and will be twenty-four foot cars They will have double trucks. The Fidalgo & Anacortes Construction company is building a 4,000 foot bridge for the railway over which the cars are to be run. The line is to run to the water's edge, where connection is made with the boats, thus securing a more rapid transit, and a safer passage than could be made through the Straits and Pass.

The combination car which the Pullman company is exhibiting at Buffalo, during American Street railway convention, is 34 feet in length, over all, and divided into two compartments, the forward end (about one fourth of the car) is to be used as a smoking compartment, while the balance is reserved for ladies and passengers who do not smoke. The smoking compartment is finished in oak, and the seats are upholstered in figured leather, while the passenger compartment is finished in mahogany, and the seats are covered in blue and gold upholsteay. The finish of the car is something on the order of a Pullman sleeper, the interior of the car is lighted with fifteen incandescent lights and one oil lamp, while the platforms are lighted with two incandescent lights in front and one in the rear. Arrangements have also been made for an electric headlight at each end. The bar is white while the lettering and ornamentation are in gold It is equipped with two four wheel trucks of the Hubbard pattern, upon each of which is mounted a fifteen-horse power Westinghouse electric motor. The trucks are furnished with the Allen steel tired wheels.

A letter from Denver, Colo., Sept 7th, says: "Last night the board of aldermen passed ordinances giving to the two cable companies the right to run electric roads on virtually all the streets of the city. The bills were supposed to be a sort of compromise between the rivals which have heretofore cut each other's throats. According to law the ordinances were read in full in the meeting, but the clerk rushed through at such a speed that they were merely an unintelligible jumble of words. As soon as business was finished the clerk grabbed the documents and locked them up in spite of the demands of the reporters. When one of them finally got a look at the papers he discovered instead of the ordinance which had been prepared and agreed beforehand, an entirely different document. The cover of the orginal had been carefully placed around it so it seemed quite correct. It takes away from the cable company and transfers to the tramway company numerous streets on which the former has had horse-cars for years. It runs their lines in such a way that they are hemmed in by the opposition, and it stipulates that they shall give up their special charter from the state before they string a wire. A million dollars would not repay the company for this. It is believed the majority of the aldermen were not aware of the change, but that it was done by a man who has been the champion of the cable company and has turned a somersault. The fraudulent document has been properly secured. Several aldermen were seen to night. Some profess amazement; others will not speak."

THE ELECTRIC LIGHT.

The erection of an electric light plant at Darien, Ga., is contemplated.

The Ukiah Electric Light, Water & Power company has been incorporated in San Francisco.

The Board of Trustees of Benecia, Cal., have awarded the contract for public lighting to the local electric lighting company.

The Los Angeles, Cal, trustees have not yet disposed of the question of public lighting. Bids have again been called for.

The Tennessee Industrial Land company will erect an electric light plant in connection with other improvements at Dayton, Tenn.

The Oakland, Md., Electric Light company has, it is reported, adopted the Edison system, and will install its plant immediately.

Tacoma, Va., will have an electric light plant. The Thomson-Houston company has been awarded the contract for the installation.

The Georgia Development company will install an electric light plant on its property at White Sulphur Springs, near Gainesville, Ga.

L. N. Cox, for the National Electric Manufacturing company, has also closed contract for the erection of an electric light plant at Florence, S. C. About forty arc and 300 incandescent lights will be required. The National incandescent and Western arc system will be used.

The Thomson-Houston Electric company, Boston, has been awarded the contract for the Kensington Land company's electric light plant.

A branch of the Safety Electric Light company, Boston, will establish a plant at Fernandino, Fla., the new enterprise to be capitalized at $100,000.

The Citizens' Electric Light & Power company, Houston Tex, has increased its capital stock $50,000, and contemplates enlarging its electric light plant.

The Chattanooga, Tenn., Electric Railway company has secured its franchise, obtained the right of way and consent of property owners to the equipment of its road. It will begin construction at once.

Personal Mention.

It is reported that Edison will visit Marquette, Mich, to examine the ore separating system in operation in the mines.

A. H. Patterson, manager of the Phoenix Gas company of New York was a visitor at the Chicago Electric club this week.

C. C. Warren, of the railway department of the Westinghouse Electric and Manufacturing company Chicago has severed his connection with that company.

W. S. Heger has resigned his position as manager of the Pacific coast district for the Edison company. Mr. Heger during the last year greatly advanced the interests of the Edison company on the coast and built up an excellent business in his territory. He will locate in Colorado Springs, Colo., where private interests will occupy his attention.

An interesting social event at St. Paul recently, was the wedding of Lieutenant Howard K. Gilman and Miss Mamie Lamb at the residence of the bride's parents. The groom is a son of Col. J. H. Gilman and at present occupies the position of assistant general manager of the North-Western Thomson-Houston company, St. Paul. The bride's father is an eminent lawyer and president of the Hannibal & St. Joseph railroad company. The Rev. Dr. Andrews performed the ceremony. Among the guests present were Miss McLelland of St. Louis, Miss Hatch of Hannibal, Cal., and Mrs. Gilman, Miss Gilman and Mr. E. R. Gilman of Washington, Gov. and Mrs. Merriam, Mrs. A H. Wilder, Mr. and Mrs Price, Mr. and Mrs. Auerbach, Mrs. H. M. Rice and Miss Rice, Mr. and Mrs. Chittenden and daughter, Col. Sullivan, U. S. A., Mrs. Stickeny, Mr. and Mrs. Timberlake, Judge and Mrs. Hall

Business Mention.

The T. M. Foote Regulator company, Boston, has issued an attractive catalogue describing its specialties.

The Electric Merchandise company announces that it will be pleased to display its numerous specialties to the street railway managers at the Buffalo convention.

The Great Western Mining & Manufacturing company has put new machinery in its coal mines and contemplates erecting an electric light plant at Peach Orchard, Ky.

The Detroit Electrical Works has issued a circular calling attention to the excellent features of the Rae electric railway system. The company will be represented at the Buffalo convention.

The increase in business of the Crosby Electric company, New York city, has necessitated a removal to 87 and 89 South Fifth avenue where better facilities and larger quarters have been secured.

S. Taussig, 45 River street, Chicago, western agent for synovial oils has just renewed his contract with the Chicago postoffice. Synovial lubricants have held this contract for five consecutive years against the sharpest of competitors. Mr. Taussig makes a specialty of supplying electric light and power plants.

E. D. Stiff & Co. have fitted up a very complete machine and model shop at 67 and 69 South Canal street, Chicago, and are prepared to contract for the manufacture of mechanical and electrical novelties, light machinery, etc. They have special facilities for experimental and model work, and will undoubtedly meet with success in their new undertaking.

The Central Electric company of Chicago has furnished the Davenport Street Railway company with an entire supply equipment, consisting of 110,000 pounds of copper wire and 59,000 pounds of improved Candee wire Candee wire has quite a success in railway work and it has proved equal to the severity of the tests placed upon it. The Jordan trolley supporter is used on the West End Railway in Boston with marked success, and since the Central Electric company put it on the market in the West, it has met with much favor.

The Milliken iron pole for electric street railways illustrated in the WESTERN ELECTRICAN, May 3, is having an unprecedented sale, contracts having been made within the past three months for nearly 7,000 of the different patterns. Where the business of the road requires a double track the pole is placed in the center of the street a space never used for any other purpose making a very attractive and serviceable line. For single tract roads the company also manufacture a trim handsome pole to be placed at the curb. The pole will undoubtedly be on exhibition at the street railway convention at Buffalo, Oct. 15. The western agency is located at 59 Dearborn street.

R. T. White, Boston, will have his numerous devices for

street railroads on exhibition at Buffalo. Mr. White has placed a number of practical devices on the market, and street railroad companies generally are familiar with their leading features.

The Buckeye Electric company recently formed in Cleveland to manufacture a new incandescent lamp and appliances, will be represented in Chicago by A. H. Massey, 182 Jackson street. The parties interested in this enterprise are also largely interested in the Western Mineral Wool company, and both corporations will handle their western business under the same management at the above number.

W. M. Ramsey assistant superintendant Federal Street & Pleasant Valley Passenger Railway company, Allegheny, Pa., writes the Eureka Copper company, North East, Pa., that "after a year's use, we can heartily indorse it (tempered copper) and recommend it for all descriptions of bearings and for electrical purposes; such as commutator bars, trolley wheels, etc." W. T. McEwen & Co. also highly recommend tempered copper.

The Central Electric Company of Chicago has made arrangements to furnish telegraph, telephone and electric light poles, having established a yard at Chicago, where it will keep on hand a full stock at all times. The company is decorating its attractive salesroom with a fine line of high class electroliers, and single brackets. This department of the company's immense business is becoming a very important one, and the most fastidious taste in this line can be satisfied.

The Interior Conduit & Insulation company of New York, which has some 150 miles of its underground conduits in operation in Minneapolis, carrying the feeders of the overhead trolley system of the Minneapolis Street Railway, will have an excellent exhibit of its system at the convention of the American Street Railway association, at Buffalo. The exhibit will consist of the one-half size model of its new man-hole, and will show its improved methods of entering the conduits into the same and other interesting details of the system.

The Eureka Tempered Copper company of North East, Pa., report large sales of their tempered copper for commutator segments, brushes, armature bearings, etc., during September. They entered 184 orders during the month and have been pushed to their utmost to keep in sight of their orders. The order book for September shows that they have passed beyond the experimental stage and registers among others, large orders from the following well known manufacturers during the month: Edison General Electric company, Westinghouse Electric company, Brush Electric company, Wenstrom Consolidated Dynamo & Motor company, National Electric company the Electro-Dynamic company of Philidelphia

The Murphy Iron Works of Detroit has recently closed a contract for the placing of the Murphy smokeless furnace under the boilers in use by the Denver Consolidated Electric company, seventeen in all, representing a capacity of 2,700 horse power. Under one of these boilers of extra size two furnaces are to be placed, so that 18 will be required. O. D. Catton of room 407 Rookery building, Chicago, the Western representative of this company, has also just placed 6 of these furnaces under the boilers in the West End electric street railway plant at Denver, and will shortly add 6 more. Mr. Catton returned to Chicago after a two months' sojourn in that city, arrange for the display of his company at the street railway convention in Buffalo.

Chas. G. Robinson of the Great Western Electric Supply company announces several electric railway novelties which he has in preparation for the market. Among these are a trailer-lighting connection in which the ends are perfectly dead when disconnected, and which needs no tension to insure a good contact. Some new forms of trolley-line insulators and pull off brackets are also under way, and with the treble center curve insulator which was recently illustrated, will form a set of high quality. The combination tin shades designed by Geo. Cutter are evidently meeting a growing demand, both the flat form and the new cone pattern recently described, finding ready sales. Indeed, the Great Western Electric Supply company has many orders for them in small lots. Last week alone the company shipped 3,000 of these shades, besides filling scores of orders for new designs of fixtures

When the Central Electric company, Chicago, moved into its present quarters, 116 and 118 Franklin street, last January, it was thought that the immense floor space would be sufficient for a healthy increase of the business for five years at least. In less than six months, however, the company has been crowded for storage room, and has been obliged to go outside to obtain relief. This is not only evidence of the immense growth in the electrical business generally, but is particularly expressive of the success of the Central Electric company. It is not hard to account for this success, as a glance through the establishment will show any one at all familiar with the technique of the business that the Central Electric company has gathered together a high class of specialties that are in constant demand, and which could not but help the growth of any concern of healthy business methods. The members of the company are men of tried merit and experience in the business, and attending closely to the needs of their patrons, they deserve success. The orders received for okonite wire by the Central company, Chicago, last week, have been greater than ever before in the history of the business. This speaks volumes for this excellent wire.

Electrical manufacturing companies generally look to the summer months for an opportunity to fill the orders on which they are behind, and also to prepare for the time when the heavy fall trade begins. Reports from all over the country show that this year is the greatest the electrical industry has ever known. The Westinghouse company reports that it is already so stocked with contracts for the equipment of electric lighting central station plants, for isolated plants, electric railway equipment, etc, that the works are now being operated at their utmost capacity day and night with every prospect of having to continue in hat way for the entire winter. Since the company entered the field of constructing the electric railway motors, especially, it has been obliged to increase its facilities very extensively. The total amount of orders for alternating current incandescent lighting apparatus received during the month of September aggregate 28,250 lights, which is over a thousand lights for each working day. Besides this, the demand for Westinghouse alternating current arc lighting apparatus has been unusually heavy, and the company is far behind with its orders in that department. In the electric railway department it is the same. The company has orders for the equipment of forty roads, calling for machinery valued at almost $1,000,000, and still the demand is increasing. The noiseless motor of the company on the Pleasant Valley Electric line in Pittsburg commends itself to the residents along the route. Among the new central station plants of alternating current lighting, the Westinghouse company has obtained contracts from Owensboro, Ind., 750 lights; Akron, O., 1,500; Bedford, Ind., 750 lights; Norwalk, O., 1,000 lights; Likins, Pa., 750 lights; Penn Yan, N. Y., 750 lights. In addition a number of the older central station plants have increased their capacity considerably. Among those having contracted with the company for an increase during the month of September are: Engelwood, a suburb of Chicago, Ill., 3,000 lights; Bay City, Mich., 3,000 lights; Duluth, Minn., 750 lights, and Youngstown, O., 750 lights. It is remarkable in the latter case that the plant in Youngstown is not yet completed. After the company had been organized the management contracted with the Westinghouse Electric company for alternating current apparatus of a capacity of 2,250 lights, but even before this machinery had been installed the management realized that the demand was greater than it had originally anticipated, and therefore the increase was ordered.

Electrical Patents.

Issued Oct. 7, 1890.

437,673. Electric Valve Controller. Louis Bell and Frank H. Root, Chicago, Ill

437,682. Electric Safe Lock. George L. Damon, Boston, Mass.

437,685. Insulator. Thomas F. Gaynor, Louisville, Ky.
The first claim is given:
"An insulator for electric conductors, provided with a reflecting surface for throwing the light from the sky downward, whereby the insulator may be easily distinguished from others."

437,704. Regulator for Electric Generators and Motors. Robert Lundell, New York, N. Y.

437,708. Means for Closing and Locking or Unlocking Railway Carriage Doors. Roderick N. Montgomery, Melbourne, Victoria.

437,720. Conduit Electric Railway. Ernest M. Reed, Wichita, Kan.
The second claim follows:
"In a conduit electric railway, the conduit comprising the yoke frames provided with depending prominences adjacent the surface slot and arranged at suitable regular intervals apart, the concave plates respectively secured to the opposite facing sides of the said prominences, and the concrete walls between the yoke frames, wherein a continuous unbroken arc is formed at each side of the surface slot."

437,754. Electric Meter. Jacob Einstein and Sebastian Kornprobst, Munich, Germany.

437,763. Electric Meter. Anthony Reckenzaun, Clapham, England.

437,767. Arc Lamp. Ralph H. Beach, St. Paul, Minn.
The invention consists in the combination, with the carbons movable one from the other and their holders, of a solenoid in circuit having its core connected with one of said holders to move the same and separate the carbons to establish an arc, and an elongated pole-piece extended in the direction of the carbon points, and made flaring at its outer end to repel the arc and maintain it near the tips of the carbon points.

437,771. Electric Steam Generator and Water Heater. Henry R. Butterfield, Waterville, Me.

437,789. Electric Ceiling Block. Albert E. Nichols, Leeds, England.

437,798. Electric Guest Call. George F. Ransom, Minneapolis, Minn.

437,832. Electric Motor. Julius Emmner, Jr, Washington, D. C.

437,835. Electric Motor. George Little and George Judge Little, Passaic, N. J.
The object of this invention is to revolve by the action of electro magnets one or more wheels, which wheels are especially adapted to the propulsion of cars on railways.

437,844. Commutator. Harry H. Blades, Detroit, Mich.

437,848 Secondary Battery. Henry Lampert, Jr., Chicago, Ill.
Claim one reads:
"A storage battery, consisting of apertured plates arranged side by side with the apertures in alignment, and a filling of fusible metal within said apertures rigidly securing the plates together."

437,851. Electric Light Fixture. James E. Brown, Brooklyn, N. Y.

437,859. Electrical Transmitter and Indicator. Dennis Kelley and Melville C. Parkhurst, Somerville, Mass.

437,868. Galvanometer. Andrew M. Ritchie, Brookline, Mass.

437,883. Pulley Attachment for Electric Lamps. Thos. H. Brady, New Britain, Conn.

437,901. Electric Arc Lamp. Charles W. Hazeltine, St. Louis, Mo
The invention consists of an arc lamp to which is applied near the arc a protective tip or shield to prevent the rapid consumption of carbon, this tip or shield being fed as the opposite carbon wears away, and automatically adjusted by any suitable means, but by preference being fed by the movement of the upper carbon, to which it is by preference applied.
The inventor says: "By applying this simple expedient to an arc lamp I have found by actual practice that the consumption of carbons is decreased fully and even more than one-half, thus making carbons burn twice as long as they ordinarily would without in any way decreasing their candle power."
Claim one reads:
'An arc lamp having a suitable protective tip or shield applied to such lamp near the arc, and regulating mechanism for adjusting the tip to the arc as the carbons are consumed."

437,905. Electric Advertising Clock. Moritz Levi, New York, N. Y.

437,913. Covering for Electric Wires. David Brooks, Jr., Philadelphia, Pa.
The invention consists in providing the wires with a covering composed of a double layer of tin foil having between them an adhesive oil, the adjacent edges of each of the layers overlapping.

437,926. Galvanometer. Thomas Harris, Detroit, Mich.
The last claim is as follows.
"7 In an electrical measuring instrument, the combination of the solenoid secured in a vertical plane at an incline, the wedged shaped spool of metal upon which said solenoid is wound, a deflecting filament suspended within said spool and consisting of a flexible thread, a magnetic or soft iron portion secured to said thread, and a non-magnetic light extension forming a pointer at the lower end."

437,927. Telephone Support. Fred. C. Hughes, Detroit, Mich.

437,930 Receiving Instrument for Telegraphy. Willard M. Miner, Plainfield, N J.

437,946. Brush Holder for Electric Motors. Edgar A. Sweet, Milford, Mass.

437,953. Conduit and Electric Conducting Rail Therefor. Joseph H. Wehrle, Newark, N. J.

437,961. Trolley. Isaac F. Baker, Lynn, Mass.
"Claim 2: The combination, with the electric contact or trolley arm bifurcated at its lower end and terminating in the two segments, as described, to which the pressure springs connect, of a cross-bar connecting said segments and a stop spring adapted to be engaged by said cross bar when the trolley escapes the conductor."

437,985 Automatic Passenger Register. Adrian Gajardo, Valparaiso, Chili.

437,986. Telephone System. Alfred Graham, London, England.
The second claim reads:
"In a switch for telephone circuits, a number of contact pieces in circuit with separate and distinct telephone apparatus, and an adjustable contact piece capable of being moved into position to connect the calling circuit with any one of the said separate apparatus without removing the home receiver from its support, in combination with a notched wheel or segment, with a yielding detent to retain the adjustable contact piece in its adjusted position, a device controlled by the movable support for the telephonic receiver and adapted to come into line with the yielding detent when the receiver is raised from its support and to free the detent when the receiver is replaced, and a spring to return the adjustable contact piece to its normal position."

438,003. Aerial Conduit for Electric Conductors. Adolphus A. Knudson, Brooklyn, N. Y.
Claim one follows:
"The combination, with a line of columns or vertical supports, of a conduit for electric conductors supported thereby, and consisting of horizontal beams or girders bolted together in pairs to form the spans, and provided with flanges projecting from their upper and lower edges."

438,036. Poles for Electric Wires, etc. Edmond Verstraete, St. Louis, Mo.

438,037. Rheostat. Joseph C. Vetter, New York, N. Y.

438,041. Metal and Circuit Detector. Robert L. Watkins, New York, N. Y.

438,084. Railway Train Signal. Daniel S. McElroy, New York, N. Y.

438,116. Electrode for Secondary Batteries. Waldron Shapleigh, Camden, N. J.

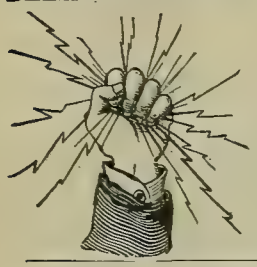
438,117. Method of Purifying Lead or Alloys Thereof. Waldron Shapleigh, Camden, N. J.

438,118. Terminal Switch or Cut-out Device for Electric Lighting Systems. Walter F. Smith, Philadelphia, Pa.
The first claim follows.
"The combination of a conduit, a line circuit mounted therein, and a terminal switch or cut-out inclosed within an air-tight housing filled with a fluid insulating substance."

438,127. Burglar Alarm. William J. Ackerman, Grand Rapids, Mich.
Of the twelve claims is given the seventh:
"The combination, in a burglar alarm, of metallic plates secured to the window jamb and connected with an electric battery and bells, and metallic plates secured to the sash stile, with a spring between the sash stile and stop."

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

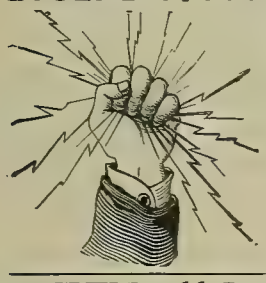
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

---

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

Cheaper than Overhead Wires,

MORE THAN TEN TIMES AS DURABLE.

Guaranteed to stand a pressure of 100,000 volts when used for Electric Light Mains. Write for Estimates to the

Brooks Underground Telegraph Co., 207 Walnut Place, Room 5, Philadelphia.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

DO YOU USE

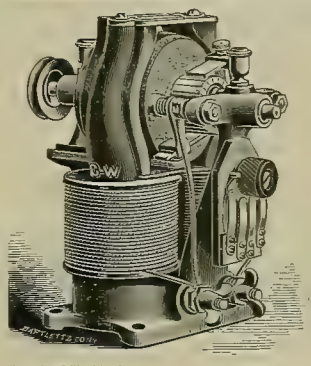
THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE CROCKER-WHEELER

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base—Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

NO LOSS OF CANDLE POWER.

FOR PARTICULARS WRITE

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

Cleverly 1018 CHESTNUT ST. PHILA.

Electric Specialties

—WE MAKE—

Electric Supplies Under Contract.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue **1--66** of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

OKONITE TRADE MARK.

INSULATED WIRES AND CABLES.

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

THE OKONITE COMPANY, - - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, and San Francisco.

ESTABLISHED IN 1861.

E. BAGGOT.

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES, SHADES, Etc., Etc.,

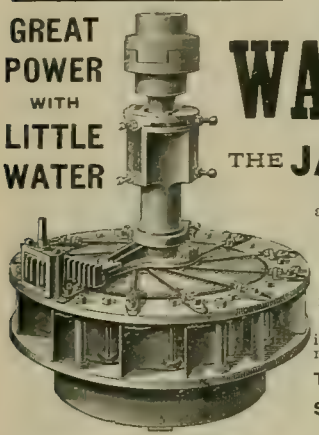
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

GREAT POWER WITH LITTLE WATER



JAMES LEFFEL

WATER WHEELS

BUILT BY

THE **JAMES LEFFEL & CO.**

Nearly 30 Years Business

affords every convenience for making Wheels of highest excellence and

Specially Adapted to All Situations.

Among the Wheels in operation may be found the

Largest and Smallest Wheels

in greatest variety of form, style and finish under the

Highest and Lowest Heads

in this country. Write, stating head, size of stream, kind of mill. We will send our fine pamphlet, and advise you.

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO.

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acide. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 6 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FOR SALE.

One 15-light	50 volt	Dynamo
One 25-light	50 volt	Dynamo
One 50-light	50 volt	Dynamo
One 75-light	110 volt	Dynamo
One 100-light	110 volt	Dynamo
One 150-light	110 volt	Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.

Standard Devices for all Systems.

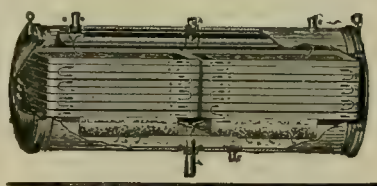
11 Adams St., CHICAGO

CATALOGUES FURNISHED.

W. R. MASON, General Manager.

ELECTRIC RAILWAY SUPPLIES.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

Binders

FOR THE Western Electrician

$1.00.

A MODEL RAILWAY.

The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

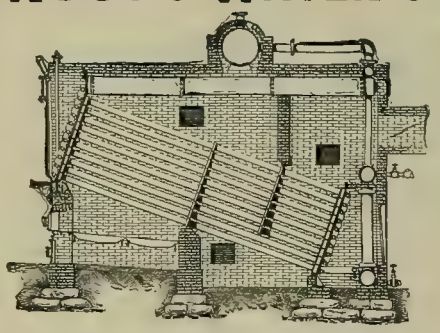
IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

SHULTZ BELTING CO.

Manufacturers of

RAWHIDE LACE LEATHER AND PICKER LEATHER.

BRANCHES: 161 Summer St., Boston, Mass; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago.

St Louis, Mo.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets

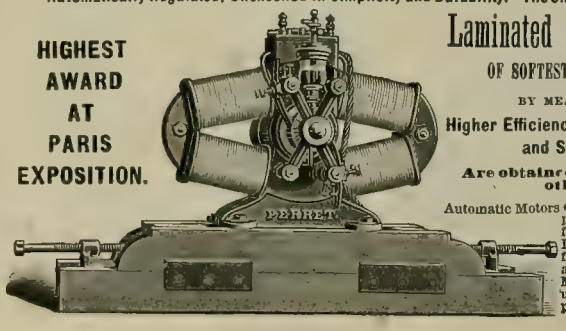
OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

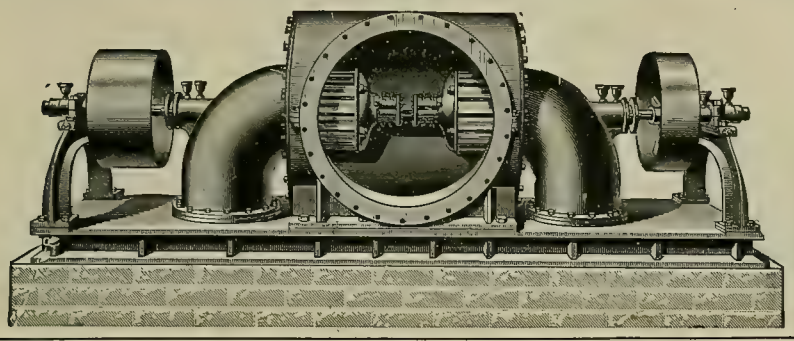
Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes. Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its diameter, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

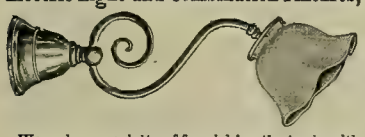
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

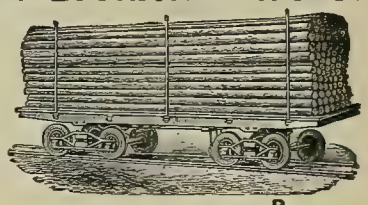
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

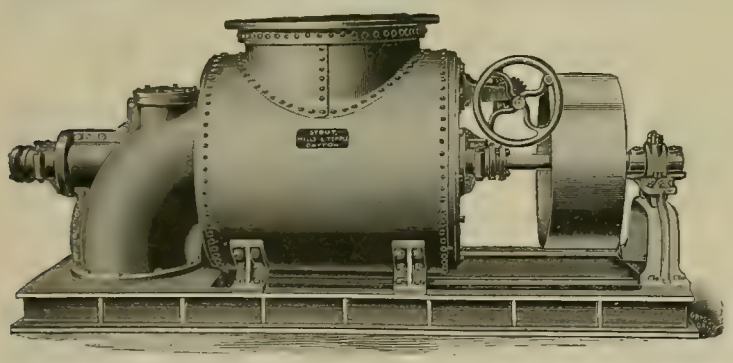
GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

Electrical Testing Apparatus manufactured to order, repaired or calibrated.

WESTERN ELECTRIC COMPANY, NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

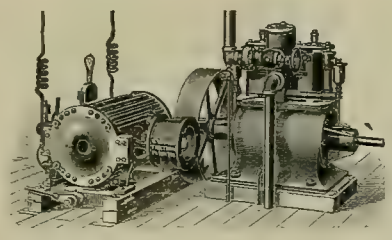
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

LIST OF PARTIES WHO HAVE ADOPTED THIS SYSTEM:

City of Boston, Water Department, Chestnut Hill, Mass.
City of Boston, Sewerage Department, Dorchester, Mass.
Pettee Machine Works, Newton Upper Falls, Mass.
Morgan Engineering Co., Alliance, Ohio.
Fitchburg Steam Engine Co., Fitchburg, Mass.
Portland Steam Packet Co., S. S. Portland.
Metropolitan Steamship Co., S. S. H. M. Whitney.
Chas. L. Seabury, yacht "Aztec."
Shoe and Leather Exchange, Boston, Mass.
Cocheco Manufacturing Co., Dover, N. H.
Hospital Cottages for Children, Baldwinsville, Mass.
Pennsylvania R. R. Co., Shops, Altoona, Pa.
Steamship Naugatuck.
Vanderbilt Building, New York.
William Tod & Co., Youngstown, Ohio.
Am. Waltham Watch Co., Waltham, Mass.



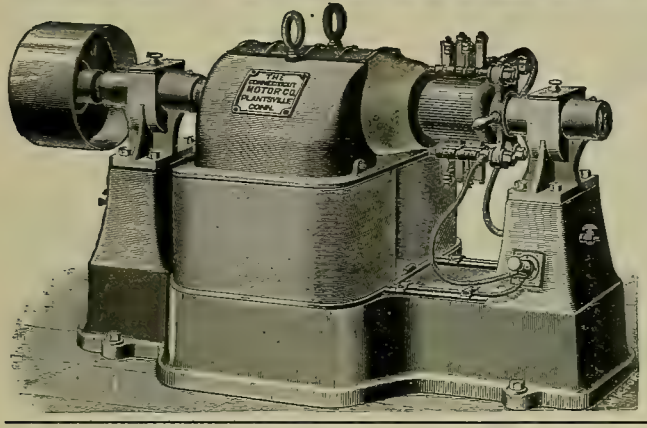
Seamless Rubber Co., New Haven, Conn.

C. F. Hovey & Co., Boston.
P. S. Malcolm, Portland, Oregon.
Chatham Hotel, Chatham, Mass.
Waltham Gas Co., Waltham, Mass.
Union Electric Light Co., Franklin, Mass.
Florence Electric Light Co., Florence, Ala.
Hutchinson Water, Light & Power Co., Hutchinson, Kan.
Walworth Light and Power Co., Boston, Mass.
North Attleboro Steam and Electric Co., Attleboro, Mass.
Jamestown Electric Light and Power Co., Jamestown, N. Y.
Weymouth Light and Power Co., E. Weymouth, Mass.
Leavenworth Electric Light Co., Leavenworth, Kan.
Willimantic Electric Light Co., Willimantic, Conn.
Towanda Electric Light Co., Towanda, Pa.
M. C. Dizer & Co., Weymouth, Mass.
Derby Gas Co., Derby, Conn.

AGGREGATING OVER 8,000 HORSE POWER.

THE EVANS FRICTION CONE CO., 85 Water St., BOSTON. Send for Catalogue D.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

THE UNDERGROUND FEEDERS

For the Buffalo Street Railway are being laid with the

NATIONAL CONDUIT MFG. CO.'S

CEMENT-LINED PIPE.

Go see the work now being done by the Field Engineering Co., then write to us.

THE NATIONAL CONDUIT MFG. CO.,

Times Building, NEW YORK.

OKONITE TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee **WIRES.**
Okonite and Manson **TAPES.**

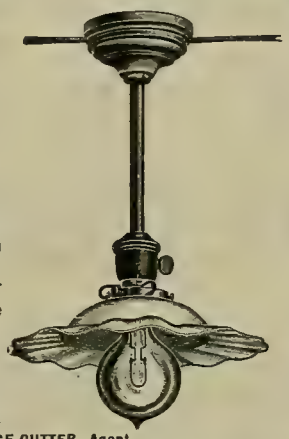
Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., **ST. LOUIS, MO.**

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

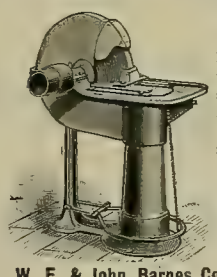
SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

THE BARNES WATER EMERY Tool Grinder.



It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.

Sold subject to approval. Send for full description and price.

W. F. & John Barnes Co., Rockford, Ill..
Address No. 761 Ruby Street.

Barnes' Patent UPRIGHT DRILLS.

20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.

Barnes' Patent ENGINE LATHE,

15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.

They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to **W. F. & JOHN BARNES CO.,** Rockford, Ill., Address No. 761 Ruby st.

SAFETY SEAMLESS RUBBER COVERED WIRE

IS THE BEST.

We carry a full line of ELECTRICAL SUPPLIES and can fill orders promptly. Write for quotations. Send a trial order.

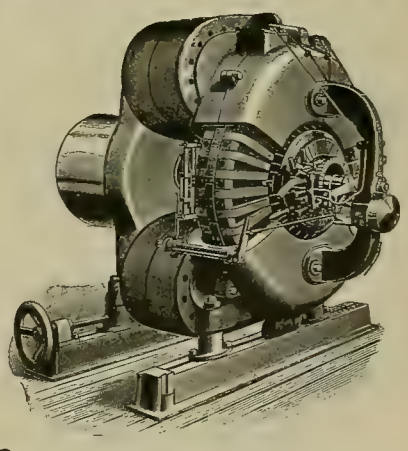
ST. LOUIS ELECTRICAL SUPPLY CO., - 403 N. Eighth St., ST. LOUIS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)

MANUFACTURERS OF

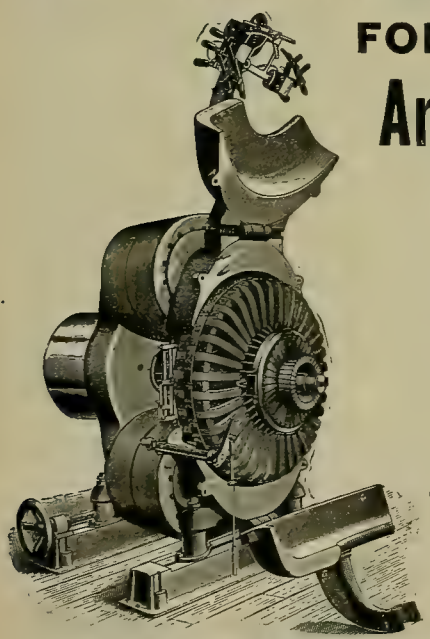
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

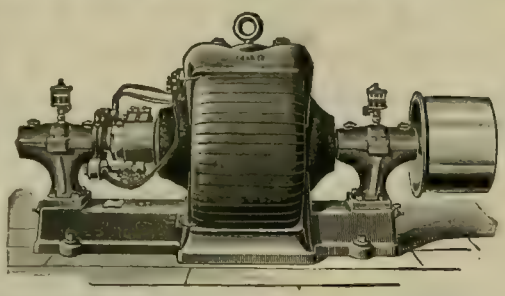
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

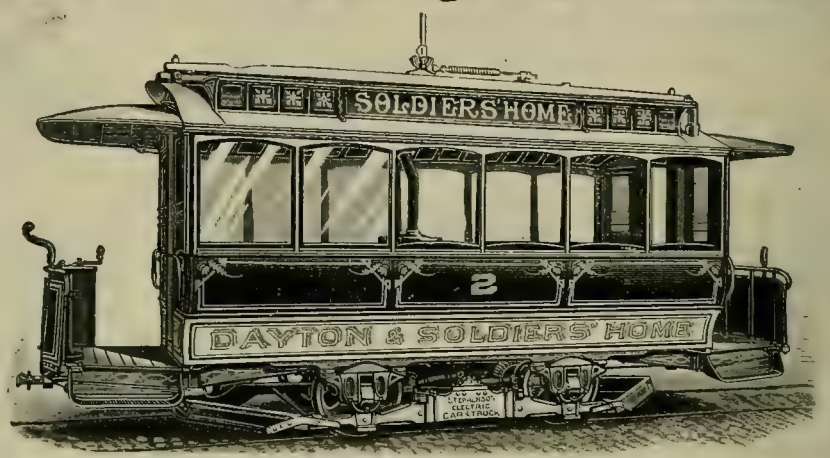
NEW YORK.

STREET CARS

FOR

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.



EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP

and 1914 Olive

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent. 19 Dey St., NEW YORK.

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2 000	"
" " " "	3d " (Just ready.)	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition (Just ready.)	2,500	Copies
Bell Hangers' " "	1st "	2,500	"
" " " "	2d "	1,000	"
Total within Eighteen months		15,000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel-Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System,
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1.00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE of MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

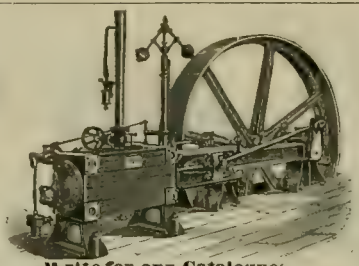
Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues.

SOLE BUILDERS
EDW. P. ALLIS & CO.,

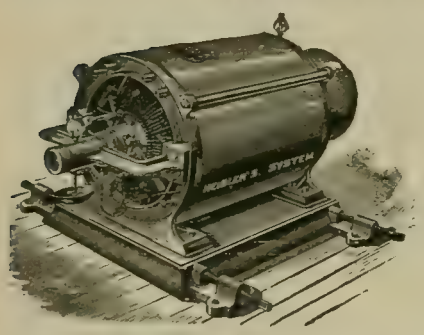
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

THE HEISLER PATENT LONG DISTANCE
INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

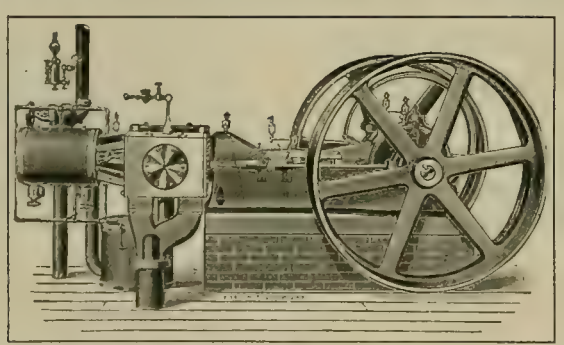
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

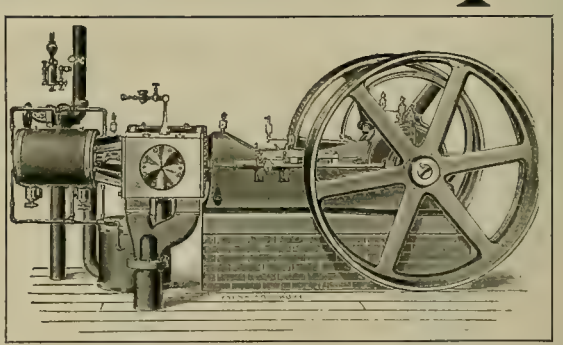
SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

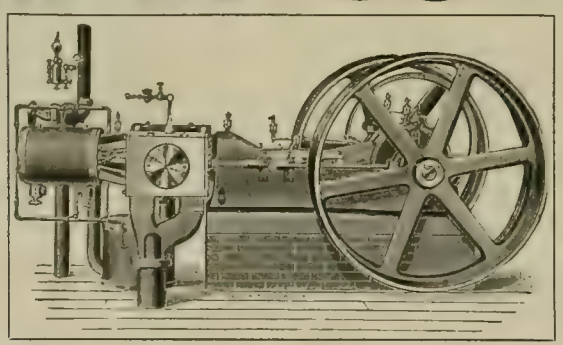
None so Good, None to Equal.



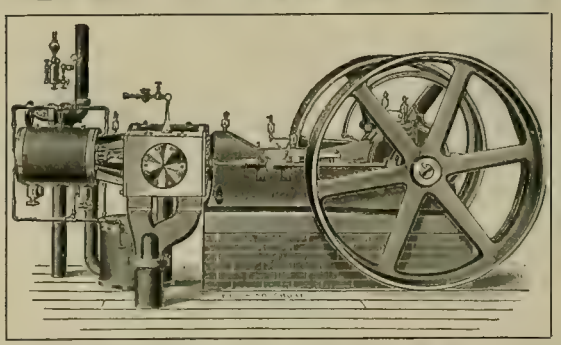
TANDEM



McINTOSH & SEYMOUR.



COMPOUND

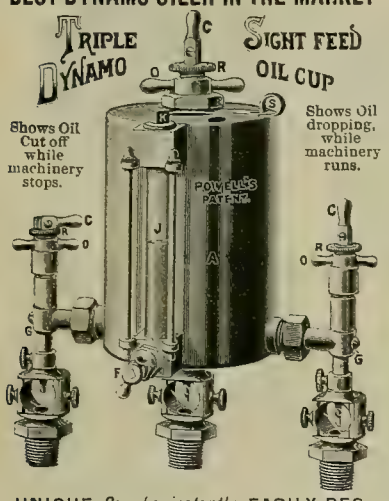


WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

Endorsed by all users as the BEST DYNAMO OILER IN THE MARKET



UNIQUE APPEARANCE. *Can be instantly started or stopped at will of operator* EASILY REGULATED. CONVENIENT TO FILL.

MANUFACTURED ONLY BY

THE WM. POWELL CO., CINCINNATI, O.

SEND FOR CIRCULARS AND PRICE LISTS.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO ERIE PA.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.

THE
Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,
170 TWENTY-SECOND ST.,
CHICAGO, ILL.

Chicago Electric Club

Will hold its next regular meeting at the Club Rooms, Monday Night, October 20.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

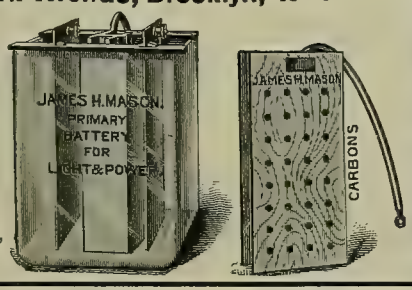
JAMES H. MASON,

MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

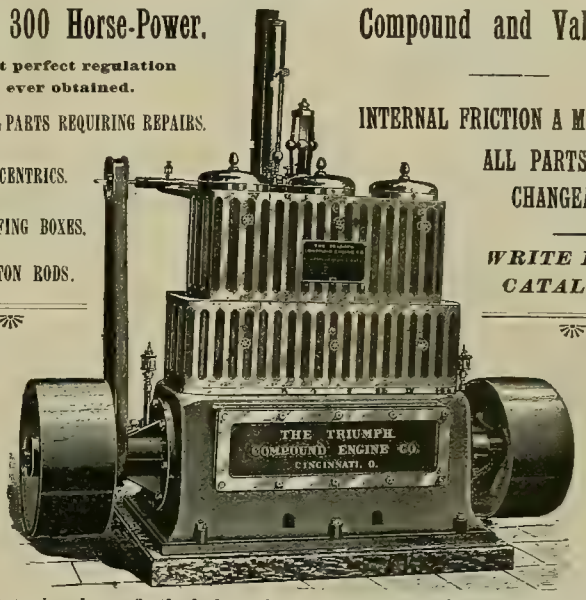
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

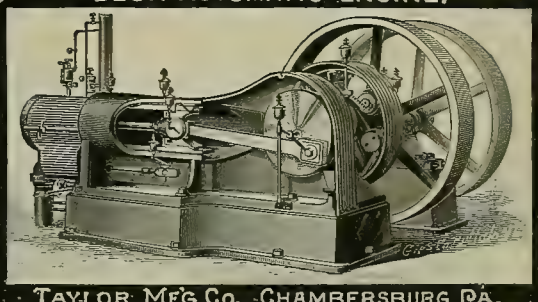
211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.

ECONOMY UNEXCELLED

REGULATIONS PERFECT



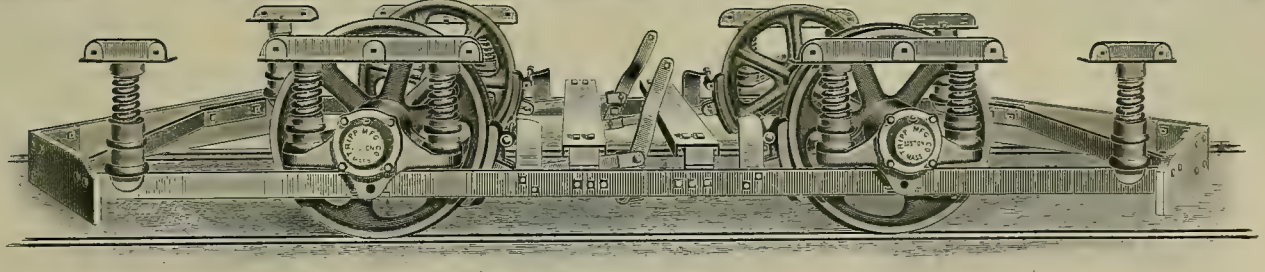
HOT BEARINGS UNKNOWN

PRICES MODERATE

TAYLOR MFG CO. CHAMBERSBURG, PA.

COMPLETE STEAM PLANTS A SPECIALTY.

THE TRIPP ELECTRIC TRUCK.



Substantial, Durable, and with Plenty of Room for the Application of Motors, and Electrical Apparatus.

OFFICERS:
ALBERT A. FOLSOM, President.
CONVERSE J. SMITH, Vice Pres. and Gen. Mgr.
JOHN E. BLAKEMORE, Treasurer.
SAMUEL A RANDALL, Superintendent.

AGENTS:
STANNARD & DILLON, Chicago, Ill.
FAIRBANKS, MORSE & CO., St. Louis, Mo.
GEO. W. STORER, Philadelphia, Pa.
JAMES BEGGS & CO., New York.
GREEN & BOULDING, London England.
H. C. RUSSELL & CO., Montreal, Canada.
CHARLES POWER & CO., Seattle, Wash.
ROBINSON & CARY CO., St. Paul, Minn.
J. & E. R. BARBOUR, Portland, Me.

Equipped with TRIPP'S ANTI-FRICTION JOURNAL BEARINGS, which are absolutely dust-proof, saving in power over ordinary bearings of from 30 to 70 per cent.

EVERY DESCRIPTION OF TRUCKS FOR ELECTRIC, CABLE AND STEAM CARS,

— MANUFACTURED BY —

TRIPP MANUFACTURING CO., 180 Summer St., Boston, Mass.

SEE MODEL OF ABOVE TRUCK AT STREET RAILWAY CONVENTION.

THE

THOMSON-HOUSTON ELECTRIC CO.'S

RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

o

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

o

Companies desiring Centre Pole Construction should see the Indianapolis Plant, illustrated below. Also Washington, D. C., Rochester and Brooklyn, N. Y.

Citizens' Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

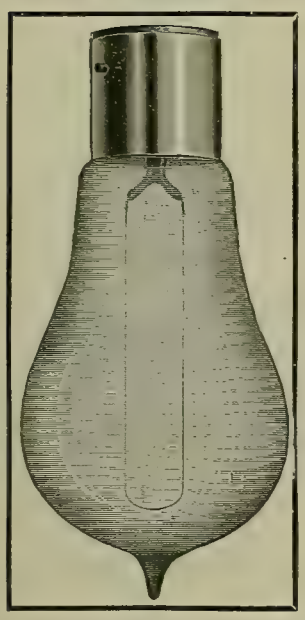
PRINCIPAL OFFICES:

BOSTON,
620 Atlantic Ave

CHICAGO,
148 Michigan Ave.

ST. PAUL,
408 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

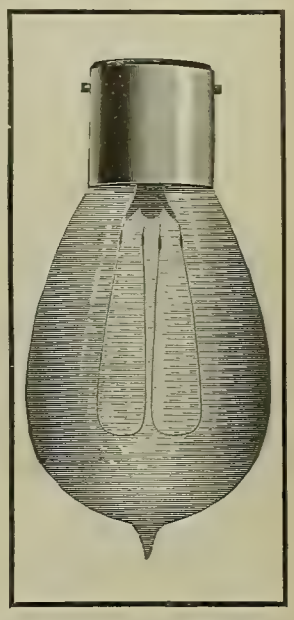
THE

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

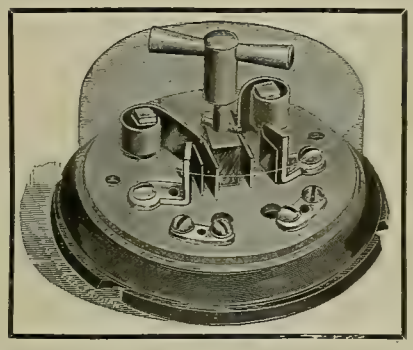
GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

WE CALL SPECIAL ATTENTION TO

THE DIAMOND
"K"
SWITCH AND FUSE BOX.



DOUBLE POLE
—FOR—
INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

ELECTRIC RAILROADS.

We are manufacturing a full line of Wire and Supplies used in the Construction and Operation of Electric Roads, including

Hercules Trolley Wire. Shield Brand Moisture-Proof Feeder Wire. Weatherproof Feeder Wire.	Habirshaw Wires, Cables and Cores.
Iron Box Poles. Angle Iron Poles. Latticed Iron Poles. Iron Pole Brackets.	Octagonal Wood Poles. Plain Wood Poles. Pole Ratchets.
Trolley Hangers. Rubber Strain Insulators. Trolley Strain Shoes.	Line Spreaders. Trolley Line Circuit Breaks. Automatic Cross-overs.
Rail Bonds. Center Cone Insulators. Galvanized Iron Wire. Galvanized Iron Strand.	Pins. Cross-Arms. Insulators. Wirt Lightning Arrester.

Special Tools of All Kinds and Other Articles too Numerous to Mention.

☞We call special attention to the merits of our

HERCULES TROLLEY WIRE,

Which we can furnish, without joints, in any length desired. Our facilities are such that we can turn out the largest orders on very short notice.

When requiring Standard Goods, Prompt Shipments, Low Prices

REMEMBER OUR ADDRESS.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

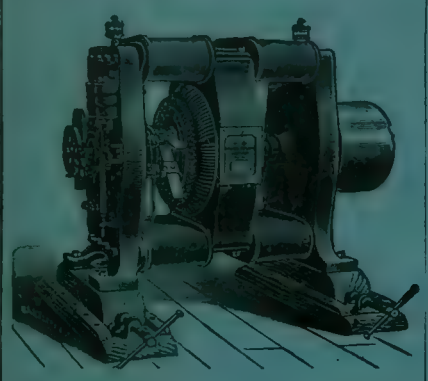
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



WOOD ARC DYNAMO.

MAIN OFFICE:

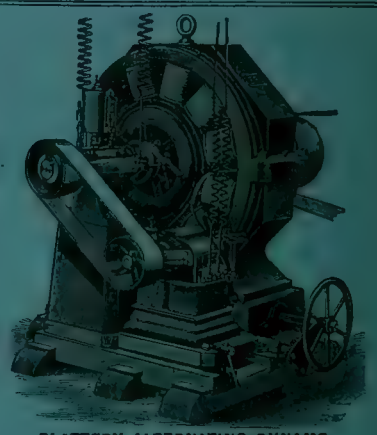
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



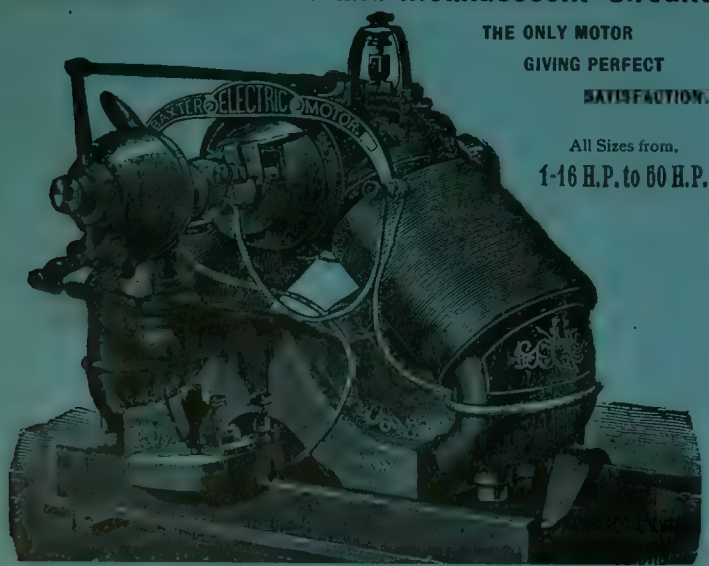
SLATTERY ALTERNATING DYNAMO.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,

BALTIMORE, MD.

CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

PHŒNIX GLASS CO

OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES SHADES

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

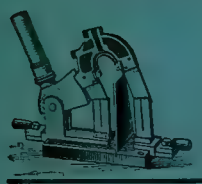
729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, OCTOBER 25, 1890. No. 17

"AJAX SWITCHES"



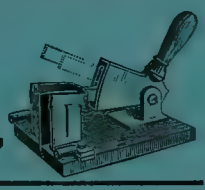
In all Sizes, for any Potential,
Single, Double and Treble Pole.

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,

74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas.
PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin' ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4⅞-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

WIRE DEPARTMENT.

For Addresses of DISTRICT OFFICES SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave, CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment. Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964		3,964
Westinghouse		27,710	27,710
Edison		10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734		734
Bali	613		613
Western Electric	566	250	816
Indianapolis Jenney	794		794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324		
Van Depoele	285		285
Waterhouse	222		222
Heisler		500	
Remington	159	300	459
Sperry	130		130
Excelsior	90		
Hochhausen	60		60
Weston	30		30
Fuller	10		
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,303.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System	Arc	Inc
Thomson-Houston	16,927	
Brush	6,090	4,259
Westinghouse	321	49, 67
Edison		13,853
American	1,537	
United States	632	6 141
Schuyler	1, 68	
Bali	962	6
Western Electric		
Fort Wayne	1,756	
Van Depoele	450	
Waterhouse	287	
Heisler		
Remington	129	
Sperry	160	
Excelsior	205	30
Hochhausen	70	
Weston		
Fuller	10	
Reliance	30	
National		1,000
Bernstein		215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889.	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co. xxxii
Abendroth & Root Mfg. Co. —
Alexander, Barney & Chapin. xiv
Allis, E. P. & Co. xxvi
American Electrical Works. xvii
Ansonia Brass & Copper Co. i
Automatic Switch Co. vii
Baggot, E. xviii
Bain, Foree. xviii
Ball Engine Co. xxvi
Barnes, W. F. & Jno. xxii
Barton, Geo. P. xviii
Baxter Electric Motor Co. xxxii
Bernstein Electric Co. —
Bleckert & Nelson. xix
Brown, Frank T. xvii
Brooks Underground Tel. Co. xvii
Brush Electric Co. xxxi
Bunnell & Co., J. H. —
Butler Hard Rubber Co. xxii
C. B. & Q. R. R. xviii
C. & C. Electric Motor Co. xxiv
Central Electric Co. xii
Cleverly Electrical Works. vii
Colburn & Co., I. W. xviii
Columbia Incandescent Lamp Co. xix
Connecticut Motor Co. —
Consolidated Electric Storage Co. —
Continental Dynamo Co. iv
Cowles Electric Smelting and Aluminum Co. xvi
Crocker-Wheeler Motor Co. xvii
Crosby Electric Co. iv
Curtis Regulator Co. —
Day's Kerite Insulation Co. i
Dayton Globe Iron Works Co. xx
Eastern Electric Cable Co. xvii
Eddy, Henry C. xvi
Edison Mfg. Co. xxiv
Edison General Electric Co.,— Lighting Dept. viii
Edison General Electric Co.,— Wire Dept. i
Edison Lamp Co. xxiii
Electric Construction & Sup. Co iv
Electric Merchandise Co. xviii
Electrician Publishing Comp'y xxi
Electrical Supply Co. xxx
Elektron Mfg. Co. xviii
Empire City Electric Co. xx
Empire Cuina Works. xviii
English, Morse & Co. xix
Eureka Tempered Copper Co. xix
Evans Friction Cone Co. xxi
Excelsior Electric Co. xxiii
Fibrone Mfg. Co. xvii
Fletcher & Fletcher Electric Co xviii
Forest City Electric Works. xxv
Fort Wayne Electric Co. xxxii
Gibson Gas Fixture Works. xx
Globe Carbon Co. xix
Great Western Electric Sup. Co. v
Greeley & Co., E. S. xvi
Harmount, G. A. vii
Hawkeye Electric Mfg. Co. —
Hazelton Tripod Boiler Co. xviii
Heisler Electric Light Co. —
Hill Clutch Works. xxvii
Holmes, Booth & Haydens. xix
Holmes & Co., C. H. xix
Holtzer-Cabot Electric Co. i
Humphrey, H. H. xviii
Illinois Electric Material Co. xvi
India Rubber & Gutta Percha Co. i
Interior Conduit & Insulation Co. xvi
Ireson, Chas. L. i
Jewell Belting Co. xvii
Jones Bros. Electric Co. vii
Knapp Electrical Works. xxix
Laminar Fibre Goods Co. xix
Law Telephone Co. xvii
Leclanche Battery Co. vii
Leffel & Co., James. xviii
Magnolia Anti-Friction Metal Co i
Mason, James H. xxv
Milliken & Co. xxv
Monitor Electric Co. vii
Munsell & Co., Eug. xvii
Munson Belting Co., Chas. xvi
National Carbon Co. iv
National Conduit Mfg. Co. xxii
National Electric Mfg. Co. xii
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T. xxvii
N. Y. Belting & Packing Co. —
Okonite Co. ix, xvii
Ostrander & Co., W. R. xx
Page Belting Co. —
Paiste, H. T. xvi
Peckham Street-Car Wheel & Axle Co x
Partrick & Carter xxii
Phillips Electrical Works, E. F xvii
Phoenix Glass Co. —
Pond Engineering Co. xxvii
Powell Co, Wm. —
Pumpelly Storage Battery Co. vii
Queen & Co. xvii
River & Rail Elec. Light Co. xi
Roeblings' Sons Co., Jno. A. xxi
Sawyer-Man Electric Co. xiv
Schieren & Co., Chas. A. xvi
Schoverling, A. xxi
Schuyler Electric Co. xxv
Shultz Belting Co. xxv
Southern Electrical Supply Co. xxiii
Sperry Electric Co. xx
Standard Electrical Works. xvii
Standard Paint Co. xvi
Standard Underground Cable Co. i
Standard Carbon Co. xxii
Stanley & Hall. xvi
Stephenson & Co., Jno. xxiv
Stiff, E. D. & Co. xviii
Stilwell & Bierce Mfg. Co. xviii, xix
St. Louis Electrical Supply Co. xxiii
Sunbeam Incandescent Lamp Co. xvii
Taussig, S. xviii
Taylor Mfg. Co. xxvii
Thomson-Houston Electric Co. Lighting department. ii
Thomson-Houston Electric Co., Railway department. xxviii
Triumph Compound Engine Co. xxvii
Tripp Mfg. Co. xxvii
Turner Brass Works. xvii
Union Hardware Co. xvi
United Electric Traction Co. vii
United States Electric Lighting Co. xv
Van Nuis C. S. i
Wanted. xvi
Western Electric Co. xx
Western Power Construction Co. xxvi
Westinghouse Electric Co. xv
Weston Electrical Instrument Co. xvi
White, R. T. iv
Wollensak, J. F. xxiii
Woodbridge & Turner. xix

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Aluminum.
Cowles Electric Smelting & Refining Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.'
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co

Belting—continued.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Brooks Underground Telegraph Co.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.
National Conduit Mfg. Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brooks Underground Telegraph Co.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
River & Rail Electric Light Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
White, R. T.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
River & Rail Electric Light Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.

Lamps, Incandescent—Con td
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
Tripp Mfg. Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co, James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

DAISY CHAIR
For T Girder or Rail, having a T Form of Base.

R. T. WHITE,

PATENTED MATERIAL FOR

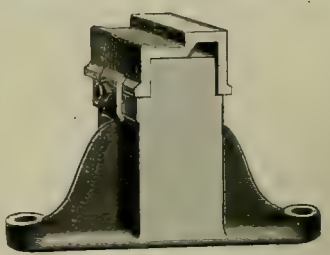
STREET RAILWAY ROAD-BEDS

Also **Cable, Electric and Elevated Railways,**

12 PEARL STREET, Rooms 6 and 7, BOSTON, MASS.

NEW YORK OFFICE, 52 Wall Street, Room 41.

Patented January 28, 1890—No. 420,135. *CORRESPONDENCE SOLICITED.*



EUREKA CHAIR
For Channel Iron Form of Rail.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT,
CLEAN,
EFFECTIVE,
SIMPLE,
COMPACT,
PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

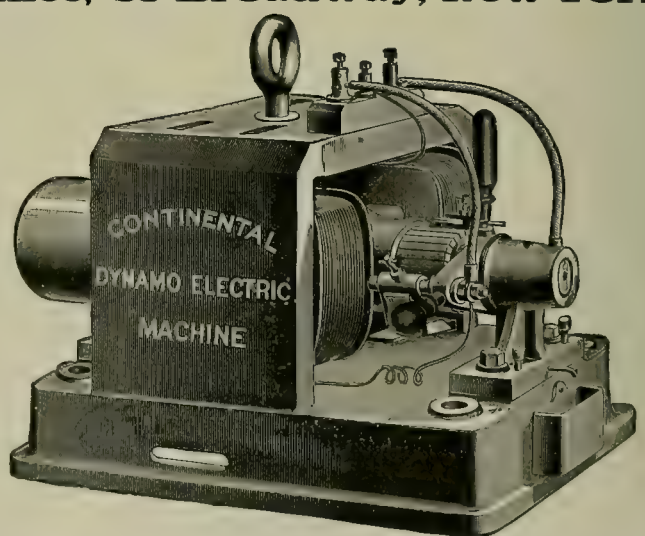
87 and 89 South Fifth Avenue, - - NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190-192 Fifth Avenue, CHICAGO.

DESIGNERS
—OF—
Electric Railway Specialties.

MAKERS
—OF—
Choice Electric Supplies.

DEALERS
—IN—
Standard Electrical Goods.

POLES

Of Extra Strength in all Sizes and Styles.

PLAIN WOOD POLES:
GET OUR PRICES.

OCTAGONAL WOOD POLES.
NEAT AND LOW PRICED.

POLES

ANGLE IRON POLES

Superior to pipe po'es at about half the cost.

Our 28 foot pole will stand a strain of 3,000 pounds without deflection.

LATTICED CORNER POLES.

Extra strong and stiff. Will stand all strains, met in practice without appreciable deflection.

BRACKETS

Of angle iron. Stronger and neater than those made of piping. Maintain their shape perfectly.

Try us on

BRACKETS AND POLES.

IF YOU WANT MATERIALS

That have the greatest strength,
That give the highest practical insulation,
That pay best in the end:

TRY US FOR YOUR SUPPLIES.

TREBLE CURVE INSULATOR.

Gives the Greatest Strength and the Highest Insulation. Try it and you will use no other.

RESISTS ABRASION AND GIVES THE HIGHEST LINE INSULATION.

SIMPLEX WIRE.

THE WIRE THAT PAYS BEST IN THE LONG RUN.

Try it for mains and you will always use it.

For lines in mines or among trees it is unequaled.

SEND FOR A SAMPLE.

ALL-COPPER RAILBONDS.

SEND FOR A SAMPLE.

Have practically no resistance. Are quickly and cheap'y applied. Will not oxidize.

WATCH FOR NEW ADDITIONS TO OUR

Electric Railway Specialties.

We insist on having only the very best, and that at figures which will command your orders.

ALL OF OUR

SPECIALTIES

WEAR WELL.

Prove it for yourself by trying them.

Our place at 190-192 FIFTH AVENUE is the

HEADQUARTERS

For Electric Railway Supplies

In any quantity,
For any system,
And to meet any circumstance.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

405 Sibley Street, ST. PAUL. PORTLAND, ORE., Branch, 266 1st St.

ELECTRICAL SUPPLIES.

Having recently reorganized our supply department and greatly enlarged our quarters, we are prepared to fill all orders promptly, from our stock, to which we would call attention as the largest and most complete line of **ELECTRIC SUPPLIES,** in the Northwest. We invite correspondence and will cheerfully quote prices or give any information in our power.

WRITE TO US FOR PRICES ON CARBONS.

Let us quote you bottom figures on

Wire and Incandescent Lamps.

A large line of Porcelain Articles constantly on hand.

Send for **CATALOGUE** and **DISCOUNT SHEET.**

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING.
BALTIMORE, MD., U. S. A.
Sole Manufacturers of the
WHITTINGHAM
AUTOMATIC SWITCH.
The only reliable protector to the Armature of an Electric Motor.
Applicable to Constant Potential Motors of all sizes and patterns.
SEND FOR CATALOGUE.

Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.
—WE MAKE—
Electric Supplies Under Contract.

Trade Mark Registered.

For twenty years these batteries have been recognized as the very best open circuit cells made.
They have always maintained their superiority, and are to-day unequaled.
All imitations and modifications of them are greatly inferior.
Be sure that the trade mark "GONDA" is on every cell.

The LECLANCHE BATTERY CO., NEW YORK.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.
STREET OR TRUNK LINES.
ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.
AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.
FACTORY: JERSEY CITY, N. J.

CINCINNATI HEADQUARTERS
ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.
WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE ·
FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE, ASK FOR PRICES BEFORE PURCHASING.
The JONES-BROS-ELECTRIC-CO. 28 30 & 32 WEST COURT ST.

EDISON

GENERAL ELECTRIC CO.

NOTICE.

A complete stock of Lamps of every candle power and voltage is always on hand at each District Office.

Also, Incandescent and Arc Lighting Generators, Railway and Stationary Motors, Armatures for all machines manufactured by this Company, and a full line of Construction Devices and Supplies for every kind of Electric Light, Railway and Power Plant.

Customers are requested to deal with the District Office of the territory in which their plant is located, as indicated below.

DISTRICT OFFICES:

NEW YORK,
Edison Building, Broad Street.

Connecticut, Delaware,
New York, Maryland,
Pennsylvania, Virginia,
New Jersey, West Virginia,

BOSTON, MASS.,
38 Pearl Street.

Maine, Massachusetts,
New Hampshire, Rhode Island.
Vermont,

DENVER, COLO.,
Masonic Building, 16th and Welton Sts.

Montana, Colorado,
Wyoming, New Mexico.
Utah,

SAN FRANCISCO, CAL.,
Edison Building, 112 Bush St.

California, Nevada, Arizona.

PORTLAND, OREGON,
Fleischner Building.

Washington, Idaho, Oregon.

CHICAGO, ILL.,
Rialto Building.

North Dakota, Michigan,
South Dakota, Indiana,
Minnesota, Ohio,
Iowa, Kentucky,
Missouri, Kansas,
Wisconsin, Nebraska.
Illinois,

NEW ORLEANS, LA.,
Cotton Exchange Building.

Texas, Alabama,
Indian Territory, Georgia,
Arkansas, North Carolina,
Tennessee, South Carolina,
Louisiana, Florida.
Mississippi,

TORONTO, ONT.,
Bank of Commerce Building.

Dominion of Canada.

Every Delegate

—TO THE—

STREET RAILWAY ASSOCIATION

Convention at Buffalo who is interested in the use of Electricity as a Motive Power will find it to their profit to look into the following

FACTS:

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES have the indorsement of the best electrical experts and electricians in the world.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not deteriorate, but improve with age.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not crack when exposed to severe changes in temperature.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will not deteriorate when placed in lime or mortar.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are not affected when immersed in sulphuric acid.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES will stand a greater amount of kinking and tortion than any other wire in the market.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are immersed in water for three days (72 hours), and then carefully tested with Thompson's Reflecting Galvanometer.

IT IS A FACT that OKONITE INSULATED WIRES AND CABLES are tested in addition to the Galvanometer, with a dynamo current of 2,000 volts.

IT IS A FACT that the OKONITE INSULATED WIRES AND CABLES were awarded the GOLD MEDAL at the Paris Exposition, 1889.

IT IS A FACT that the OKONITE INSULATED WIRES AND CABLES are giving better satisfaction, are more carefully made, and are not only the best, but cheaper in the end, than any other wires on the market.

THE International OKONITE COMPANY, Limited, 13 Park Row, New York, will furnish INSULATED WIRE OR CABLE of any size or number of conductors for use as SUBMARINE, UNDERGROUND or AERIAL CABLES, FEED WIRES, WIRING of CARS, or for any other purpose where first-class insulation is required.

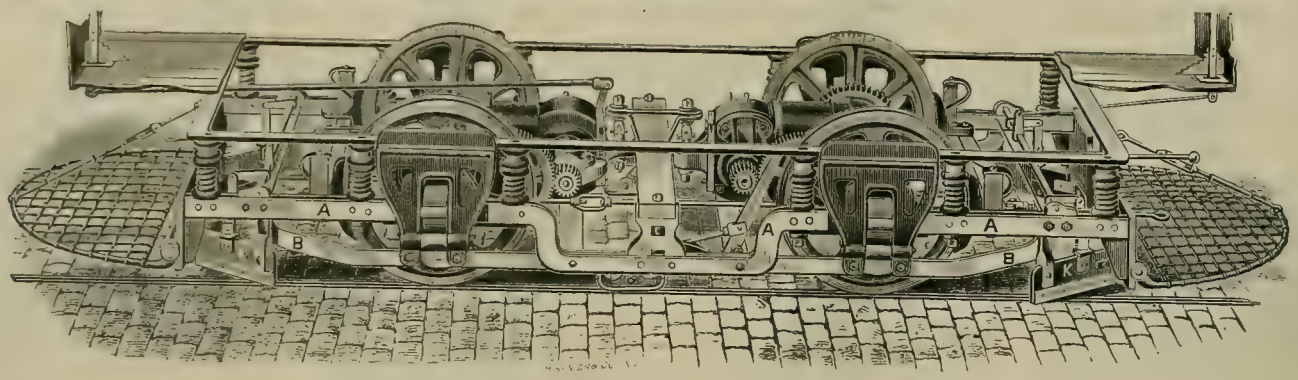
THE INTERNATIONAL OKONITE CO., Limited,

13 Park Row, New York.

WILLARD L. CANDEE and H. DURANT CHEEVER, Business Managers. F. CAZENOVE JONES, Superintendent of Factories.

BRANCHES:—Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, Kansas City and San Francisco.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM WHEEL & AXLE CO., 45 Broadway, NEW YORK.

DICTIONARY
OF
ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

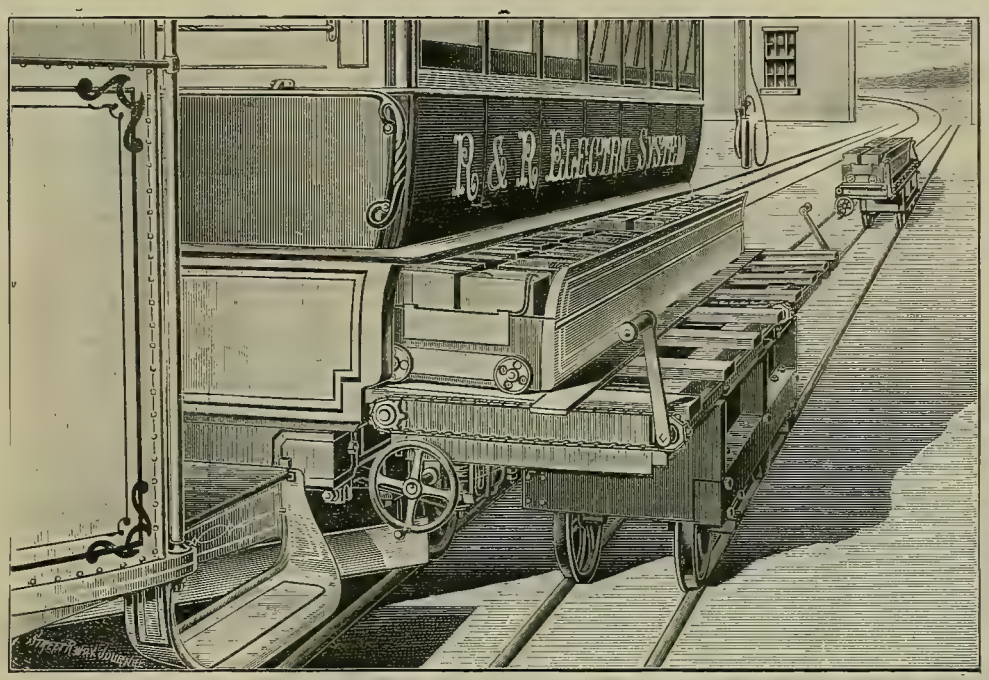
ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

GEO. L. WRIGHT, Pres. and Gen. Man. ALBON MAN, Vice-Pres. F. F. RANDOLPH, Sec. and Treas. WM. MAIN, Electrical Engineer.

RIVER AND RAIL ELECTRIC LIGHT CO.

ALDRICH COURT, 45 BROADWAY, N. Y.

Street Car Companies and Electric Railway Corporations Should Investigate This System.



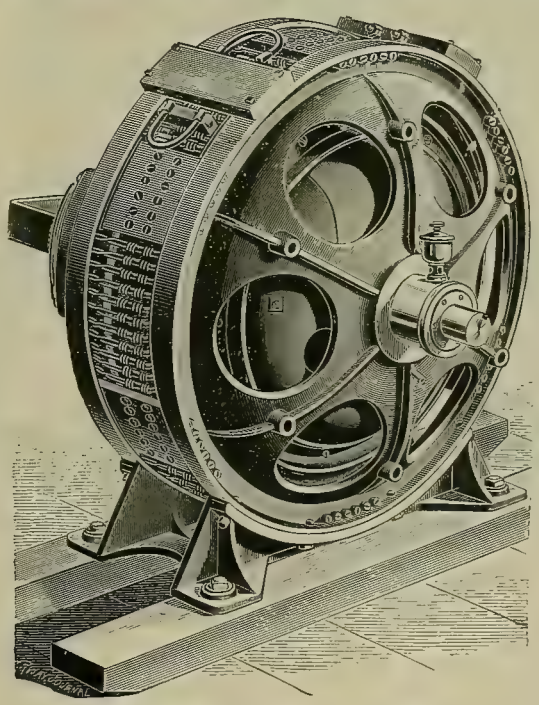
Cars are Lighted by Batteries That Propel The Motor.

METHOD OF CHANGING BATTERIES IN THE RIVER AND RAIL SYSTEM.

THE MAIN
Electric Motor

Owned by this Company differs both in appearance and principle from those of the common type, much as the turbine water-wheel does from others.

The lines of force take the form of a vortex or whirlpool. No wire is in motion, and the moving part is in the form of a smooth disk. A larger output of power in proportion to weight with fewer revolutions per minute, is the result of this construction.



THE RIVER AND RAIL MOTOR.

THE MAIN
Storage Battery

Has no applied oxides or compounds of lead, either as paste or powder. The positive electrode is formed by the action of the current alone. The Mechanical Construction is such as to secure unusual durability with a capacity several times that of the old Plante battery, and in excess of any of the usual "grid" batteries.

The negative electrode contains no lead, is lighter than electrodes of spongy lead, and gives higher electromotive force. The battery is adapted to withstand high rates of discharge and rough treatment.

THE CAR MACHINERY

Allows the coupling of both axles to a single motor, without the hard running action heretofore the result of this construction. It enables a motor of moderate weight to start and handle a car, under severe conditions of grade and curve, without wasteful or dangerous demand upon the batteries.

It allows the motor to revolve under its most favorable conditions, while the speed of the car and power consumed may vary widely.

This is done without electric resistance or shifting battery connections.

It does NOT belong to the numerous family of "car starters." The mechanism is quiet in action and durable.

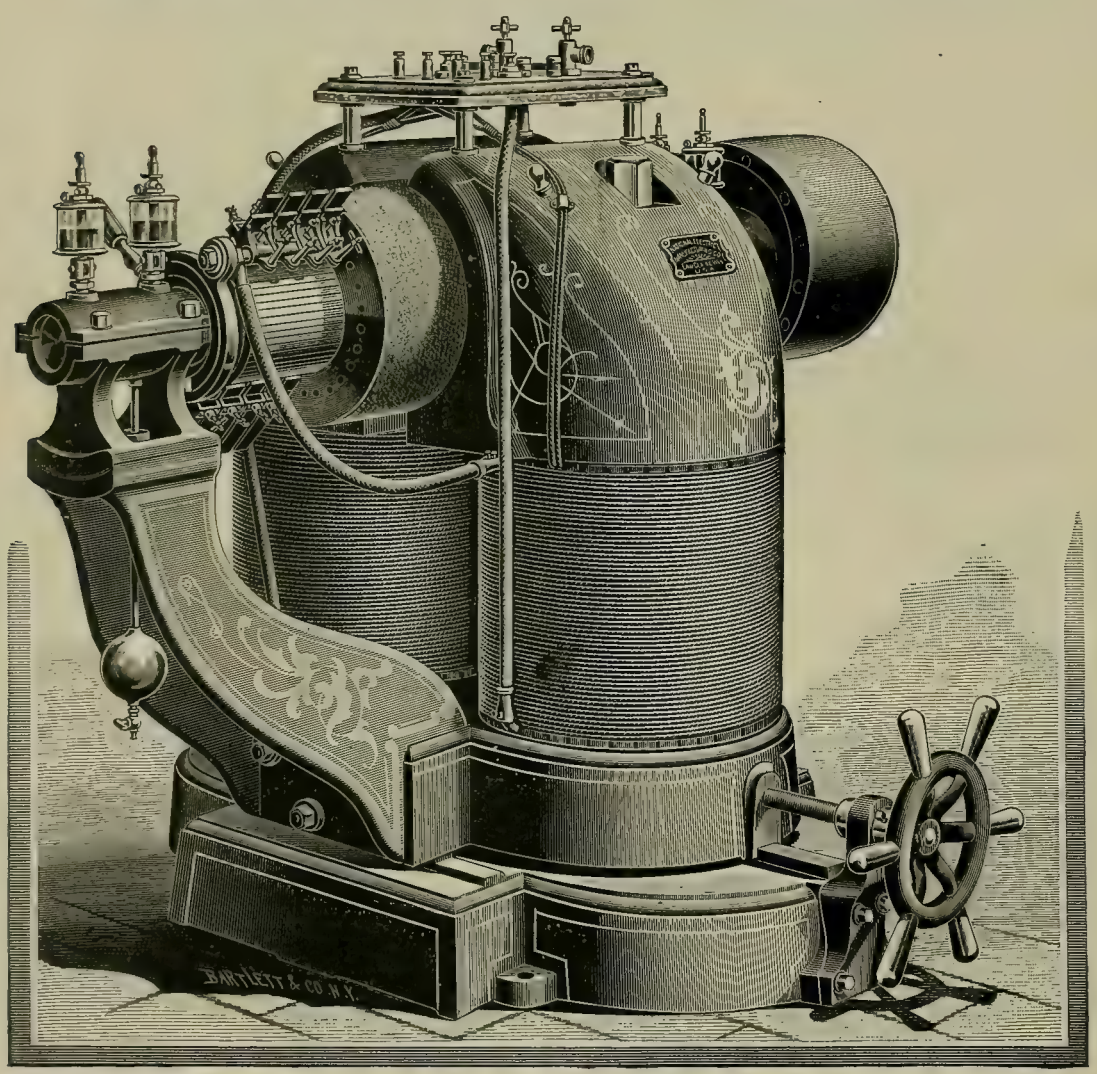
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMO ,CAPACITY 500 16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building, St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

116 & 118 FRANKLIN STREET, CHICAGO.

ELECTRIC RAILWAY SUPPLIES.

BARE TROLLEY WIRE,

INSULATED FEEDER WIRE,

JORDAN'S TROLLEY WIRE INSULATOR AND SUPPORTER.

Absolutely Safe and Reliable. No Soldering.

Connected by Private Wire with Postal-Telegraph Cable Co.

OKONITE TRADE MARK.

General Western Agents for **Okonite AND Candee Wire.**

The Central Spark Arrester.

This device prevents the dropping of sparks from arc lamps. It also keeps flies and other insects from getting into the globe.

THE HOT WIRE

LIGHTNING ARRESTER.

No Magnet or Self-Induction.
Furnishes Absolute Protection,
And is Automatic in its Action.

Our Price on these Instruments is very Low.

THE PERRY WIRE PEELER.

This handy little tool is becoming very popular with bell hangers and incandescent wire men.

WE ALSO CARRY A FULL LINE OF

K. W. Porcelain Cut-outs,
Stoddard Porcelain Cut-outs,
Cleveland Switches, Paiste Switches,
Branch Blocks,
And all kinds of Electrical Supplies.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., TRADE A.B.C. MARK NEW YORK.

LINEMEN'S TOOLS, TELEGRAPH INSTRUMENTS,

ALL KINDS OF BATTERIES

INCANDESCENT LAMPS TO FIT ANY SOCKET.

CENTRAL STATION SUPPLIES.

VOLTMETERS.

AMMETERS.

MEASURING · AND · TESTING INSTRUMENTS.

WIRE, FLEXIBLE CORD, TAPE.

SAWYER-MAN LAMPS,

Any Candle Power,

To Fit Any Socket.

NEW SERIES LAMP AND SOCKET FOR

ARC CIRCUITS.

SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.

THE UNITED STATES
Electric Lighting Co.,

(The Westinghouse Electric Co., Lessees.)

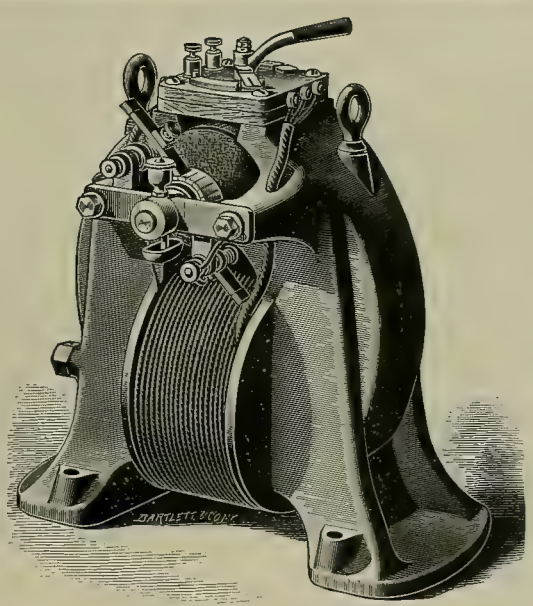
ARC AND INCANDESCENT ISOLATED
Electric Light Plants.

AUTOMATIC DYNAMOS---PERFECT DEVICES.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC MOTORS AND GENERATORS.

Direct Current
GENERATORS
and
MOTORS
for all purposes
1-8 H. P.
up to any power
required,
and at any
required E. M. F.



NEW U. S. MOTOR.

Superior
in
Design
and
Workmanship
and
unequaled
in
efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

General Offices:

Equitable Building, 120 BROADWAY, NEW YORK.

POSITION WANTED.

Designer Electrical, wants position; rapid and inventive, used to designing and superintending construction of arc, motor and incandescent apparatus right through.

Address "Coulomb,"
Care WESTERN ELECTRICIAN.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed. Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

THE E. S. GREELEY & CO.,

GENERAL ELECTRICAL SUPPLIES,

5 and 7 DEY ST., NEW YORK.

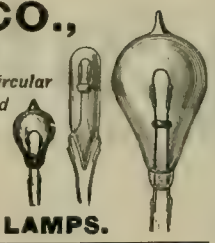
ELECTRICAL MEASUREMENT

Instruments and Batteries of the Very Highest Grade,

Precision and Constancy, Quality and Finish, the Best in the World.

Catalogue of Standard Test Instruments furnished upon application.

Illustrated Circular of Lamps and Lamp Novelties upon Application.



MINIATURE INCANDESCENT LAMPS.

DUST-PROOF BELLS.

None Genuine Without the Washer.

STANLEY & HALL,

(Formerly HAZAZER & STANLEY,)

32 and 34 Frankfort St.,

NEW YORK.

THIS SPACE IS RESERVED FOR

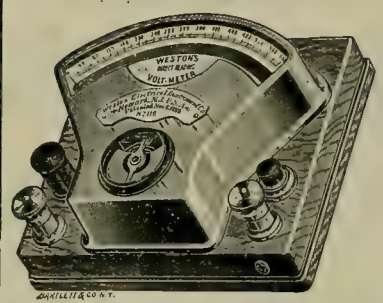
CHAS. A. SCHIEREN & CO.'S

PATENT PERFORATED

Electric Leather Belting.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, Newark, N. J.

"CANVAS JACKET"

LINE WIRE

MOISTURE & FIREPROOF.

ILLINOIS ELECTRIC MATERIAL CO.,

POLES

"BISHOP" RUBBER

CABLES.

COVERED WIRES AND

"The Rookery," CHICAGO, ILL.

THE TUBES OF THE **INTERIOR CONDUIT & INSULATION CO.**

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

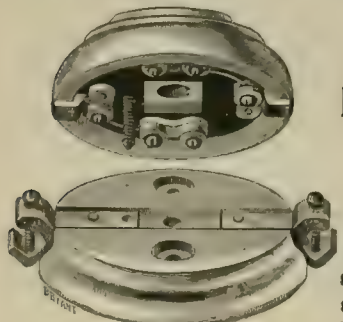
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.



DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.

A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.

Patented.

H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.

Kept in Stock and for Sale by all Prominent Supply Houses.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co

MANUFACTURERS OF

EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

GET THE BEST!

P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, OCTOBER 25, 1890. No. 17

The Electric Fountain in Lincoln Park, Chicago.

To excite public curiosity and attract a crowd nowadays one has merely to use the word "electric" in describing anything to which he wishes to engage public attention. Label an article electric, or even magnetic, place it on exhibition and in five minutes a lot of open-mouthed and inquisitive people will be jostling each other to have a look. Whether it is the lines of force about the magnet which are so attractive or whether the general public, like the small boy, thinks a thing is great until it understands it, is hard to say, but it is certainly a fact that the word electrical is, to the ordinary man, synonymous with "wonderful." There are only a few, however, outside the "electric belt" men, who fully appreciate the money value of the adjective. Prominent among the number who not only possess this knowledge but also have the ability to make capital of it is C. T. Yerkes of the North Side Railway company, Chicago. Not long since the daily papers announced that the generous nature of Mr. Yerkes had prompted him to inaugurate an entertainment for the "dear public," which would not only be highly edifying, but would at the same time have a tendency to turn a tide of superfluous nickels into the till of the North Side street railway. It can be said authoritatively that Mr. Yerkes' generosity has been rewarded. During the last month, three times every week, vast crowds have assembled at Lincoln Park, Chicago, to witness a display, beautiful in itself, but none the less attractive from the fact that few of the spectators had the least idea of the manner in which it was accomplished. It was an "electric fountain"—that was enough. Crowds have assembled night after night and the enterprising daily papers have each announced that its particular representative was the only one allowed the special privilege of an inspection of the operating room beneath the fountain, but as yet few really know anything definite in regard to the apparatus employed or the method of operation.

FIGS. 1 AND 2. ELECTRIC FOUNTAIN IN LINCOLN PARK, CHICAGO.

To relieve the impression that the water was colored like "circus lemonade," and also to give an accurate idea of the mechanical and electrical devices employed, the accompanying views of the fountain, the operating room beneath it, and a description of the apparatus are herewith presented.

Referring to Fig. 1, a good idea of the exterior of the fountain will be obtained. Just beneath the cemented brick spouts or pipes which project upward in the center of the fountain, is a roomy vault or cavern. This vault contains all the electrical apparatus for the fountain proper and eight men employed in operating it. G. P. Green is the electrician in charge of the equipment. The dimensions of the vault are 20x20 and 7 feet high. Fig. 2 is a reproduction from a photograph of this cavern. Fig. 3 is a diagram which will give an idea of the construction of the spouts and their connection with the vault. The simplicity of the outfit will be appreciated.

The fifteen spouts at the center of the pool on the outside are piped and the water connections arranged so that one man in the vault can at will produce various combinations of streams and sprays with but little labor. One 10-inch pipe supplies the fountain with water at 40 lbs. pressure. The average height to which the water is thrown is 70 feet. A stream is thrown 125 feet in certain combinations. Beneath each spout and provided with a parabolic reflector is an 8,000-candle power arc lamp, Fig. 2. The lamps are set with the carbons in a horizontal position and the spouts are closed to the outer air and water by a thick circular glass plate set in the brickwork as indicated in Fig. 3. Just beneath the base of each spout between the parabolic reflectors and the glass windows is a case containing five framed colored glass plates. These plates may be pulled out into a position between the arc lamp and the opening in the spouts. It is in this manner that the light is colored and its tint changed as it is reflected and projected upward to mingle with the streams of water and the spray.

The power plant which drives the dynamos to supply current for the 15 8,000-candle power lamps in the vault, consists of a 100-horse power boiler and a 100-horse power Ideal engine. Two Brush constant current machines, each furnishing a current of 40 amperes and having a maximum output of 400 volts, feed the two circuits running to the fountain. The object of having two separate lines is to decrease the liability of a complete extinguishment of the lights. The conductors are of No. 4 Grimshaw white core wire. These wires run to the fountain in a wooden conduit or trough, laid about 2 feet deep and made simply of 2-inch plank. The space for the 4 wires is 4x4 inches and the conduit is provided with openings 400 feet apart. The distance from the power house to the lamps is about one mile. At the lamps two plug switches are provided, one for each loop in the cavern. The diagram, Fig. 4, shows the disposition of the 15 lamps. The general construction of the lamp and the arrangement of the reflector, etc., is shown quite clearly in Figs. 2 and 3. The lamp proper is focused by hand, the

electro-magnet shown in the cut first forming the arc. An automatic cutout is attached to each lamp to prevent an opening of the circuit should the 5/8-carbons break. It may be mentioned that when the lamps were first set up in the vault the various parts were insulated with fiber. It was soon found, however, that fiber was a very unsatisfactory insulator on account of the great dampness of the cavern. Hard rubber was then substituted and the base of each lampstand was set upon glass plates and insulators as indicated in Fig. 2. This arrangement has thus far proved efficient and the men are now enabled to handle the lamps with impunity. In addition to the eight men already mentioned as being required to work the apparatus at the fountain, five more are employed. Two of the five are stationed at the pump house and three look after the machinery at the power station.

It is estimated that this fountain has attracted as many as 20,000 people on an evening which it had been announced would be the last one during which the exhibition would be given. Mr. Yerkes has presented the fountain to the park and it forms one of its chief attractions.

Electrical Department of the World's Fair.

M. H. DeYoung, the Californian, who has been engaged on the plan of classification of exhibits for the World's Fair, submitted his report to the directors last week. His system after a few changes had been made, was adopted. The electrical exhibit will undoubtedly be located on the Lake Front. It will be known as "Department H, Electricity and Electrical Appliances." Speaking of this department Mr. DeYoung said: "This having been made a department, an opportunity is offered for the erection of a handsome building, which, by the use of cunningly devised lights, will produce from the exterior most startling and beautiful effects. I do not desire to estimate upon the size of this building, as it would depend a great deal upon the extent of the exhibit." Thus far little or nothing has been done toward organizing this important department. Two committees have been appointed—one representing the national commissioners, and the other the directors of the local organization. Speaking of the appointment of the committee representing the national commission the *Evening Post* of Chicago says: "There is a rumor since their appointments were made, however—indeed, something more than a rumor—that a member of the committee is log rolling to have himself appointed the executive head of this important department. This commissioner was appointed on the commitee because he was one of the few national commissioners who knew something about electricity, not because he was an expert equipped for the management of such a department as this is designed to be. 'He is not competent for the place,' said a man well posted on electricity, 'and before he commits himself to an open candidacy he may as well understand that his appointment by the national commission would not be taken kindly by the profession. Unless the superintendent of the department is in full accord with the electricians who will be asked to contribute to the display, he cannot succeed. And one who cannot gain the indorsement of the fraternity cannot expect its support. The commissioner alluded to cannot or could not have such indorsement, and his appointment would mean a total failure of the department," to say nothing of the policy which would apportion among its own members the offices at the gift of the national commission." Nothing was known of the matter at headquarters where it was thought highly improbable that any commissioner would become a candidate for an appointment of this kind."

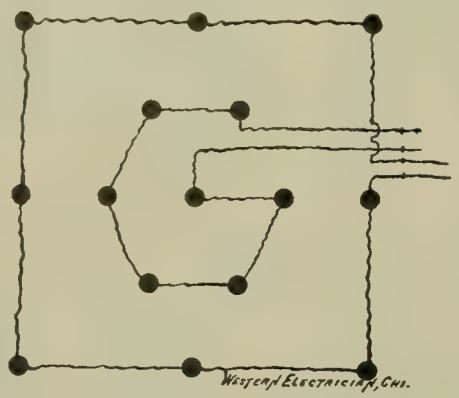


FIG. 4. ELECTRIC FOUNTAIN IN LINCOLN PARK, CHICAGO.

"I believe" said one gentleman, "that the appointment of manager or director of the electrical department will eventually be left with the director general. You see that official will have direct supervision of the heads of these departments, and will be in a great measure responsible for their acts. It would therefore appear quite proper that he should have the selection or at least that his approval of the men selected would be required."

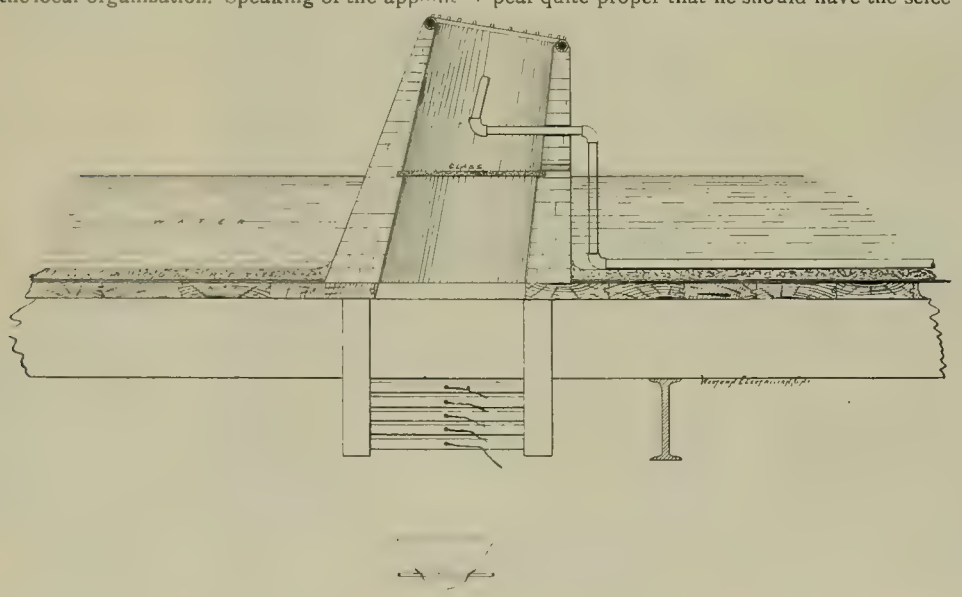


FIG. 3. ELECTRIC FOUNTAIN IN LINCOLN PARK, CHICAGO.

Another Electric Railway Company Organized in Chicago.

The South End Electric Railway company, Chicago, was incorporated last week by F. B. Dyche, C. J. Wood and C. E. Loss. The capital stock is $100,000. The company will construct an electric railway on the South Side, but the route of the proposed line has not been made public. It is quite probable that the proposed road will be in one of the recently annexed suburban districts, and the work done under a franchise obtained before the territory became a part of Chicago.

Edison Arc Lamp.

The accompanying cuts illustrate, partly diagrammatically, a simple form of arc lamp upon which Mr. Edison has recently been allowed a patent.

The lamp was designed with the view of having the regulating mechanism so constructed as to move the carbon positively in both directions, thus preventing the sticking of the carbon-holding rod and making the mechanism independent of the position in which the lamp is placed.

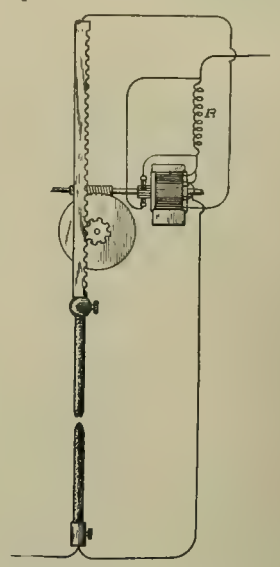


FIG. 1. EDISON ARC LAMP.

The above advantages, the inventor claims, are attained by the employment of a small continuously wound motor of the Pacinotti or Siemens type. The armature of this motor is connected as shown with the holding rod of the upper carbon by a worm gearing. The motor is provided with a compound differential winding of its field magnet or armature, or both, one winding being of low resistance and the other of high resistance. The two windings are connected respectively in series with the arc and in shunt around the same. The winding of lower resistance predominates in effect when the carbons are in contact and causes the motor to turn in the direction to separate the carbons. This motion continues until the effects of the two windings are equal, when the motor stops.

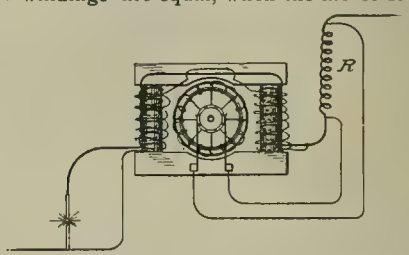


FIG. 2. EDISON ARC LAMP.

The further separation of the carbons causes the winding of higher resistance to exert the greater force and to turn the motor armature in the direction to make the carbons approach. Fig. 2 is a diagram showing the arrangement of the circuits when the field magnets are wound as above described. In the cuts R is a resistance.

A gas journal recently contained the following: "Now that a large portion of Montreal is electrically lighted, it was a problem what to do with the disused gas lamps, which are owned by the city. Some of the aldermen thought it would be a good plan to sell them as old iron, but Alderman Stephens suggested that the lamps might better be put in store, 'so that the city would not be at the mercy of the Electric Light company,' and the alderman carried his point." This is rather a frank admission on the part of the gas men's organ, but truth will out, no matter how unwilling the speaker or writer. The gas journal realizes that the day of gas lamps for street illumination is gone never to return.

Gas Retort and Self-Feeding Smokeless Furnace.

The crusade of the Chicago city health department to reduce the number of smoking chimneys in the Garden city, has been an additional incentive to furnace inventors. A number of devices are now being put in under boilers in the business portion of the city and if the present earnest effort is continued there will be no cause to complain during the World's Fair of Chicago smoke.

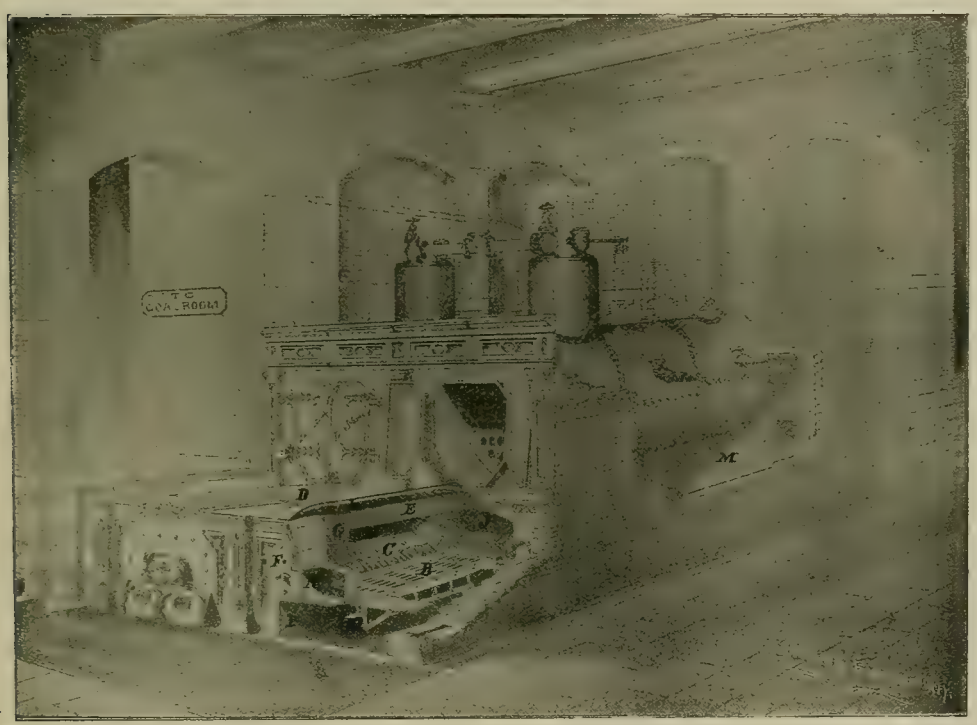
Prominent among the various so-called "smoke consumers" which have been favorably considered is the Ritter furnace. This furnace is claimed to be absolutely smokeless and also an economizer of fuel.

With this type of furnace the boiler is at no time exposed to cold air as there are no doors to be opened to charge the furnaces with fuel, like on the ordinary setting. A glance at the accompanying engraving will enable the reader to understand the construction of the furnace when applied to a horizontal tubular boiler.

It will be noticed that the setting projects out in front of the boiler about five feet. During operation the coal is fed through the pockets and iron work of the furnace. It is claimed by the manufacturers, Ritter & Burke, Chicago, that the circulation is so perfect that the hand may be placed without discomfort on any part of the outside of the furnace. There is no necessity for the use of a forced draft or mechanical device owing to the natural circulation of the gases. *M* represents the fire-bed, which is built about twenty inches from the boiler and carried from the combustion chamber *J* to the rear end of boiler, and forms a flue through which the gases have a clear sweep.

Operating Chicago's Bridges by Motors.

There are sixteen bridges in Chicago's business district between Rush and Twelfth streets. These structures are turned by steam power, but it is proposed to operate them in the future by electric motors, thus doing away with the unsightly structures that now surmount them, getting rid of the smoke and noise and cutting down the staff of engineers and bridge tenders to two, one for day and one for night. This project has been under consideration for some time and will undoubtedly be adopted at an early day.



GAS RETORT AND SELF-FEEDING SMOKELESS FURNACE.

D, on top of the furnace, through the brick arch *E*, falling by its own weight upon the inclined grate *C*. Thence it gradually works its way as required on the center shaking grate *B*. The principle upon which the apparatus is constructed is this: The coal is fed through the pocket *D*, and the escaping gases are mixed with air heated by the masonry and supplied through tubes *F I*. As the gases combine and come in contact with the brick arch *E*, which is heated to a temperature of from 2,500 to 3,000 degrees, they are ignited and pass in a clear flame through the combustion chamber *J*, directly under the boiler. The door *N* in front is used for cleaning purposes only. The radial plate *L* is placed over the arch *E* as a protection for it as well as to be a guide for the fuel to the feed pockets. The heated air from the arch *E*, which would otherwise be radiated into the fire-room, is carried back by a natural circulation due to the intense heat of the furnace, through a small flue at the rear end of the arch. The heated air from the masonry and iron work in front of the furnace, which would otherwise be radiated into the fire-room, is carried back into the furnace through tube *G*. From this it will be seen that there is obtained not only the benefit from all the gases contained in the coal, and also the coke which is on the center grates, but there is also the benefit to the process of combustion from the heated air contained in the masonry

It would of course be necessary to establish a day circuit and install a motor at each bridge, but the saving effected by the displacement of the engineers and firemen at the bridges would pay for the equipment. Power could be obtained from the city electric light stations, all within a short distance of the river.

There are many features of this project which commend themselves to the city authorities. When the plant is established the cost of maintenance will be trifling as compared with the present expensive system. Practical engineers favor the adoption of the plan, and the outlook is favorable to the substitution of electricity for steam.

Chicago City Electric Light System.

Work is progressing on the South Side power house, Chicago, and it is expected that the machinery and electrical equipment for that district will be ready for operation by the middle of December. It has been decided to extend the river service, lighting all the bridges as far south as Thirty-second street. Twenty-second street will be lighted by electricity from the lake to the river, and State street will be lighted from the South Side plant as far as Twenty-second street. The displacement of the gas lamps in the districts to be illuminated by electric lights will enable the city to maintain its lighting system and materially extend it.

Electricity in Shaping Sheet Metal.

Most persons who have witnessed the process of manufacturing sheet metal articles similar to the ones shown in Fig. 1 are familiar with the manner in which a workman forms in a lathe almost any desired shape. The accompanying cut illustrates an application of the electric current in this process. As it is well known that a successful forming of the article depends upon

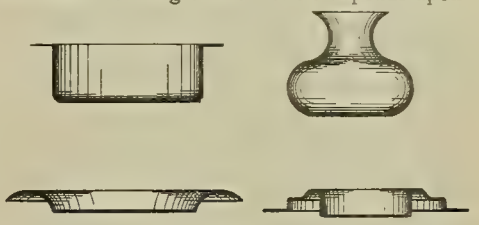


FIG. 1. ELECTRICITY IN SHAPING METALS.

the malleability of the metal, it is the purpose of the method here described to keep the metal annealed during the formation of the article.

Fig. 2 shows the apparatus required to carry out the process. A disk of sheet metal is placed in a lathe as represented. This disk is heated by passing a current of electricity through it from a point near its center, or where the head-stock bears against it, to the point where the burnisher is in contact with it. The current may be circulated through the apparatus from the conductor through the back head, the spindle and head-stock to the disk, through to the point where the burnishing instrument is pressed against it, and through the burnishers back to the source of electricity.

Instead, however, of passing the current through the lathe-spindle, another contact

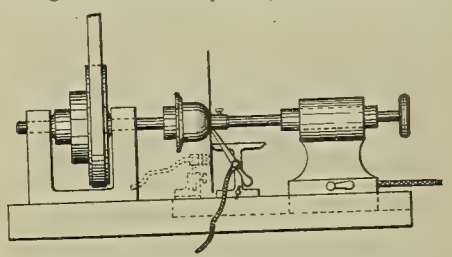


FIG 2. ELECTRICITY IN SHAPING METALS.

attached to conductor may be provided to bear upon the disk. This arrangement is shown in Fig. 2.

W. W. Dewey of Syracuse, N. Y., is the inventor of this process.

Electric Launches.

One of the attractions at the recent exposition at Edinburgh, Scotland, was an electric launch, current for which was furnished by accumulators. In the cut is shown a view of the boat, and the charging station at Edinburgh. Electric launches are growing in popularity on the other side of the ocean, especially in England. Ten charging stations have been located between London and Oxford where cells can be charged any time during the day or night. The launches are in great demand among pleasure

ELECTRIC LAUNCH.

parties on the Thames, and a French exchange urges electric companies to install similar crafts on important rivers on the Continent. It calls attention to the fact that it will not be necessary to construct a great many charging stations, inasmuch as electric light plants in the cities located on the river banks can be called upon for current by the launches.

THE CONVENTION

Of the American Street Railway Association at Buffalo, N. Y.

The ninth annual convention of the American Street Railway association was held Oct. 15, 16 and 17, at the Hotel Iroquois, Buffalo. The meeting in point of attendance as well as in the character of the papers presented, was the most successful in the history of the organization. The fact that the operation of street cars is becoming an electrical industry was abundantly demonstrated. The most interesting discussions in the convention were those which related to electric railways, and the only exhibits of marked interest were those of an electrical character. Among the attendants at the meeting were a large number of those whose faces are familiar at all electrical conventions.

The following is a list of the members and delegates who were present:

MEMBERS AND DELEGATES.

Abbott, G. M., South Covington & Cincinnati Street Railway company.....Covington, Ky.
Allen, William L., president Davenport Central Railway company.....Davenport, Ia
Andrews, Horace, Broadway & Newburg Railway company.....Cleveland, O.
Avery, R., director North & East River Railroad company.....New York, N. Y.
Baber, William D., People's Railway company, ...Pottsville, Pa.
Baker, R. F., secretary and treasurer Columbia Railroad company .....Washington, D. C.
Bailey, D. E., Toledo Consolidated Street Railway company.....Toledo, O.
Bamford, C. Y., treasurer City Railway company, ...Trenton, N. J
Barnes, C. E., superintendent Plymouth & Kingston Street Railway company .....Plymouth, Mass.
Barr, Thomas E., president Newark Passenger Railway company.....Newark, N. J.
Beale, Robert, director Metropolitan Railroad company.....Washington, D. C
Beckley, J. N , vice-president Rochester Railway company.....Rochester, N. Y
Benedict, W. G., president Boston & Revere Electric Railway company.....Boston, Mass
Bliss, E. W., director Brooklyn City Railway company.....Brooklyn, N. Y;
Bliss, E. W., director New Williamsburg & Flatbush Railway company.....Brooklyn, N. Y.
Bradford, H. B., secretary Little Rock & Citizens' Street Railway company .....Little Rock, Ark.
Breed, A. F., president Lynn & Boston Railroad company.....Boston, Mass.
Briggs, J. E., superintendent Citizens' Traction company.....Pittsburg, Pa.
Bronsdon, M. H., superintendent Providence Cable Tramway company.....Providence, R I.
Brown, R. R., director Newburyport & Amesbury Horse Railroad company.....Newburyport, Mass.
Brown, G. G , treasurer Camden Horse Railway company.....Camden, N. J.
Bullock, Geo., South Covington & Cincinnati Street Railway company.....Covington, Ky.
Burgett, H. W., vice president Union Street Railway company.....Dover, N. H.
Calhoun, J. M., superintendent Forty-second Street & Grand Street Ferry Railway company. New York, N Y.
Callahan, Francis J., president Oswego Street Railway company .....Oswego, N. Y.
Carlton, B. E., president Hamilton Street Railway company.....Hamilton, Ont.
Chapman, W. D,, engineer Canton Street Railway company.....Canton, O.
Cleminshaw, Chas., president Troy & Lansingburg Railroad company.....Troy, N. Y.
Collins, J. A , secretary Cincinnati Street Railway company.....Cincinnati, O.
Cook, Fred., director Rochester Railway company, ...Rochester, N. Y.
Cronyn, V., president London Street Railway company.....London, Can.
Cross, William M., president Brockton Street Railway company.....Brockton, Masss.
Davies, F. C., secretary Piqua Street Railway company .....Piqua, O.
Delaney, W. H., president North & East River Railroad company.....New York, N Y.
Dunlap, William, superintendent Washington & Georgetown Railroad company.... Washington, D. C.
Eppley, F. M., president Orange Crosstown & Bloomfield Street Railway company .....Orange, N. J.
Everett, H. A., secretary East Cleveland Railroad company.....Cleveland, O.
Ferguson, William L., superintendent Citizens' Electric Street Railway company.....Decatur, Ill.
Ferguson, W. B., president Merrimac Valley Railway company.....Lawrence, Mass
Foster, E. C., superintendent Lynn & Boston Railroad company .....Boston, Mass.
Gaskill, C. B , president Niagara Falls & Suspension Bridge Railway company.....Niagara Falls, N. Y.
Gaylor, J. M., director Little Rock & Citizens' Street Railway company.....Little Rock, Ark
Gleed, C. S., president Topeka City Railway company.....Topeka Kas.
Goff, Robert E., secretary Globe Street Railway company.....Fall River, Mass.
Goodrich, E. S., president Hartford & Wethersfield Railway company.....Hartford, Conn
Goodwin, N. W., secretary Ft. Wayne & Elmwood Railway company.....Detroit, Mich.
Green, G., president Forty second Street & Grand Street Ferry Railway company .....New York, N. Y.
Green, Chas., president People's Railway company, ...St. Louis, Mo.
Griffith, T. B., secretary and treasurer Hamilton Street Railway company.....Hamilton, Ont.
Griffith, J. B., Hamilton Street Railway company .....Hamilton, Ont.
Gulick, W. S., assistant superintendent Trenton Horse Railroad company.....Trenton, N. J.
Guise, F., treasurer York Street Railway company, ...York, Pa.
Gunn, J., secretary Toronto Street Railway company, ...Toronto, Can.
Hall, Morris W., secretary Camden Horse Railway company.....Camden, N. J.
Harris, John, superintendent Cincinnati Street Railway company.....Cincinnati, O.
Hawver, R. J., superintendent Lafayette Street Railway company .....Lafayette, Ind.
Hasbrouck, D. B., vice president Houston, West Street & Pavonia Ferry Railroad company, ...New York, N. Y.
Heald, E. W., general manager Wilmington City Railway company.....Wilmington, Del.
Hendricks, George B., secretary North Side Railway company .....Ft. Worth, Tex.
Henry, D. F., president Federal Street & Pleasant Valley Passenger Railway company .....Pittsburg, Pa.
Hill, C. B., secretary Niagara Falls & Suspension Bridge Railway company.....Niagara Falls, N. Y.
Hobson, W. J., president Wyatt Park Railway company.....St. Joseph, Mo.
Holmes, J. G., president Citizens' Traction company .....Pittsburg, Pa.
Hornick, C. W., president Riverside Park Railway company.....Sioux City, Ia.
House, William A., Jr., general manager Baltimore Traction company.....Baltimore, Md.
Howe, Frank M., director Lowell Horse Railroad company .....Lowell, Mass
Hughes, A. L, treasurer Ft. Scott Rapid Transit Railway company.....Ft. Scott, Kas.
Hulsizer, John, secretary Joliet Street Railway company.....Joliet, Ill.
Jewett, N. M., director Boston & Revere Electric Railway company.....Boston, Mass.
Johnson, G. E. C., president Lafayette Street Railway company.....Lafayette, Ind.
Johnson, T. H., director Newburyport & Amesbury Horse Railroad company.....Newburyport, Mass.
Johnson, G. B., superintendent Niagara Falls & Suspension Bridge Railway company. Niagara Falls, N. Y.
Johnson, B. H., director Niagara Falls & Suspension Bridge Railway company..... Niagara Falls N. Y.
Jones, B. M., secretary and treasurer Asheville Street Railway company.....Asheville, N. C.
Joslin, H. V. A., secretary Union Railroad company. .....Providence, R. I
Keefer, T. C., president Ottawa City Passenger Railway company.....Ottawa, Can.
Kelker, H. A., president Harrisburg City Passenger Railway company .....Harrisburg, Pa.
Kelsey, I. A., president New Haven & West Avenue Horse Railway company. .....West Haven, Conn.
Kerr, J. K., Newburyport & Amesbury Horse Railroad company.....Newburyport, Mass.
Kiely, G. W , managing director Toronto Street Railway company.....Toronto, Can.
Kinney, H. R., secretary Alton Improvement association.....Alton, Ill.
Knight, P. S., president Capital City Railway company.....Salem, Oregon.
Knowles, George H , president Nashua Street Railway company.....Nashua, N. H.
Lanius, W. H., president York Street Railway company.....York, Pa.
Lang, A. E., president Toledo Consolidated Street Railway company.....Toledo, O.
Laredon, W. S., superintendent Atlanta Street Railway company.....Atlanta, Ga.
Lasher, B F., superintendent Bridgeport Horse Railway company.....Bridgeport, Conn.
Lewis, D. F., president Brooklyn City Railway company.....Brooklyn, N. Y.
Lewis, Dr F., president New Williamsburg & Flatbush Railway company.....Brooklyn, N. Y.
Littell, H. M., president Cincinnati Inclined Plane Railway company.....Cincinnati, O
Littell, H. H., general manager Louisville Railway company .....Louisville, Ky
Littlefield, E. H., superintendent Topeka City Railway company.....Topeka, Kas.
Loftus, M., superintendent Citizens' Railway company .....Wheeling, W. Va.
Lowry, Thomas, president Minneapolis Street Railway company.....Minneapolis, Minn.
Luetchford, A., treasurer Rochester Railway company.....Rochester, N. Y
Martin, Henry, president Mt. Auburn Cable Railway company.....Cincinnati, O.
McCarty, R J., general manager Metropolitan Street Railway company.....Kansas City, Mo.
McCulloch, R., general manager St. Louis Railway company.....St. Louis, Mo.
McKee, S., director Rochester Railway company, ...Rochester, N. Y.
McLean, T. H., secretary Twenty-third Street Railway company.....New York, N. Y.
Mevot, A., director Niagara Falls & Suspension Bridge Railway company.....Niagara Falls, N Y.
Miller, J. A , president Citizens' Railway company. .....Wheeling W. Va.
Monks, F. H., general manager West End Street Railway company.....Boston, Mass.
Morse, George C , superintendent Taunton Street Railway company.....Taunton, Mass.
Munningham, John, director Merrimac Valley Railway company .....Lawrence, Mass.
Murphy, E. B., president Lombard & South Street Passenger Railway company. .....Philadelphia, Pa.
Noyes, E. J , superintendent Lowell Horse Railroad company.....Lowell, Mass.
Odell, C., president Newburyport & Amesbury Horse Railroad company.....Newburyport, Mass.
Owen, B. F., president Reading City Passenger Railway company.....Reading, Pa.
Parsons, Henry, engineer City & Suburban Railway company.....Savannah, Ga.
Parsons, George, director City & Suburban Railway company.....Savannah, Ga.
Pfetch, J. F., general manager Erie Passenger Railway company.....Erie, Pa.
Pfingst, Louis, master mechanic West End Street Railway company.....Boston, Mass.
Pearson, George W., president Metropolitan Railroad company.....Washington, D. C.
Peavey, J. F., president Sioux City Street Railway company.....Sioux City, Ia.
Pennington, T. C., treasurer Chicago City Railway company.....Chicago, Ill.
Perrine, L., Jr., president Trenton Horse Railroad company. .....Trenton, N J.
Pratt, C. B., president Worcester Consolidated Railway company.....Worcester, Mass.
Porter, A. J., director Niagara Falls & Suspension Bridge Railway company.....Niagara Falls, N. Y.
Potter, A. T., general manager Union Railroad company.....Providence, R. I.
Ramsey, W. M., electric superintendent Federal Street & Pleasant Valley Passenger Railway company .....Pittsburg, Pa.
Reardon, Edmond, vice-president West End Street Railway company.....Boston, Mass.
Reed, Walter P., superintendent Salt Lake City Railroad company.....Salt Lake City, Utah.
Richardson, William, president Atlantic Avenue Railway company.....Brooklyn, N. Y.
Richardson, W. J., secretary Atlantic Avenue Railway company.....Brooklyn, N. Y.
Richardson, William, director Dry Dock, East Broadway & Battery Railway company.....New York, N. Y.
Rippetoe, R. W , president Terre Haute Street Railway company .....Terre Haute, Ind.
Roberts, A., secretary Harrisburg City Passenger Railway company.....Harrisburg, Pa.
Rogers, H. B , general manager Brockton Street Railway company.....Brockton, Mass,
Rude, C., superintendent Sandusky Street Railway company.....Sandusky, O.
Rupp, D. A., stockholder York Street Railway company.....York, Pa.
Sage, H. A., president Easton, South Easton & West End Railway company.....Easton, Pa.
Sailor, C. C., Washington & Georgetown Railroad company .....Washington, D. C.
Scull, William S., president Camden Horse Railway company.....Camden, N. J.
Seeley, H. S., secretary Worcester Consolidated Railway company.....Worcester, Mass.
Seiberling, F. A., treasurer Canton Street Railway company .....Canton, O.
Semmes, R., of the Citizens' Street Railway company. .....Memphis, Tenn
Shaffer, William H., general manager Richmond City Street Railway company .....Richmond, Ind.
Shaffer, J. C., president Citizens' Street Railway company.....Indianapolis, Ind.
Shipley, G. F., solicitor Toronto Street Railway company.....Toronto, Can.
Smallman, T. H., director London Street Railway company.....London, Can.
Smith, Chas., superintendent Findlay Street Railway company.....Findlay, O.
Smith, A. E., treasurer Springfield Street Railway company.....Springfield, Mass.
Smith, Chas. H., superintendent Troy & Lansingburg Railroad company.....Troy, N. Y.
Smith, W. A., general manager Omaha Street Railway company.....Omaha, Neb.
Spaulding, S. S., president Buffalo East Side Street Railway company.....Buffalo, N. Y.
Stanley, J. J., Broadway & Newburg Railway company.....Cleveland, O.
Stephenson, W J., president Columbia Railroad company .....Washington, D. C.
Stevens, S. A., secretary New Haven & West Avenue Horse Railway company ..West Haven, Conn.
Thomas, Leslie D., secretary Terre Haute Street Railway company .....Terre Haute, Ind.
Thomas, Jos., director Mt. Adams Inclined Plane Railway company.....Cincinnati, O.
Trimmer, D. K., secretary York Street Railway company.....York, Pa.
Tucker, E. M., president Lowell Horse Railroad company.....Lowell, Mass.
Valentine, J. N., secretary Central Park, North & East River Railroad company.....New York, N. Y.
Verner, M. A., general manager Rochester Railway company.....Rochester, N. Y.
Vhay, Jas. H., secretary Ft. Wayne & Elmwood Railway company.....Detroit, Mich.
Walker, N. H., superintendent Manchester Street Railway company.....Manchester, N. H.
Watson, H. M., treasurer Buffalo East Side Street Railway company.....Buffalo, N. Y.
Watson, H. M., president Buffalo Street Railway company.....Buffalo, N. Y.
Wason, Chas. W., president East Cleveland Railroad company.....Cleveland, O.

Williams, C., president Manchester Street Railway company.....Manchester, N. H.
Williams, Chas., director Nashua Street Railway company.....Nashua, N. H.
Windsor, H. H., secretary Chicago City Railway company.....Chicago, Ill.
Wolley, E. L., superintendent Lincoln Street Railway company.....Lincoln, Neb.
Wood, H. Holton, president Derby Horse Railway company.....Birmingham, Conn.
Woodward, H R., vice-president and general manager of the Central Railway company .....Peoria, Ill.
Worthington, A. L., director City Railway company, ...Trenton, N. J.
Wyman, C. Densmore, vice-president Central Park, North & East River Railroad company. New York, N. Y.
Yates, A. G., president Rochester Railway company, ...Rochester, N. Y.

The President's Address.

After calling the convention to order President Thomas Lowry of Minneapolis delivered the following address:

I am pleased to meet you in this beautiful city of Buffalo, assembled in the ninth annual convention of the American Street Railway association.

I congratulate you upon the progress made and past good work of the association. When organized in 1882, in the city of Boston, street railroading was in its infancy, but such rapid advancement has since been made in city passenger traffic that the United States government has deemed it of sufficient importance to incorporate in its census statistics for 1890, a report on street railways in cities of over 50,000 inhabitants. In this report fifty-six cities are included, and out of a total of 3,150 miles of track in these cities, 2 351 miles are operated by horses, 260 miles by electricity, 255 miles by cable, 221 miles by steam, and the balance, about 60 miles, being elevated roads in New York and Brooklyn. This report would seem to indicate that in the larger cities the faithful old horse is still the favorite propelling power for street cars.

The first special subject on which we are to receive a report from a committee appointed at the last convention, is "A Perfect Street Railway Horse." From this we must assume that the association has not yet discarded the idea that the horse is the most reliable power for street cars.

In the smaller cities electricity is generally being adopted, and I am informed that there are already in operation in cities and towns outside of those enumerated in the census report, about 1,600 miles of electric street railways. I am so thoroughly convinced that electricity is the coming power for street railways (except on heavy grades where the cable is best suited) and that it will prove so effective, as a means of rapid transit for cities, that I believe this is the last convention that will ever seriously consider horses for the operation of street railways.

Rapid transit in growing cities is becoming a necessity. While municipal corporations in the larger cities, for many reasons, are slow to grant new privileges to corporations and in the case of electricity they are very closely scanned and criticised, it will soon become self-evident that a municipal body can grant no greater boon to its middle and laboring classes than to provide them with the means of rapid and cheap transportation to and from homes in the suburbs, where they can live under a clear sky and in a health-giving atmosphere, When the people of a city understand clearly the great benefits of rapid transit, by electricity or other improved motive power over horses, they will demand that their city authorities grant such rights as will enable street railway companies to operate by the most improved methods.

Heretofore street railway securities have not been looked upon by the financial world with favor. However, since they have been so successfully operated by electricity the financial men of the country are looking to its development and application to street railways as an additional reliable security for the investment of savings and trust funds. This should give encouragement to street railway companies to give their various cities the most improved and best possible service. They will not only please their patrons but the investment will prove very profitable. If street railway companies do this, no better security can be offered for the savings of the widow and orphan than a good street railway bond in a thriving city.

In order to bring this about municipal corporations should grant liberal franchises for street railway improvement. The bond of the street railway company should be as good as the bond of the city in which it is located. The growth of the city is, to a large extent, dependent on street railway extension, and the prosperity of the street railway company means the prosperity of the city in which it is located. It is one of the largest factors in the development of any city, and as necessary as are its schools and its churches.

On the other hand the street railway company should be required to equip its road with the finest and most modern cars, construct the best and most substantial tracks so as to inconvenience the public as little as possible in making repairs, and in short supply the road in every department with the best and most modern appliances of all kinds.

In view of the agitation of the labor question, it may not be out of place for me to say a word on that subject. In so doing it will only be the expression of an individual opinion, not intended to bind the convention to the views expressed. When organizations are formed by laborers and others for the purpose of building up and dignifying its members as men and women, or to improve their moral, physical or financial condition, no one would foster or favor them more than he who now addresses you. Unfortunately, however, most of the present so called labor organizations are the worst delusion and snare into which a laboring man was ever entrapped. The recent "strike" on the New York Central road developed a state of cruelty, depravity and wrong that should make it the absolute duty of every corporation having public interests to subserve and charged with providing for the comfort, convenience, business necessities, and above all the life and property of its patrons, to refuse to employ or to retain in its employ any one who does not renounce his connection with the Knights of Labor or any other labor organization, the rules of which permit employes of a corporation to be "ordered to strike." Men have a right to quit work with such notice as the contract with their employer requires, either singly or in a body. if the terms of their employment are not satisfactory; but they have not the right to interfere with those emp'oyed to fill their places. The first duty of a lawyer is to his client, of a doctor to his patient, a minister to his congregation, and a teacher to his pupil The engineer, the conductor, the switchman have even a greater responsibility, as the lives of the passengers are in their keeping, and in order to properly discharge it they must be loyal to their employers. They cannot be plotting and laying out rules for their employer and be faithful in the discharge of their duty. "The laborer is worthy of his hire" but when he seeks to change the relation between himself and his employer, by asserting himself as master, he ceases to be the laborer that is "worthy of his hire." He also unfits himself for any kind of advancement. A man, to be successful and take advantage of promotion earned by efficiency, must be contented and perform his work cheerfully. A "labor agitator" cannot be contented or work in the interest of his employer. A few days ago United States Commissioner Rogers rendered a decision at Baltimore, in a case where four sailors were arrested for refusing to go aboard a schooner after they had signed articles to do so. The Knights of Labor interfered and undertook to defend the prisoners. I cannot express my views better on the question than to quote from the decision of Commissioner Rogers, who said:

"I perceive you are men of intelligence, and no doubt know and appreciate the advantages of union. Every man has a perfect right to unite with his fellow man to better his condition in life. There is one great mistake made, however, and that is the constant conflict of labor and capital. Now, I can't see why such a state of affairs should exist, because labor is in itself capital, and capital merely represents labor. A capitalist you will find is a man of strictly sober habits. He has to keep a clear head, and the man who to-day earns a dollar and to-morrow morning wakes up with 75 cents in his pocket is the man who may become a capitalist. No doubt your union is a good thing—the land we live in is a union. But now let me impress upon your minds that, while you have a perfect right to form a union, you have no right to interfere with the manner in which another man conducts his business. When a union attempts to interfere with or molest a free-born American, or tries to prevent his earning a living simply beoause he does not join that union, it then becomes a conspiracy, and amenable under the law, and punishable by the court. The great trouble with the unions is that they overstep their bounds and endeavor to force people to do as they direct, and that is an act in direct violation of the laws which grant an American citizen his liberty. In these days of enlightenment and freedom the press—the most powerful agent of the people—is ever ready to air the grievances of any one who is oppressed or molested. Nothing, from the great acts of a government to the death of a pauper, escapes the eagle eye of the press. Tyrants fear the press more than any other power which can be brought to bear against them, and the press of America, as it is to-day, edited by men of the greatest ability and highest order of enlightenment, is the bulwark of the country. Now, in conclusion, let me say to you that the man who endeavors to persuade you to fight against capital, except in a legal manner, is no friend."

I thank you for your attention, and I hope your deliberations will be characterized by the good judgment and discretion you have always heretofore exhibited.

Treasurer's Report.

The treasurer's report was read and showed the financial transactions during the year to be as follows:

Receipts	$7,165.91
Expenses	5,389.96
Balance on hand	$1,775.95

Executive Committee's Report.

The following is an extract from the report of the executive committee:

"The subject, 'Electric Motive Power Technically Considered' was selected for the purpose of having the cobwebs, which were for the most part confessedly before our mind's eye, brushed away from this occult science, in order that it might be as plainly comprehensible to the ordinary street railway man as to the expert who manipulates the wires. The necessity for this knowledge is becoming greater as the days go by, for the transition of roads from horse to electric power is of almost daily occurrence, so rapid is the progress made by electricity as a motive power. In this connection we take occasion to say that the information which it is hoped will be freely given at this meeting concerning the cost of operation by electricity will doubtless still more rapidly hasten the emancipation of the horse from his bondage."

Dr. W. L. Allen presented the following paper as the report of the committee on electric motive power technically considered:

Electric Motive Power Technically Considered.

BY W. L. ALLEN.

To go over the entire subject of electricity for street railways, and consider all the technical details, would occupy too much of your time. The subject naturally divides itself into

(1) The Central Station.
(2) The Transmitting Line.
(3) The Motors.

The National Electric light association has so fully and exhaustively considered the matter of power or central stations, that, most fortunately for street railway men, this subject is one that troubles us but little; but there are some points in which our work differs materially from that of an electric lighting station.

The engine we require must be strong in all its parts for there is no work where the demands on it vary so suddenly and so frequently, from the entire absence of load to the extreme capacity of the engine, as in street railway work. Some roads report that the cars average but five-horse power each; supposing that such a road has eight cars in operation with one 150-horse power engine in the station, and, as is often the case, the cars either become bunched or happen to start at the same instant; here a sudden demand is made upon the engine for 150 or 200 horse power, while a moment later the meter may register but 40-horse power. You will, of course, be provided with safety plugs and current breakers, but you cannot allow safety strips to be blown out half a dozen times a day, possibly just at the moment you are ascending a heavy grade.

Electric light men state that a station with a number of small high-speed engines is more economical on account of being more flexible in its operation, but in their business the loads upon the station vary gradually, while we may be called upon at any moment for our maximum capacity. To arrange our station for this varying load, and at the same time avoid operating a tremendous engine on an average light load, is a problem that experience must solve for us. We are also more greatly troubled with lightning than we should be. There should first of all be established as perfect a ground connection as possible, either by means of a well or a deep hole; it is better to have two grounds, and thereby make sure of a moist contact for galvanized ground-plates or rods; then with proper lightning arresters so placed that they can be conveniently examined and kept in order, we will be fairly well protected; but with our great lengths of exposed trolley wires we are very certain to have frequent calls upon our lightning arresters, and those in use at the present time are not such as to warrant perfect confidence.

Are we not all personally firm believers in the overhead system of transmission? What can there be simpler, cheaper, more durable and more convenient? We have only poles, bare copper wire, galvanized iron span wire, insulators and, where needed, additional feed wires, of which these last can be placed under ground if desired. It is a rare thing to have a trolley wire break except at the curves. Curves are certainly troublesome on account of the constant liability of trolleys to jump off at some sharp angle; and the trouble is more generally due to faulty trolley stands, wheels or springs than to the overhead wire. For insulators we have only those for the straight line and those for the curves; and I show you a sample of each, such as were used two and a half years ago on one of our lines. It is not to be wondered at that street railway men at that time considered electricity, for the rough usage required by street railway work, to be in an embryonic stage of development. There is little to be asked for in the way of improvement of what we now have for overhead material. There is practically no difference whether we use the Thomson-Houston system, Sprague-Edison, Westinghouse or what not. A single trolley wire which may be large and heavy, say 00, and thus avoid feed wires where distance for transmission is not too great, or the wire may be small, say number 4, light and easy to handle with, in that case, the necessary feed wires. We can take our choice and find equally good results with either. It will often be convenient to utilize both plans, with the large trolley in the central parts of the city where feed wires might not be desirable, and with the small overhead and feed wires to reinforce the suburban parts. Undoubtedly the small wire is more easily handled and repaired in case of a break, and the feed wire prevents a dead line being the result of a break. The rail bonds may be galvanized iron, which cost but four cents, instead of tinned copper, and the supplemental ground wires can be of the same material. The supplemental wires do not give any better return except so far as to prevent a bad break in the return circuit, which might occasionally be caused by the breaking of both rail bonds at neighboring joints. Rails on both sides of track should be connected with bonds.

It will not be necessary to discuss the merits of the conduit system or the storage battery. Actual experience has proven that there need be so little trouble or danger from the station and overhead line that we cannot concede the need of either conduit or storage battery, so far as *we* are concerned. It is true that the ever-restless mind of the public has been so stirred up by accounts of the numerous successful storage-battery and conduit railways, that it has suddenly (and to us most unpleasantly) become aware of the fact that we are using *poles*, and while are congratulating ourselves upon the beauty and symmetry of our neat line of poles, it suddenly demands that we remove what it terms our unsightly poles. Nearly every one of the street railway men present will uphold the statement that the only problem before us, and the one about which we are always anxious, is, "What can we do to keep our motors out of the repair shop?" We don't worry about our station or our overhead wires; we scarcely have time to think of them; we are constantly at work upon and perpetually annoyed by our motors, a lame armature, a burnt field magnet, a broken gear—these are our everyday trials. A motor, such as is made by the Thomson-Houston, Sprague-Edison, or Westinghouse companies has among its mechanical parts an axle-gear and intermediate shaft gear, shaft pinion and armature pinion, and the axle and intermediate shaft and armature have each their boxes or bearings. We want gear and pinions to be wide and heavy enough not to break. We don't want any more pinions like this, which was in use two years ago. We want gear of some material that will be reasonably durable, and at the same time noiseless; cast iron may do for the axle gear, which is large and runs slower, and steel for the intermediate shaft pinion; steel, we believe, is better than bronze, as it lasts longer and is less expensive. To overcome the noise it is necessary either to have the gear covered and running in oil, or to have the gear of wood or the

pinion of raw hide. The large gear on the axle and intermediate shaft, if made with wooden teeth and used with steel pinions, certainly runs noiselessly, and it ought to make the life of the pinions much longer. Care must be taken to have the keys, in all the gear pinions, tight and self-retaining. The shaft boxes and bearings must be made of some compound metal that will not wear out too fast, for but little wear on the armature bearing will allow the armature to scrape on the pole pieces of motor, be damaged and laid up for repairs. Aluminum bronze gives satisfaction as a material for the bearings.

The electrical parts of the motor in which we are most interested are the armature, field magnets, and the controlling switch or rheostat. The armature of an electric motor is its most wonderful and interesting, as well as its most expensive and troublesome part. A street car is the most overloaded vehicle known to mankind. It may run a week with a light load and then suddenly receive enough passengers to load fairly well three or four ordinary cars; the motorneer may forget to oil either the car or motor, he may reverse motor accidentally or purposely to avoid an accident; these and many other causes require of an armature more work than it is capable of, hence a burn-out. On the other hand, the armature itself may be at fault; an armature such as we use to-day consists of a shaft surrounded by a metallic core. Around this core is wound the best insulated wire, each coil terminating at the same end of the armature and being attached there by means of solder or screws to the bars of commutator. The shaft of the armature will in a few years become worn by its bearings, and it would be well to have bushings or sleeves placed around shaft at those points, such as the Thomson-Houston company use, which sleeves can be removed. As there is no wear to the core, and as the commutator can be renewed when worn down, which ought not to occur in less than two or three years, an armature should then have as long a life as one could desire, were it not for the coils of wire. Where these coils cross around the head of the armature they chafe on each other and destroy their insulation. Where they end at the commutator they loosen; by an excessive load or careless driver they burn out. It may be possible to repair the armature by rewinding one coil or by refastening the loose ends, and even when a deep coil is burnt the total rewinding with new wire should not cost but forty or fifty dollars. Could we but prepare for the burn-outs by having the car on some side track near the repair shop where it would not inferfere with our running time or cause a hindering of cars, we would not feel so aggravated, but it happens invariably at the time we need the cars so urgently. We can watch our gear and bearings, and when worn they may be replaced at our convenience or at night, but an armature gives out without warning. It is on this account that those systems advocating but one motor to a car, must give us positive assurance of *no burn-outs*, for were it not for the double motor now so generally in use we would see crippled cars being *towed* into the shop greatly to our discomfiture. In the matter of minor details such as cables, terminals, trolleys and gearing, the electric manufacturers have made the greatest improvements during the past eighteen months, but so far as we can obtain information based on actual facts, there has been but little improvement in the armatures. The Edison company has recently announced a new armature, but we have been unable to learn what results it may show.

The switch-box, such as used by the Sprague-Edison and Westinghouse, is an apparatus, that, if given proper care, so as to keep the brass plates and buttons smooth, ought not to cause much trouble. It is arranged so as to distribute the current through different parts of the magnets or the motor according to the degree of speed or work required. It is somewhat in the way of passengers when the platform is overcrowded. The rheostat used by the Thomson-Houston company is out of the way, being underneath the platform, although it is burnt out occasionally and damaged by rain leaking through the platform; these defects should be easily overcome. It is claimed that owing to the use of the rheostat of the Thomson-Houston company and the resistance coils as used by the Westinghouse company, that the cars start more easily and without jerking, and that the motor is less liable to burn out, as they avoid throwing in an excess of current. The first claim is true, but we cannot find evidence to support the latter claim. On the other hand, it has been claimed that motors using a rheostat require on an average run from 15 to 20 per cent. more power than the Sprague-Edison motor. It does not necessarily follow that this is due to the rheostat; it seems likely that it is due as much to a difference in the winding of armature or fields. It would be most desirable, therefore, to ascertain from our various members the actual number of burn outs of fields and armatures, of both varieties of motors, and at the same time the average power used per car. This cannot be obtained by writing for reports, as many roads do not keep an exact record, or will not report the same. The grades of roads must be considered, the car mileage, and loads carried, also the system or manner with which motors are repaired and cared for.

This is a matter of the greatest importance. Our fuel costs about $1 per car per diem, and our repairs over $1.50 per car per diem. If we can save 10 per cent. on fuel each day by giving up the rheostat we do not want to do it at the expense of adding 25 per cent. to our repair account which, we all know, is too large already. As an example of the approximate cost of repairs I give the cost of four 30-horse power Sprague cars for the six months ending Oct. 1, 1890, each car making ninety miles a day, a grade 1,900 feet of 9 to 9¾ per cent., one 300 feet of 5 per cent., one 300 feet of 8 per cent.

MECHANICAL.

3	Bronze intermediate pinions, at $14	$42 00
3	Steel " " at $9	27 00
8	Steel armature " at $7	56 00
4	Intermediate Gear, at $11	44 00
2	Main Gear (cast), at $16	32 00
6	Axle, brasses, at $4.50	27 00
8	Shaft Bearings, at $4.50	36 00
12	Armature Bearings, at $2.75	32 00
	Total	$296 00

ELECTRICAL.

180	Carbon Brushes, at 10 cents	$18 00
6	Trolley Wheels, at $1.25	7 50
3	Field Magnets, at $20	60 00
6	Armatures repaired, at $35 00	210 00
		$295 50

For Labor:

2	Motor repair men, at $50 per month	600 00
	Total	$1,191 50

Average per diem, per car, $1.62

There are other minor repairs that would increase this about 20 cents a day.

The fuel is sawdust and slabs, at $1.30. This fuel is about equal to screening or slack at $1.50 a ton. A greater number of cars would reduce this fuel account per car. During the six months the expense on the overhead line was less than $25 on five miles of line.

We have learned of an eight-car road running at $1 per car for fuel, another six-car road at 90 cents per diem per car. We do not believe in any case that the fuel will equal the cost of motor repairs. The first year of operation must not be taken as a fair estimate. The prices for gear and bearings will vary considerably from those given above. Some axle brasses cost $9, while those above are given at $4.50. Aluminum or some such compound may be mixed and used to decrease the cost and increase the durability of bearings. It was sold a few years ago at $3 and upward per pound, now at $1, and it is stated can be produced for 20 cents per pound.

In the matter of gear the Westinghouse company has so boxed the same that it can run in oil and grease; this must undoubtedly add much to the life of the gear and pinion, and at the same time practically deaden the noise. Whether this boxing will stand the wear and jar, time will best demonstrate.

The following report of a road operating Thomson-Houston motors is most valuable in showing the proportion of cars disabled from electrical and mechanical causes. During fourteen consecutive days in July, 1890:

Equipped.	Operated.	Disabled. Electrically.	Disabled. Mechanically.
286	150 to 200	0	15
286	150 to 200	0	12
286	150 to 200	2	12
286	150 to 200	5	8
286	150 to 200	0	11
286	150 to 200	3	11
286	150 to 200	3	9
286	150 to 200	1	10
286	150 to 200	5	7
286	150 to 200	2	11
286	150 to 200	2	15
286	150 to 200	2	13
286	150 to 200	1	12
286	150 to 200	0	12
		26	158

In seven consecutive days in August:

Equipped.	Operated.	Electrically.	Mechanically.
308	150	3	10
308	150	5	11
308	150	0	9
308	150	4	7
308	150	0	5
308	150	4	5
308	150	1	8
		17	55

During seven consecutive days in September:

Equipped.	Operated.	Electrically.	Mechanically.
312	150	2	3
312	150	5	3
312	150	3	2
312	150	3	3
312	150	0	5
312	150	1	4
312	150	1	4
		15	24

From this it appears that in July about 1 per cent. of cars operated were disabled each day from electrical causes, and about 6 per cent. from mechanical causes, and this during a period of extraordinary heavy business.

During the August period the electrical trouble appears to have increased slightly in excess of 1 per cent., and the mechanical decreased to about 5 per cent., and in September the mechanical trouble decreased to about 2 per cent. This decrease was probably due, in some degree, to a lighter business and less mileage. As the report does not state the nature or degree of the electrical disabilities, it is not fair to assume that they were all due to crippled armatures, but we can deduce from it that a car ought to run 100 days without electric repairs.

THE DISCUSSION.

After the reading of the report, the association adjourned to meet in the evening in executive session, at which it is understood that there was some discussion involving the cost of operation and repairs of electric railroads. The general testimony, however, did not vary much from that given in the report above.

George W. Mansfield of the Attleboro electric road addressed the meeting as follows: I came here, like many others, to listen and learn. I am a director in the road, and take a deep interest in its operation, but I cannot give you any specific and accurate figures in regard to the cost of operating the road, either for power or repairs to the motor. We hire our power, and are in one of those unpleasant predicaments that no doubt many other electric railroad men have found themselves in when they came to pay another concern for the power supplied to their car. Some of these companies want from three to five dollars per day for the first three or four cars, and perhaps fall off fifty cents per car thereafter. I have even heard that one company wanted eight cents per car mile. I doubt not that in the East and in a great many other places they are paying in the neighborhood of from four to seven dollars on small roads of from four to seven cars, the cars making in the neighborhood of one hundred to one hundred and twenty miles a day. I do not know but that in some cases the electric light companies are warranted in making such a charge. They may have to pay four dollars and a half or five dollars a ton for coal, and I know that electric railway managers get all they can out of their electric cars. When an electric car has to climb a grade of eight or nine per cent, with perhaps ninety or one hundred passengers on it, there is a pretty severe strain on the steam engine; and perhaps at the time it gets up or half-way something necessitates the current being cut off and the brakes applied, and then the car starts again under these conditions. The indication of the steam engine on one car under these conditions has run as high as seventy-one or seventy two horse power. In Albany, on the Capitol Hill, they stop half-way up the grade, about an eight per cent., and they have very heavy traffic, too. In a general way it has been my experience that the cost of operating an electric car per mile is about three cents, the mileage being in the neighborhood of one hundred and ten miles, not to exceed one hundred and twenty or fall below ninety. I make that provision since I know of some roads running as high as one hundred and sixty miles, which is an excessive duty to impose on the car. If the manager of such a road permits it, and he has to pay ten cents per car mile on repairs, it is nothing more than he ought to do. I say in the neighborhood of one hundred and ten miles, and under average conditions, perhaps grades of five per cent., under these conditions and counting simply the maintenance expenses, meaning the oiler, wipers or cleaners, grease, repairs to all the electric apparatus on the cars including even the truck, and not including any fixed charges or anything of that kind at all, the cost of operation can be reduced on many roads to about three cents per car mile. On small roads it costs more, perhaps four or four and a half. The whole matter is very largely a question of brains on the part of managers of electric roads; and so far as my observation goes there is somewhat of a want in that direction. By brains I mean an intelligent mechanical inspection of the car and maintenance of the electrical apparatus. On this account largely it is difficult for any man to give at this time any accurate figures in regard to both the operating expenses and repairs of cars and at the station that would be applicable to all roads.

R. J. McCarty, superintendent of the Metropolitan Street Railway company of Kansas City, read a paper and spoke at consideaable length on the comparative cost of operation of horse, electric and cable roads. His statistics showed that the cost of operation of a ten-car road would be the same by electricity or horses; that when the number of cars was above ten the road could be operated more economically by electricity, and that when the number reached fifty cars and upward, he considered the cable to be the most reliable and economic.

The meeting on Thursday morning was, on motion, open to all interested, and a special committee was appointed to apprise the representatives of the different electrical systems that an opportunity would be afforded them to address the convention.

D. H. Bates, vice-president of the Accumulator company, read the following paper on storage battery street cars:

THE EDCO STORAGE BATTERY STREET CAR.

BY D. H. BATES.

The horse is a noble and extremely useful animal, but he seldom combines high speed with great endurance. The fast trotter is made to run his mile in from two and a quarter to three minutes, but he does it only on rare occasions and is well fed and cared for between times.

It was not until yesterday, when Mr. Odell's very interesting paper was read, that I had any idea of the innumerable obstacles to be surmounted in first securing a perfect street car horse and second in maintaining him in a constantly efficient condition.

Judging from the expressions of a large number of street car men with whom I have talked on the subject of storage battery cars, I have inferred that your street car horse was ready for continuous hard work at all hours of the day or night; that it took no time to change horses at the end of a trip and that you only fed them at night after a sixty-mile run, and that oats and hay were always cheap.

For all these or like requirements must be met with in our storage batteries, if they are to satisfy the average street car official.

But when we undertake to show that the energy requisite to propel a sixteen foot car with its average load of passengers at the horse car rate of speed must be increased 100 per cent. if the speed be doubled and that the cost of producing that increased energy by whatever means you employ must necessarily be doubled, the scientific fact is perhaps admitted, but if storage batteries are the medium it is always taken for granted that they ought to do double the service at half the cost.

The overhead systems in operation throughout the country have demonstrated to you, gentlemen, the fact that electricity is not the coming power but the power already come The mileage of street roads in the United States which in June, 1890, were operated electrically is, according to the eleventh census, 8.26 per cent. of the entire mileage, but omitting fifty-nine cities the proportion runs up to 25 per cent. This means one of two things, either that as a rule the authorities of our large cities will not allow overhead poles in the street, or that street car

managers prefer to await the result from the use of the electric system on a small scale in the towns and smaller cities before introducing it in the cities on a scale of greater magnitude.

The overhead systems already introduced in many places have so far improved upon the horse and mule that the public once given rapid transit would not go back to slower methods and are clamoring everywhere for such facilities.

You street car owners and representatives, however, must look at the resultant in the matter of cost per car mile and net profits, and before some of you yield to the loud demands of the public for rapid transit by adopting the overhead system we beg of you to carefully consider the merits of the storage battery.

It will propel a car just as fast and just as efficiently with all that that implies as the trolley system. Every word that can be said in favor of the trolley system applies equally to the storage battery.

A storage battery car is capable of much work that a trolley car can not accomplish.

Storage battery cars can be introduced gradually one or two at a time in connection with horse cars, cable cars or trolley cars.

We have already had proposals from a cable road for a few cars to be run at night when the cable could only run at a great proportionate expense, and from a trolley road where an extension was needed on a route that did not permit of trolley poles.

Storage battery cars can be run over any track or route where a horse car can be run, thus avoiding blocks in cases of fires, processions and other obstructions.

Transfers of cars can with this system be made from one road or route to another in cases of necessity or convenience in handling an unusual traffic.

In cases of breakdown at power station during hours of heavy traffic, storage battery cars could run for two or three hours with the 33⅓ per cent. reserve always remaining in the double set of batteries.

Now, as to the figures relating to the battery system. What is the cost of a storage battery car plant? What does it cost per car mile to maintain? What does it cost per car mile to operate? Let us take a unit of fifty cars: Fifty cars at $1,000—$50,000; storage plant engine, nominally 500-horse power (triple expansion), $12,500; 500 nominal horse power boilers, 50 per cent. margin, $10,000; 50 sets of car motor equipments each consisting of two 15-horse power slow speed motors capable of being exerted up to 20-horse power each for brief periods with dust tight covers, gearing and motors running in oil; starting, regulating, reversing and speed, switches, lamps, signals, batteries, etc., complete, $249,400; central station equipment, including dynamos, rheostats, switches; reserve batteries, shifting appliances, etc., complete, $128,400.

The grand total will be $450,300—say $9,000 per car for everything except buildings, road bed and tracks.

MAINTENANCE PER ANNUM.

Steam plant, 10 per cent	$2,250
Cars, 10 per cent	5,000
Electric plant exclusive of batteries, 10 per cent	21,500
Batteries, 20 per cent	31,680
Shifting appliances, 5 per cent	200
Total maintenance per annum	$60,630
Maintenance per car per annum	$1,212.00
Maintenance per car per day	3.32

Maintenance per car mile (on basis of 120 miles per day), 2¾ cents. With a smaller run the wear and tear would, of course, be reduced.

POWER PLANT AND COST.

Horse power required	500
Time required for producing such power	18 hours.
Total horse power hours	9,000
Coal per horse power with triple expansion engine	2 lbs.
Coal per day 18,000 or	9 short tons.
Coal being estimated at $3.00	$27.00

LABOR.

One chief engineer	$4 00
Two assistants at $2.50	5 00
Two firemen at $2.00	4 00
Two assistants at $1.50	3 00
Six shifters at $1.50	9 00
One electrician	4 00
Two assistants at $2.50	5 00
One dynamo man	3 00
Total labor	$37 00

SUPPLIES.

Water per day	$5 00
Oil and waste	2 80
Appurtenances and miscellaneous	2 80
Total supplies	$10 60

RECAPITULATION AND SUMMARY.

Fuel per day	$27 00
Labor per day	37 00
Supplies per day	10 60
Total cost per day for operation	74 00
Cost per car day for operation	1 48
Cost per car mile for operation	$01\frac{75}{100}$
Cost of maintenance per car mile	$02\frac{2\frac{1}{2}}{100}$
Total cost of maintenance and operation per car mile	$03\frac{99}{100}$

The following are some of the conditions fulfilled by this company with its storage battery cars.

Each car will be delivered in first-class order with appliances for keeping it well under control and for readily operating it with such skill as would be possessed by an intelligent car driver after suitable instruction.

Each car will be run fifteen miles an hour on a straight level and suitable track in good order when carrying fifty passengers, or an equivalent weight not exceeding 6,000 pounds.

Each car with the above load will ascend grades not exceeding 5 per cent. and not longer than 500 feet at the rate of at least five miles an hour.

Two sets of batteries per car will be delivered, either of which, when fully charged will be capable of propelling a loaded car on a straight level and suitable track for a distance of sixty miles if required when it shall be replaced by the reserve battery which meanwhile shall have been fully charged. Each battery can be charged while its alternate is being used. As a matter of policy, we advise retaining one-third of the charge of the battery, as a reserve for emergencies.

The batteries when treated according to printed instructions and their parts renewed as required will remain in an efficient condition.

We have already touched upon some points of advantage in the storage battery traction over the trolley system. We will now refer to the inherent defects of the trolley system which do not pertain to storage traction.

1st. The disfigurement of streets by double lines of poles and trolley wires, with cobwebs at every curve.

2d. The frequent interruption of the entire system by a break-down at the power station or in the feeder wires.

3d. The great and sudden fluctuations in the load which make such break-downs of the power plant extremely frequent, many such break-downs having already occurred. With trolley and cable lines, the extremes of no load and full load are reached suddenly from one to a dozen times every five minutes. This is not only destructive to the machinery (steam, electric and cable) but frequently causes a break-down of the whole line, involving heavy outlays for repairs, serious loss of revenue and dissatisfaction on the part of the public.

4th. Bad economy in the power station due to the fact that maximum power must be provided in the engines and dynamos instead of the average power as provided in the storage system, causing the engines with the trolley system to run with an average of about half their load and therefore uneconomically; with storage battery traction the engines and dynamo run with an even and unfluctuating load continuously, giving the best possible economy of coal and increasing the life of the plant.

5th. Economy and inconvenience of operation as compared with requiring an expenditure of energy in all portions of the line, even though but one or a few cars may be running. For suburban roads and all night runs this feature is of special importance.

6th. Liability of generators and motors being burned out by lightning passing through the bare trolley wires through the motors to the ground.

7th. Liability to motors burning out with the high voltage current.

8th. The business public is inconvenienced by the derangement of the telephone service due to induction and leakage from the trolley lines to such an extent as to make the telephone service useless and dangerous.

Last and perhaps most important at least to the general public the trolley system requires a current of high potential conducted along bare wires extending over the entire route of the line, always liable to contact with electric light, telegraph, telephone, district messenger, fire alarm and police alarm wires, the system thus being a constant menace to life and property throughout the city. Contact with any foreign wire may lead to a conflagration such as destroyed immense values of property in Lynn and Boston within a year, and death to horses and human beings, numerous instances of both having been frequently reported in the public prints.

Therefore we feel warranted in asking street car companies to give storage battery traction, which possesses none of these disadvantages, and involves none of these dangers, a fair trial under reasonable conditions and under the supervision of men experienced in the various branches of engineering involved in the business, and who have had nine years' experience in the manufacture and use of storage batteries.

THE DISCUSSION.

MR. RICHARDSON, of Brooklyn: I understood the gentleman to say that the storage battery car could run fifteen miles an hour for four hours; and that it takes as long to charge the battery as it does for the battery to work.

MR. BATES: You are correct.

MR. RICHARDSON: There lies my great doubt as to its practicability on a road that wants to run fifty cars three minutes apart.

MR. BATES: By a suitable provision of alternate batteries that is accomplished easily. One of our cars has been in daily operation in Dubuque for sixty days, and we are now equipping the road with six cars.

MR. RICHARDSON: How long does it require to take out one set of batteries and substitute another.

MR. BATES: It depends largely upon the skillfulness of the men employed; from one and a half to three minutes.

MR. RICHARDSON: What do you base your calculations upon as stated in your remarks; from actual figures that you have, or by approximation?

MR. BATES: From figures which we have very carefully prepared, and which are approximately correct, based upon ten thousand miles of service with our three cars.

MR. MCCARTY, of Kansas City: How many horse power per car is required?

MR. BATES: It depends upon the number of motors we put out; ten-horse power is about the amount of steam plant we require per car.

WENSTROM SYSTEM.

A. H. CHADBOURNE, representing the Wenstrom system addressed the convention as follows: Nearly every year there is brought to you something new in this line. This year we come before you with something that is a novelty. I think it is generally acknowledged that it is desirable to have a slow speed armature in a street car motor, and that the motor should be reduced in weight as much as possible, and if possible a device provided whereby the armature could be allowed to run free at all times without relation to the car speed. We accomplish these results in a very satisfactory way. We expected to have had a car in operation here, but owing to delays at our factory, have not been able to do so. We have a cast of our field magnets here. It is cast solid. The machine is twenty-five-horse power. The fields are cast in one solid piece of mitus metal. The speed of the armature is four hundred revolutions a minute, developing twenty-five-horse power. The metal is cast in such a way that it has nearly the same properties of wrought iron, and has the advantage that it can be welded. The wires instead of running over the periphery of the armature, run through it, and the external portion is turned down true, so that it presents a plain surface. The advantage of this is that it is impossible to have the wires spread or thrown apart. Another feature of the motor is the method of connecting the wires on the commutator. Sometimes there is a great deal of trouble with these connections by reason of the solder melting. We have no road in operation yet, but will have in operation at Pottsville, Pa., by the first week in November. We also expect to have a motor in operation in Baltimore very shortly. Our construction is not unlike other companies in its detail, the overhead arrangement of wires being the same. You know what the trolleys are. The generator is unlike those with which you are familiar. It is a machine that works at slow speed. We also have a patent connection between the armature and the commutator. It runs at four hundred and twenty-five revolutions per minute, developing sixty-seven and a half horse power, running perfectly cool. A peculiar feature is that their construction is such that they utilize to a greater extent than any other machine the magnetic qualities which are generated in it. Another point is the gearing. You are all familiar with the ordinary gearing. We have a gearing which we are prepared to put under any system. It is an inexpensive gearing to buy, and it is economical to operate. It is a gearing with wooden teeth and has a removable rim, which is absolutely noiseless; and we have reduced the point of wear to the cheapest part of the gear, the teeth. No matter how small the accident, if one of the teeth breaks, the gear is gone. There is no reason why our gear should ever break, and the wooden teeth will last anywhere from four to six months, in accordance with the work. In Atlantic City they ran all summer long. The manager there stated that the gears had done excellent service. We use this gear on our system, and will put it on any other. Another point is, that owing to the slow speed we do away with the intermediate counter shaft, and consequently that does away with two bearings and two gears, We gear direct from the armature to the car axle. There is another feature worthy of your attention, and that is the method by which we allow the armature to run at full speed at all times. The amature is started up, and the gear runs freely; the rim revolves freely around the axle and is connected to it by a system of hydraulic gearing. It is by the operation of the oil in the gear that we get the difference of speed in the armature and car axle. The oil is forced up from one part to another and when the valve is open the rim will run free. If the valve is half way open you will get a variation of speed.

MR. HENRY, of Pittsburg: Do you propose in that machine to do away with the intermediate gearing entirely?

MR. CHADBOURNE: Yes, sir.

MR. HENRY: In that way you get rid of one-half the machine under the car?

MR. CHADBOURNE: Yes, sir. We do away with a large factor in repairs. It is the high speed of the street car motor that makes the trouble with the gearing. If your intermediate gear only ran one hundred and twenty-five revolutions, it would be a very simple matter to keep the gears on. In a slow speed machine much of this trouble is overcome, and it is acknowleged to be a very desirable thing.

WHELESS SYSTEM.

MALONE WHELESS, of the Wheless Electric company, addressed the meeting as follows: We have a system in Washington that differs in no respect from the other systems, except that we carry our cars by an underground cable. It extends the whole length of the road, and feeds from the sections which are laid in the conduit in the usual way. The sections of the conduit are carried along, and at every three hundred feet, more or less, as occasion requires, switch boxes are put in. These are about sixteen inches square, and laid between the tracks in double tracks, or between the rail and slot rail for single track roads. The object of these switch boxes is that when the car comes along they automatically connect the current in the cable with a given section. Suppose we have a mile of road, there is a mile of cable laid by the side of the track. From that cable at every three hundred feet is laid a feeder that furnishes current for one insulated section of conduit wire. The conduit wire is at all times dead; there is no current in it. The current at all times is in the cable, and when the car comes on to a section a device attached to the car acts in conjunction with the switch-box, and the result is that the connection is made from the cable to the wire in the conduit. The car instantly receives the current and passes over that section and on to the next, when the passage of the car off the section releases the armature in the switch box, and as a consequence the section is cut out. The "cutting in" is adopted because putting a continuous conductor in a conduit has been found inexpedient, for two reasons. The first is the escape. I believe it is impossible to take a continuous conductor and transport it through five or six miles of conduit, and not have such an escape, no matter how well insulated it may be. The other reason is, the liability to short circuit The

(*Continued on page* 225.)

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
P. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

The Electric Fountain in Lincoln Park, Chicago. Illustrated. 217, 21
Electrical Department of the World's Fair. 21
Another Electric Railway Organized in Chicago. 218
The Edison Arc Lamp. Illustrated. 218
Gas Retort and Self Feeding Smokeless Furnace. Illustrated. 219
Operating Chicago Bridges by Motors. 219
Chicago City Electric Light System. 219
Electricity in Shaping Sheet Metal. Illustrated. 219
Electric Launches. Illustrated. 219
American Street Railway Association—Report of the Annual Convention:
- Members and Delegates. 220, 221
- The President's Address. 221
- Treasurer's Report. 221
- Executive Committee's Report. 221
- Electric Motive Power Technically Considered. By W. L. Allen. 221, 222
- The Edco Storage Battery Car. By D. H. Bates, and Discussion. 222, 223
- Wenstrom Electric Railway System. 223
- Wheless Electric Railway System. 223, 225
- Julien Storage Battery System. 225
- Short Electric Railway System. 225
- Birmingham Street Railway System. 225
- Edison Electric Railway System. 225
- Thomson-Houston System. 225, 226
- Public and State Treatment of Corporations. 226
- Novel Schemes for the Development of Street Railways. 225
- The Banquet. 226
- Mayor's Address of Welcome. 226
- Excursion to Niagara Falls. 226
- The Exhibits. 226, 227, 228

Editorial. 224
The Central Lighting Station as an Investment. By B. E Sunny (Chicago Electric Club). 228, 230
Floor Mats for Electric Cars. Illustrated. 229
Pullman Palace Car Company. 229
The Government and the Telegraph. 229
The Death Penalty. By George P. Schrady, M. D. 229, 230
Thomson-Houston Electric Railway Work. 230

DEPARTMENTS.

Correspondence. 230, 231
The Electric Light. 231
The Electric Motor. 231, 232
Electrical Patents. 232

In another column B. E. Sunny's paper on "The Central Lighting Station as an Investment," is presented. This paper was read at the opening meeting of the Chicago Electric Club. As might naturally be expected the author looks with favor upon electric lighting enterprises. He takes a conservative view of the question, though, and points out a number of mistakes which are often made by projectors of central lighting systems. Underestimation of the development of the service he considers one of the gravest mistakes which have been made. "With the one possible exception of the telephone," says Mr. Sunny, "the future of no business has been more greatly underestimated than the electric light."

Referring to the non-dividend paying plants, attention is called to the station in which, although well designed and substantially built, there has been no provision made for an indefinite extension. "Is it not, wise, therefore," continues the writer, "to pattern after the most substantial and permanent institutions of the time, and build not for the present and immediate future, but for twenty-five or more years ahead of us?" Mr. Sunny also points out one pertinent fact which the alarmists who croak about the dangers of the electric light, might consider with profit to themselves and others. The fact referred to is that the development of any great agency for the benefit of the community, calls for our tribute in the shape of annoyance, loss and injury. If we study the progression of the various existing public corporations and, as Mr. Sunny states, analyze the advantages and disadvantages growing out of the service they perform, we will find this true in every instance.

A DESCRIPTION of the electric fountain in Lincoln Park, Chicago, is presented in this issue. The apparatus employed is quite simple. A number of arc lamps with horizontal carbons and each provided with a parabolic reflector is located in a vault or cavern beneath the fountain pool. Openings covered by plate glass and inclosed by brick spouts, permit of the upward projection of the light into the streams of water and spray. By means of colored glass slides interposed between the lamp and the lower openings in the spouts, a great variety of beautiful combination effects are secured. To a number of electricians the equipment will seem to contain few novel features. To the general public in Chicago, however, "Yerkes electric fountain" has been an object of considerable curiosity, and on this account an accurate description of the electrical apparatus employed cannot fail to be of interest.

THE report of the ninth annual convention of the American Street Railway association appears in this issue. The meeting was the most largely attended and most interesting convention in the history of the organization. The cause of the great interest in the convention is not difficult to find. The fact that street railway men are at the present time vitally interested in securing all possible information in regard to electric railways and their operation affords the reason for the large attendance. Very little was heard of the horse car; scarcely any interest was shown in the cable; the electric system constituted the one absorbing topic of interest. The exhibits, which are described somewhat in detail in the convention report, were almost wholly of electrical apparatus. It was a significant fact that the manufacturers in their circulars particularly emphasized that their wares were adapted for electric cars. The maker of wheels stated that his product was especially suitable for use on electric railways, the manufacturer of trucks, heaters, rails, brakes, tools or any device asserted that the peculiar feature of his appliance was its adaptation for employment in connection with electric cars. There is at the present time apparently no general apparatus, if the circulars of exhibitors warrant an inference, specially made for any system except an electric railway. Manufacturers have, it is manifest, appreciated thoroughly that electricity furnishes the only means of moving street cars, and are shaping their course accordingly. The report shows what an amount of time was devoted to the consideration of electrical topics in the convention. President Lowry's address, which is referred to in another paragraph on this page, was devoted mainly to a consideration of the electric railway. Representatives of the several electric companies were invited to address the members, an opportunity which they were not slow to grasp. Their remarks brought out the advantages of electrical propulsion in a very striking manner. The visitors were entertained at Buffalo in a most hospitable manner by the local street car companies, and the convention will be remembered as one of the most instructive and enjoyable in the history of the association.

ONE of the most instructive papers read at the convention of the American Street Railway association at Buffalo last week was that of W. L. Allen, whose subject was "Electric Motive Power Technically Considered." The paper, which is presented in full elsewhere in this issue, is well worthy the careful perusal of those engaged in the manufacture and installation of electric railway apparatus. Dr. Allen considers the subject from the standpoint of a street car man, and his criticisms are the result of his observation of electric railways, considered not as an installation of electrical apparatus, but as a system useful for transporting passengers. As a preliminary the author states his unqualified indorsement of overhead construction. Such a system involves, he says, so little danger and trouble that, as far as street railway men are concerned, there is no need for the abandonment of poles. The real interest in the paper centers in Dr. Allen's treatment of the problem which he states interrogatively, "What can we do to keep our motors out of the repair shop?" He does not answer the query, but he gives considerable statistical information going to show that the problem is one to which a great amount of attention should be devoted. "We want," says Dr. Allen, "gear and pinions to be wide and heavy enough not to break. We want gear of some material that will be reasonably durable and at the same time noiseless." He desires an armature which will not burn out at the worst possitime. Unquestionably there has been a vast improvement in mechanical construction in electric railway work during the last year so that every plant is far more durable and will stand far better the rough usage to which it is daily subjected than ever before. The tendency is all in the direction of making the mechanical work better, and there is less desire to make startling electrical innovations. We have no doubt, therefore, that Dr. Allen's problems will be solved, and that the operation of an electric railway will be as perfect as human ingenuity can make it.

THE address of President Lowry at the convention of the American Street Railway association at Buffalo was an unqualified indorsement of the electric railway system as used both in large and small cities. Mr. Lowry has given the best possible evidence of his belief in electrical propulsion by his decision to equip electrically the extensive street car systems in Minneapolis and St. Paul. This decision was reached, too, after the company of which Mr. Lowry is the president had already purchased a large amount of material for cable construction. Mr. Lowry stated that his conviction that electricity on railways was the best system was so strong that he thought the Buffalo meeting would be the last at which the association would seriously consider horses for the operation of street railways. Mr. Lowry did not wholly throw over the cable. He thought it useful when the heaviest grades were to be surmounted. Of the growing demand for rapid transit in cities Mr. Lowry had this to say: "While municipal corporations in the larger cities for many reasons are slow to grant new privileges to corporations and in the case of electricity they are very closely scanned and criticised, it will soon become self-evident that a municipal body can grant no greater boon to its middle and laboring classes than to provide them with the means of rapid and cheap transportation to and from homes in the suburbs, where they can live under a clear sky and in a health-giving atmosphere. When the people of a city understand clearly the great benefits of rapid transit, by electricity or other improved motive power over horses, they will demand that their city authorities grant such rights as will enable street railway companies to operate by the most improved methods." Electric railways have already in many cities accomplished the results of which Mr. Lowry speaks, and the laboring classes have been enabled to purchase homes where real estate was cheap in parts of a city in which, on account of time consumed in travel to and from work it was previously impossible for them to reside. When this fact is more generally appreciated public opinion will force many a common council into granting franchises now for some trivial reason withheld. The street car companies, however, Mr. Lowry said were bound, as the public favored its projects, to provide for patrons the best cars, to make the best construction and supply the road with the best and most modern appliances. The last requirement, in Mr. Lowry's opinion, would unquestionably include an electric equipment.

(*Continued from page* 223.)

advantage we found in cutting our wire in sections was that only a certain section was charged with current, and consequently a short circuit could only occur at the point where the car was. This constitutes about what our underground system is; it is simple, and does not exceed in cost the ordinary conduit, or very little more. Our overhead system is a duplicate of the main feature of our conduit system. We feed in sections. The overhead line is dead at all times, and there is no way in which a person can receive a shock from it. I shall be glad if the gentlemen present would come to Washington and see our system.

Julien System.

KNIGHT NEFTEL of the United Election Traction company of New York spoke as follows: It is unnecessary for me to say anything regarding the value of storage battery traction. After the very apt remarks made by my friend of the Accumulator company I will simply give concisely our results in operating ten storage batteries cars on the Madison avenue line in New York.

The equipment of each car consists of 108 Julien cells in 12 trays, and 9 cells in each; total weight 3,600 pounds. The motors in use until recently, and on the old cars now running, are of the Thomson-Houston type. We have now constructed a motor especially adapted to this class of work, and which is now being put on this line. An estimate of cost of operating has been submitted to you by another company based on the performance of 50 cars. Our experience with 10 cars in actual operation over an extended period, which by the way, is the largest storage plant in this country, and next to the largest in the world is as follows: The generating plant requires 8-horse power per car. For ten cars fifteen batteries are necessary. The rate at which the battery is charged is one and one half hours, for two hours' discharge. One charge is adequate for a run of forty miles on a level track. With the old cells and the old type of motor, these ten cars were operated at 10.6 cents per car mile. The life of the existing plants of the battery, at the present rate of disintegration, is at least three years. It is generally conceded that the reasons storage batteries have not been applied more extensively, are lack of confidence in the endurance of the batteries and litigation on patents.

We are prepared to demonstrate to you practically the life of the batteries, and the question of patents has been greatly cleared by the final decree, giving Chas. F. Brush of Cleveland a fundamental award of priority.

Our batteries are manufactured under the patents of Brush Julien, Morris, Salome and others. We are now equipping a road in Indianapolis, Ind., on this system. Our company also furnishes overhead equipments and we shall be pleased to have any member of the convention visit the plant at Madison avenue and the other roads equipped by us.

MR. GRAHAM, of Baltimore: Can you tell me the number of miles per day each car runs?

MR. NEFTEL: Eighty.

MR. GRAHAM: The maximum grade?

MR. NEFTEL: The maximum grade is about five and a half or six per cent.; there is a very severe grade for a short distance on one part of the road between Seventy-second and Seventieth streets going down.

MR. GRAHAM: What is the length of the grade?

MR. NEFTEL: About two blocks.

MR. GRAHAM: Do you ever run on a grade higher than five and a half per cent.?

MR. NEFTEL: Yes, sir; there is one grade which is seven and a half per cent. The motors will go up that, but, of course, it discharges the batteries very rapidly, when you subject them to such heavy work.

MR. GRAHAM: Is the car capable of ascending any usual grade, say ten per cent.?

MR. NEFTEL: Yes, sir; it is simply a question of discharging the batteries.

MR. HENRY: When you say ten cents per car mile, what is included?

MR. NEFTEL: Everything except the conductors and drivers. Of course, there is a reasonable amount for the repairs of the motors.

Short System.

J. POTTER of the Short Railway and Brush Electric companies said: The Brush company, as you know, has been building dynamo machines and electric batteries for many years and it recognized that electric street railway work is the severest to which the dynamo can be put. In starting out in our electric railway work we aimed to build a dynamo that would stand the rough work, with as few failures as possible; and in the next place to make the delays incident to such failures as brief as possible, and the repair work simple and inexpensive. We claim that with our motor we have reached a high point of perfection in these respects. Our motors differ from others mainly in the type of armature. We use a ring instead of the usual drum type of armature. There are many advantages that we obtain by the use of this type of armature. The bobbins or sections of the armature are all independent, and in case of any burn out or trouble, it would be confined to a single bobbin. Again, we get a very great diameter of armature, as compared with others, and are enabled to use larger pinions and save greatly in wear. As a matter of fact, since the beginning of the present year, we have never burnt out a field magnet or armature coil in actual service. This will be confirmed by any road operating our system. Another feature is the insulation of the motor entirely from the framework of the car and from the ground. We believe that a great deal of the expense and trouble is due to the grounding of the motor, the bursting through and burning out of armatures, fields and commutators. This insulation is carried to the gears. We make them with an insulated web to deaden sound, and use steel pinions and steel gears, steel axle gears, and overcome the noise at the same time.

Birmingham Street Railway System.

W. J. CARRUTHERS WAIN, president of the Tramways Institute of Great Britain and Ireland, said: "I came to this country with the hope of learning as much as I could about electric traction in America. What I want to know is the item of depreciation and repairs; and the amount to be set aside as an annual sinking fund for depreciation, which must inevitably ensue. It has struck me, not only in this assembly but in many others, that figures, after all, are rather delusive. No man was satisfied with the system of tramway traction in Europe, up to within the last three or four years. We had leased a line from the Birmingham authorities, with the proviso that it should be operated by cable; but there was not enough business to make that system profitable. Electricity appeared to be the only visible motive power; and in November, 1888, there was tried upon the Birmingham Central Tramways an electric motor, which was designed upon the Jullien system by Thomas Parker and myself.

"The directors of the Birmingham Central Tramways company permitted the experiments to be conducted upon condition that the electric motor to be used should be in the form of an engine, insisting that before they would consider the question of electricity at all in connection with their lines, they must be convinced by actual demonstration that the power was as great, if not in excess of their most powerful steam engines then in use; and when I point out that they are some twelve tons in weight, having cylinders nine inches in diameter, and carrying a pressure of one hundred and seventy-five pounds to the square inch, you will agree it was no small task to attempt. However, upon actual trial, the electric motor, although weighing only nine tons when coupled to one of the steam engines, hauled the steam engine in spite of the fact that steam was full on and pulling against the electric motor. We afterward started and hauled with the electric car a load of thirty tons up a grade of one in thirty-two. We have also run with one charge of the accumulator seventy miles, hauling a car which, together with the load, weighed over six tons, and this on a very heavy grade of tramway, traveling up a grade of one in nineteen over five hundred yards in length during the day ten times. This electric car has been so successfully run over their heaviest steam route, and given such satisfaction to the directors, that they gave an order for twelve electric cars, which have just completed what is undoubtedly the finest installation of its kind in the world.

"The car is made to run upon a three-foot six inch gauge, and is constructed to carry fifty passengers, twenty-four inside and twenty-six outside. It measures over all in length twenty-six feet, and in breadth six feet three inches, and from floor to roof three feet six inches. The sole or foundation of the car body is made of channel iron, strutted so as to give it great strength and rigidity. The car body is carried upon two bogeys of the ordinary kind, and the motor is geared to the axles of one bogey by a train of helical gearing. The accumulators are placed in trays, each tray containing eight cells, and these are carried under the seats of the car, the outer panels of which slide up behind the seats so as to admit of their being readily placed in position. The connections are so arranged that contact is made automatically as the trays are pushed into position. The whole forms four batteries. The switches are of the Julien type, and the car can be driven from either end They are so constructed that the cells can be equalized and the batteries used either in parallel or series. The car, motor and batteries weigh nine tons, as against the steam engine and cars sixteen and a half tons, a large saving in dead load to be hauled. The work of charging the accumulators is reduced to a minimum by having a specially arranged balanced lift or elevator. These work in pairs, one balancing the other. Each shelf is fitted with automatic connections, and is in every respect an exact duplicate of the car, so that when the accumulator trays are drawn thereon automatic connection is made, and the cells are charged while in position without again being moved."

MR. RICHARDSON: How many cars are you running?

MR. WAIN: We have twelve altogether; but are only running five. I may say as a point of interest that during the time that line was under construction we worked it first by a system of horse tramways, and the average earnings were about $750 a week. During the time the electric road was in process of construction the receipts on the horse line were reduced to $600 a week. Immediately the electric cars were put on the receipts jumped up to $1,250 a week. This was not due to any additional service, because it is precisely the same; not to any increase in population, because it had not grown so rapidly; but simply to the fact that we have been able to put on in place of the wearisome horse car a comfortable car moving by electric power.

MR. HENRY: How often have you renewed the plates?

MR. WAIN: We have not renewed them at all. We expect to get a life out of our plates of six months, The question of profit on the workings of the storage battery is not a matter of speculation, but is a matter of dead certainty. Inasmuch as there are several gentlemen here connected with overhead systems I should like to say I believe there is room for all, certainly in America, if not in England.

MR. HENRY: Do you reconstruct the horse track for the electric road?

MR. WAIN: It was reconstructed, but not solely for that reason. The road was very much dilapidated.

MR. HENRY: What percentage of loss in efficiency in the motor is there?

MR. WAIN: I am not going to give you that, because three months' work is not sufficient time in which to give a general test. I understand as nearly as possible we get 50 per cent. on the wheels.

Edison System.

E. E. HIGGINS of the Edison company said: It is acknowledged that the Edison motor will consume less coal. If we can operate a hundred cars with 750-horse power as an average output, it means that we can have less dynamos, less engines, less boilers and less apparatus in general than can be done with a system which requires 1,000 or 1,200 horse power to operate the same number of cars. The cost of investment is less, and of course the interest is less. That is one advantage, and in addition the coal bill is much less. We believe that the depreciation per passenger carried with our system can be made out less than with any other. We do not claim that it has been less in the past, although not greater. We have the best roads in the country; perhaps we have some of the poorest. It is a question of management and lies directly with you, gentlemen, as to the success of electric traction. In most cases the motors do not receive the attention that would be given to an ordinary steam engine; and if you run them successively for 150 miles a day, and do not lay them up and treat them with care, you cannot expect that your armatures will not burn out and other troubles ensue.

In the new apparatus that we are bringing out we have made some very notable advances. In the first place, our armatures are wound upon an entirely new plan, one which we think is a distinct advance. In the old style what is known as the Siemens winding is employed; the wires are wound on the core and carried around at the end and form a conical shaped bundle, which gives a chance for play and abrasion; and this means short circuits and burn outs. With the new armatures we have a new standard coil some sixty of which go on to the core. They are so formed that the rear of the armature, and front alike, give no chance for motion. They are brought firmly in place, and you have a diameter of armature which is always the same, because the coils are standard. With this system burnouts will be extremely rare. We do not claim that there will not be any; but we believe in the regular daily workings of the car, with proper management, nothing ordinary will burn out the machine, except dead overloading. When it is burned out it can be replaced by any mechanic. The switches are on a little different plan. We have avoided the difficulty which has sometimes occurred of starting the car too suddenly, but which with careful management could always be prevented. We make it impossible to start suddenly by putting in a slow-starting device, which starts the car gradually and effects a saving of power. It is not a rheostat. We are the only company that uses commutated field coils. We believe in them; we do not believe in the rheostat. You all know about our dynamos. The reason of their success is that they are a development and not an invention. Its efficiency is over 90 per cent. in the ordinary sizes, such as employed on street railroads; in some cases it is higher. One reason for its success is that its moving parts and center of gravity is near the floor. The line construction of the company is acknowledged to be standard, in respect to simplicity, neatness and cost. We use the feeder system. That is a system of wiring in which the electricity is delivered at regular intervals of a few hundred feet into a trolley wire. This results in the fact that the electricity is delivered to a large meshwork of conductors in such a way that at every point in these conductors the pressure will be uniform.

Thomson-Houston System.

GEORGE W. MANSFIELD, representing the Thomson-Houston company: As all the other companies have been represented, I suppose the Thomson-Houston company ought to be also. We started in the business with the feeling that the thing we had to do, above everything else, was to make as big a difference between the net receipts and the gross receipts of the company that purchased our apparatus as possible. We recognized the exigencies of the moment, and knew that we had to put our apparatus in the hands of men who were unskilled, and who knew nothing whatever about mechanics and electricity We felt, therefore, that we had to build additionally strong to meet that necessity. We have put out in the neighborhood of 3,500 motors. I think they are nearly all running. The first motors we put out are in operation to day, and gears, armatures, spools and the various parts constituting the motors that are built to-day can be used with the motors first put out. I want to make an appeal to you in the same vein as my predecessor, Mr. Higgins, regarding the management of the electric apparatus. If there is any one thing that has injured the business in the eyes of the public, it is in many instances lack of management on the part of the railway companies that are operating the electrical apparatus. Many roads are a disgrace to the directors and every one connected with the company, because the motors are kept in a dirty condition. They are not handled by men who have the requisite skill and intelligence. Any one knows if a steam engine is not taken care of, it goes to pieces; and the same is quite as true of electric motors. The railroads should employ men of skill and brains and intelligence to look after these mechanical and these electrical details, and the more information, the more knowledge they have, the better they will perform their work.

We are making the motor stronger wherever experience has dictated it to be necessary, and we are making it lighter wherever it is necessary. We are improving each detail of the entire apparatus and increasing efficiencies, so that in a very short time we will have the most complete system. Our switches at each end of the car are under the hood of the car, so that in case of any accident or any trouble the conductor at the rear end can cut the circuit, either with his switch or by pulling a trolley wire down, and the driver also has that facility. We have a fuse-box on our car, and it is a very simple matter to replace a fuse if the driver has been careless or ignorant or unskilled and turns his current too quickly on. That operates as a check against the man as well, as a record can be kept of the number of fuses used. We have a lightning arrester, which we claim is the only one of practical value. As to our motors, we build 10, 15 and 20 horse power of one type and the same power of another type, so that we can use our motors either single or double upon trucks of any

gauge from 3 feet 3 inches up to 6 feet. If the railroad men would get down to a uniform gauge, it would help us out very much.

At the close of the morning's executive session a paper on "Public and State Treatment of Corporations," was read by G. Hilton Scribner of New York. Mr. Scribner took a very pessimistic view of the treatment of corporations by the people through the state and their legislators. He strongly protested against the "unjust burdens imposed upon the corporations by the public and state." The press also came in for its share of denunciation. "Aside from the fact that it is our duty," he said, "always to complain in indignant yet dignified terms against unjust and iniquitous treatment at the hands of the public and state, it certainly should be a matter of anxious thought and investigation on our part to discover toward what result the present trend of public opinion and of corporations is leading, and what is likely to be the end, unless a change of sentiment and action regarding them is effected." Mr. Scribner held that before a jury in a case where an individual and a corporation were contending the corporation was sure to be beaten, utterly regardless of the merits of the case. All corporations stood at a disadvantage before local authorities, legislatures and congress. To be prominently and officially connected with a corporation seemed to render a man ineligible for an elective public office. In conclusion Mr. Scribner stated: "It is an optimist, indeed, who can discover in the present attitude of the legislators or the courts, the press or the public, anything prophetic of a just or desirable consummation."

Benjamin J. Owen, president of the Reading City Passenger Railway company, presented an interesting paper on "Novel Schemes for the Development of Street Railways." He contended that three-cent fares were better than five-cent fares if they filled the empty cars with passengers. He recommended the abolition of free tickets. Thirty tickets for $1 would bring in the dollars quicker than thirty tickets for $1.50. Street car riding is largely a matter of habit. "Keep the public with you," he said, "by keeping them interested. Have every new move given to the papers," was his entirely novel advice. He also recommended the running of funeral cars in procession.

Before the association adjourned, the following officers were elected: Henry M. Watson, Buffalo, N. Y., president; W. A. Smith, Omaha, Neb , vice-president; Charles Odell, Newburyport, Mass., second vice-president; A. D. Rogers, Columbus, O., third vice-president; William J. Richardson, Brooklyn, N. Y., secretary and treasurer. The executive committee is as follows: Thomas Lowry, Minneapolis, Minn.; D. F. Henry, Pittsburg, Pa.; Albert E. Thornton, Atlantic, Ga.; H. M. Littell, Cincinnati, O.; Thomas C Keefer, Ottawa, Canada.

The next meeting of the association will be held in Pittsburg, Pa., the third Wednesday in October, 1891.

The Banquet.

The banquet was held in the main dining room of the Iroquois hotel on Thursday evening. About 250 ladies and gentlemen were present. The tables were elaborately decorated with flowers. Large flat bouquets of roses and smilax formed the center pieces, while in front of the president's chair was a beautiful car of immortelles in a large bed of roses. A large cable of smilax was gracefully wound along the tables from bouquet to bouquet. Stands of fruit and growing ferns completed the decorations.

The menu was a handsome four-leafed card, with panel cover ornamented on front by an electric car and trolley wire and lettered in red with the name and date of the meeting. On the back cover was a handsomely printed street car ticket, front and reverse side. The first page gave the name of the officers and executive committee, the second, the menu, the third, the toasts and names of speakers, and the fourth, musical programme.

After the banquet speech making was in order. Mayor Charles F. Bishop of Buffalo was introduced and made the following address of welcome:

Mayor's Address of Welcome.

It may be thought that there is an element of irony in welcoming the street railway representatives to this city. Judging from the common speech of people here, the estimable gentlemen who are at the head of the street railway business are not so modest as to require a welcome to any place when good things are to be seen or to be had, and it may be fair to infer that street railway men coming from other localities have, too, some little assurance. I would not have you think that this city is at war with her street railway benefactors. To be sure they usually take what they want, but they do it so adroitly, so graciously, and with such abundant good nature that we rather enjoy seeing our good things thus taken. And so, notwithstanding the encroachment of the able, affable and insinuating street railway men, the city of Buffalo still retains authority enough over the things which were once her own to extend a hearty welcome to any one. And I take especial pleasure, as the chief executive of this city, in welcoming the gentlemen here assembled. If it is difficult for the city to dwell in peace with these street railway corporations and retain many of her rights and franchises, it is also true that life would be hardly endurable without the street railway systems. Our people fully appreciate how inestimably these systems have in the past added and must in the future add to our wealth and comfort and prosperity. Perhaps no private enterprise is of more general public importance. The whole people watch with absorbing interest every extension or improvement in the street-car service. No man can entirely dispense with the street car and to many it is the avenue to a home and independence. At the present time in particular the city of Buffalo looks to the street car service for great benefits. It knows how much that service can do for a growing city. The enterprise and public spirit of those who have had the management of the service in the past have built up a great system and we expect to receive in the future every good thing which science and wealth can produce. Gentlemen, you are welcome here. If you come from Canada we are glad to have you here. The city of Buffalo has much reason to wish that the most cordial relations should exist between it and that great country. Our citizens are bound to you by business and social ties, and I hope that those ties may multiply and grow stronger as time goes on. If you come from any part of the United States you are a so welcome, you have the liberty and freedom of the city, gentlemen, and I hope you will be pleased that you came, and when your labors are here completed, and you return to your homes, you take with you only pleasant memories, and the desire to come again. If you cannot during your stay in our city get about on the street cars fast enough and far enough to suit your inclinations you are free and at perfect liberty to walk. I hope you will regard yourself as the guests of all our people, holding a pass to any place or thing which may contribute to your enjoyment. Again, gentlemen, on behalf of the citizens of Buffalo, I extend to you a hearty and fraternal welcome and the freedom of the city without reserve.

Hon. E. Carlton Sprague responded to the toast "The City of Buffalo." The city, he said, took pride in the fact that it had presented to the United States two presidents. He added: "It is a sad fact, but none the less true, that the agricultural state of Buffalo is in a deplorable condition. Where once you might see grazing herds and waving grain, now there is nothing but railroads, fine buildings, and business centers. It is not so in other cities, but fortunately Buffalo people are so constituted that they do not envy these cities anything they may possess of an agricultural nature."

The whole humor of the evening was concentrated in the response of Henry W. Box to the toast "Street Car Etiquette." "If I had the 'City of Buffalo' instead of this barren toast," said Mr. Box, "I might speak of its wonderful development, and the enormous fortunes which have been made here in real estate, and, mingling business with pleasure, I might sell a few lots to gentlemen from the dead cities of Minneapolis, St. Paul, Chicago, or Cleveland. I was perfectly willing to hear 'Street Car Etiquette' discussed so long as it was imposed upon somebody else." Mr. Box made laughing reference to many of his experiences and told some amusing stories which were heartily enjoyed by the delegates. He said the selfishness exhibited in street cars was now confined to one sex unfortunately, but he referred in kindliest terms to those gentle-women who are always watchful of the rights of others, yet gentle in their assertions of their own. "Man comes to an abyss, bridges it and passes on; he comes to the mountain, tunnels it and passes on; he comes to the sea where waves mockingly kiss his feet, builds a ship and passes on; he comes to the street car, takes a survey and passes on to—the platform." Mr Box gave thirteen rules relating to street car behavior, and it is safe to say more amusing directions were never given to an assemblage. Here is one. "All ladies are expected to sit side-wise and two ladies sitting side by side are expected to occupy the place of three. To avoid embarrassment, ladies thus seated are requested to look out of the window and not notice the passengers standing who have paid their fare." The following toasts were also responded to: "The Past President," C. A. Richards; "The Street Railway Press," J. H. McGraw; "The Empire State," the Hon. John Laughlin; "The Press," Edwin Fleming, editor of the Buffalo *Courier*.

Excursion to Niagara Falls.

Friday, the last day of the convention, was devoted wholly to pleasure. At 11 o'clock the delegates and attendants at the convention took a special train for Niagara Falls. The Buffalo street railway companies were the hosts of the day. The party consisted of about three hundred persons. Arriving at the falls the excursionists were provided with carriages and were driven to all points of interest and were given an opportunity to see all the marvelous beauties of Niagara Falls. Lunch was served at the Cataract House. Subsequently a train of observation cars conveyed the party to Lewiston. Buffalo was reached about 5 o'clock and the ninth convention was at an end.

Exhibits, Convention Notes and Personals.

The exhibit of the street railway supplies was the largest ever made at a convention of the association. All the parlors in the hotel, and a large hall a block distant from headquarters were filled with street railway apparatus. In the street outside the hotel were street cars and a long line of trucks, wheels, etc. The most extensive and attractive exhibits were those made by electric companies. The exhibitors could not complain of any lack of interest. The delegates to the convention made it their duty to inspect carefully all new apparatus, and thousands of residents of Buffalo filed past the scores of displays. Following is a list of those who exhibited apparatus designed for use on electric railways:

No one who passed through the halls of the Iroquois Hotel could fail to see that the Edison General Electric company was making an exhibit. Across the main hall on the parlor floor was a huge sign with the name "Edison General Electric Company" formed by several hundred small incandescent lamps which were illuminated day and night. The company had two exhibits, one in its parlor at the hotel and the other at the exhibition hall. On the wall in the parlor was hung a twenty-foot map of the United States marked by 120 dots which indicated the location of the 120 Edison electric railways now in operation throughout the country. The map was handsomely draped and above it was located a cluster of small incandescent lamps. On the opposite side of the room was a large portrait of Mr. Edison. Maps showing the projected lines of Edison railways in Minneapolis and St. Paul were also objects of interest. A model of a street car equipped with the Edison system was shown. The representatives of the company believed not only in instructing the visitors but in providing them with entertainment. With this object in view several phonographs were located in the parlors and their reproductions of songs and instrumental music entertained throngs of visitors. The representatives of the company brought to the convention a large number of phonograph letters which were sent to attendants. The latter bringing them to headquarters had the letters spoken to them by the phonograph. At Arcade Hall the company exhibited its motor and truck and all the appliances used by it in equipping electric railways. A full line of switches, voltmeters, ammeters, etc., was shown. The company was represented by John Muir, Chas. D. Shain, J. H. Vail, Charles T. Hughes, Edward E. Higgins, T. R. Chinnock, Charles E Hewitt and Messrs. Page, Van Size, Ball and McGregor. The Edison company has a road in operation in Buffalo. On Wednesday afternoon when the street car men went to Cold Spring to witness the operation of several street cars the Edison company exhibited one of the regular cars running on this road. No charge was made in the car beyond the substitution of the latest forms of switches and trolley. The car carried a large number of visitors at a splendid rate of speed. The excellent features connected with the operation of an electric system were amply demonstrated by the working of the car.

Before a person entered the convention headquarters his attention was attracted by a remarkably handsome private street car equipped with the Short motors. It was built by the Gilbert Manufacturing company for the Short Electric Railway company. All day long and late into the night a stream of people of all ages and sexes were filing through the car and admiring its beauties. It is vestibuled and is eighteen feet inside length and twenty-six feet over all. The color is black carriage finish, gold trimmed, all hand painted. The Brill truck on which the car is mounted is also painted black. The Stanwood step provides easy access. The interior is simply gorgeous. The ceilling is finished in embossed leather with ornamental headed tacks, relieved by three panels of ornamental light wood. Heavy silk damask curtains shade the windows, which are of heavy beveled glass. The sides are wainscoted in mahogany to the windows, and the woodwork is all mahogany carved in pilasters between the windows. The furniture consists of twelve rattan chairs in pairs of different design and upholstered in old blue plush, as are also the window ledges. In the opposite corner are corner chairs and lockers, also upholstered. Six incandescent lamps in fancy patterns provide the light at night. During the convention the lamps took their current from the hotel plant. After the delegates had been sufficiently impressed with the beauties of the internal furnishings the flooring of the car was removed so that every part of the Short electrical machinery as it is arranged on a street car in actual operation was visible. The reptesentatives of the Short company called particular attention to the fact that their trolley arm ended in a shoe instead of a wheel for contacts with the wire. They claim especial advantages for the sliding contact. The Short company made a very complete exhibit of its system at its headquarters in the hotel. In the center of the room was located one of the Short 15-horse power electric railway motors. Current was found for running the machine so that visitors were able to inspect it while in operation. About the room were arranged the several parts of the motor so that the street car men were able to examine them separately. The new rheostat of the company was exhibited. It is made of iron plates with plates of copper interposed at regular distances The latter metal is used so that heat may be radiated readily. The walls of the parlor were decorated with views of Short railways in operation in different parts of the country. The company was represented by S. H. Short, J. Potter, C. C. Curtis, John E. Redall, H. R. Kinzlebach, Samuel Fortinbras and T. C. Frenyear.

The Westinghouse Electric & Manufacturing company showed its new street car motor in practical operation. A Pullman car of the most handsome design equipped with two of the Westinghouse 15-horse power motors was shipped to Buffalo that the street car men might have an opportunity of familiarizing themselves with the system. The car was striking in appearance, finished white and trimmed with gilt. The finish of the interior was elaborate and similar to that employed in the Pullman palace coaches. The car was equipped with Westinghouse air brakes and Hubbard trucks were used. The exhibition of the car was made at Cold Springs in the presence of several hundred street car men. A complement of critical passengers was taken on board and the car started successfully on its first trip. The machinery operated successfully in every particular. For about an hour delegates were given an opportunity of riding in the elegant car. Subsequently a trailer was attached, and the double load was successfully carried. The car completed weighed about twelve tons. The car was in charge of Fred. Pullman. The Westinghouse company was represented by H. Mc L. Harding, J. M. Dennison, J. L. Barclay, W. G. Rose, J. E. Rutherford, J. M. Atkinson, C. B. Osgood, B. F. Stewart and F. A. Pullman.

The Thomson-Houston company realizing that a great many electric railway companies are looking forward with considerable anxiety to the coming winter exhibited one of its snow plows and one of its snow sweepers. The two machines were exhibited on Wednesday afternoon at Cold Springs Park. Their operation was watched with interest by the several hundred street car men on the grounds. The dimensions of the snow plow are: Length overall, 20 feet, width about 6 feet, height 7 feet, and from rail to floor of car, 3 feet 6 inches. The motors for propelling the car are placed on the floor and and are geared to the axles by a sprocket chain and chain-gear wheels. The truck has four wheels of 36 inches diameter, and they are fastened to a 3½-inch axle. The motors are of the consequent pole type and are 20-horse power each. The car will run at a speed of ten miles an hour. In front of each wheel are placed

small shoes to scrape the snow off the rails, so that the wheels will make good contact. The cars are wired so that the motors run in multiple arc, as in an ordinary electric car. The current comes from the trolley wire down the trolley bar. This bar is fastened to the central post, which is about six feet high. From this point the current is distributed to the motors. The reversing switch and rheostat are placed in a shut iron box on one side of the platform within easy reach of the operator. The motors also are covered by a shut iron box to keep out the flying snow. Around the center post are lights which are used at night. The car, like the ordinary electric cars, can run either way. The snow sweeper is mounted upon a car 20 feet long and 7 feet wide, and the height from the rail to the floor is 3 feet 6 inches. The motors that drive the car are placed under the floor and geared direct to the axles of the truck, as in an ordinary electric car. The truck is of the four-wheel type. The wheels are 36 inches in diameter and fastened to a 3½-inch axle. The motor for revolving the sweeper is placed in the floor of the car, so that the shaft of the motor and the shaft of the sweeper are parallel. The motor is connected to the sweeper by a sprocket chain and is geared up so as to run at about 100 revolutions per minute The headquarters of the company at the hotel were handsomely fitted up and on the walls hung a large number of views of Thomson-Houston electric railways. The parlor was thronged by those interested in the operation of electric railways. The company gave a reception to the attendants at the convention on Tuesday evening and a large number of street car men were present. The company's business department was represented by Winthrop Coffin, W. J. Clark, H. L Caszill, Norman McCarty, A. H. Sherwood and A. A Glazier. The electrical department was represented by George W. Mansfield, R. C. Wiggins and F. E. Knight.

The Detroit Electrical Works and the Sheffield Velocipede Car company of Three Rivers, Mich., had a joint exhibit which consisted of a model of the latter company's truck and the former company's Rae railway motor. The model was a beautiful piece of work handsomely finished in nickel and brass. The motor was connected with the 110 volt Edison circuit and was shown in operation. The Rae system is peculiar in that it uses a single motor. The handsome exhibit was inspected with the greatest interest by the street car men. The Sheffield company up to the present time has been building motors for the Detroit Electrical Works exclusively but is now preparing to introduce them on other systems. The truck has several peculiarities. Its main feature consists of two frames independent of each other. The one is carried by the boxes and the other is secured by the car body. They are connected by springs. Another feature of the truck is the brake which works on the toggle principle. The Detroit Electrical Works were represented by Paul W. Bossart and C. A. Benton. The Sheffield company's representative was H. F. Probert.

Chadbourne, Hazelton & Co, of Philadelphia, representing the Wenstrom Consolidated Dynamo & Motor company, made an extensive exhibit. They had apparatus in their parlor, in the lobby of the hotel and in Arcade Hall In the parlor were exhibited models of the new Wenstrom motor designed for street car work, of the hydraulic gear and the railway truck. Samples of the gear with wooden teeth which greatly reduces, it is claimed, the noise of operating an electric car, were exhibited and were examined with great interest by the electric railway men. In the lobby of the hotel the firm showed a 25-horse power Wenstrom electric railway motor. At Arcade Hall a 50,000 watt Wenstrom generator was exhibited. Mr. Chadbourne and Mr. Hazelton were both present at the convention. The former made an address in the convention in which he described the system installed by the firm. His remarks will be found in the convention report in this issue. He laid special stress upon the fact that the armature revolutions were only 400 per minute On account of the slow speed it was possible to do away with the countershaft and gear directly to the axles.

D. H. Bates of the Accumulator company of New York and W. W. Griscom of the Electro-Dynamic company exhibited at Cold Springs Park on Wednesday afternoon the Edco storage battery car, in the operation of which the street car men were greatly interested. The car was equipped with 96 of the Accumulator company's cells and an Edco motor. The car is one which has done considerable work. It has run between 5,000 and 6,000 miles, and its equipment during that period of operation has not been changed except in a few minor particulars. Some experiments have been made in changing gearing but it is now geared as originally. The cells have never been out of working order, it is stated. The car carried passengers for an hour or more. The occupants were all street car men who critically watched the operations.

The Interior Conduit and Insulation company of New York was represented by E. H. Johnson, president and general manager, E. W. Little, assistant general manager and Clift Wise, chief engineer. The exhibit occupied a space at the end of the parlor hall and consisted of an elaborate display of both their interior and underground conduits. A model of the company's new manhole excited much interest. The company has just completed its order for 150 miles of underground conduits which carry the feeders for the overhead trolley system of the Minneapolis Street Railway company of Minneapolis, Minn. The company is so confident of the efficiency of its system that it announces that it will fill any orders for its conduits, either for electric lighting distribution or electric railroad requirements and guarantee the insulation for a number of years provided the conduits are installed according to its plans, specifications and expert supervision.

C. S. Van Nuis of New York, exhibited in Arcade Hall a full line of his Ajax switches. These switches are made of metal of high conductivity, properly proportioned and finished, so as to secure a maximum carrying capacity for a minimum amount of metal. Mounted on slate bases, they are practically indestructible from any reasonable overload. The new carrier and spring cause an instantaneous break across two or more long lines of contact simultaneously, and eliminate burning of the points of contact when called upon to open or break its maximum load or a short circuit.

The Peckham Street Car Wheel & Axle company of New York had on exhibition a full line of its specialties, the merits of which were fully explained by the inventor, Mr. Peckham the representative of the company. Models of the cantilever truck were shown. The new truck, No. 2, manufactured by the company is of lighter construction than the standard truck. It is intended for use on roads where lighter cars are used. It has eight springs instead of twelve. The models showed the new brakes, life guard and other features of the Peckham trucks. The company also showed several of its trucks equipped for electric railways in the regular exhibit. Samples of the interchangeable motor wheel and fibrous motor axle used by the company were exhibited. The Peckham company has been awarded the contract for 100 trucks for the Short electric railway in Rochester.

The Aluminum Brass & Bronze company of Bridgeport, Conn., had an exhibition of aluminum and silicon bronze, which attracted no little attention. One device was of especial interest—a trolley wheel made of pure aluminum. Its weight was stated to be less than one-third of that of ordinary trolley wheels. Its lightness makes it much easier it is stated, to make a good contact on the main conductor. The friction on the trolley wire is much reduced, it is said, by the use of the aluminum wheel. The fact that it does not fuse easily was demonstrated by a practical test during the convention, when, it is said, it carried 250 amperes at 500 volts without damaging it in the slightest. The exhibit included samples of silicon bronze wire used so much in electric railway construction. The company was represented by Frank G. Stone.

The Okonite company's familiar pyramid of reels of insulated wires was seen in Arcade Hall. The company was represented by T. McCoubray of New York and B. B. Daggett of the Buffalo Engineering company, the local representative of the Okonite company. All of the cables and insulated wires manufactured by the company were shown.

The Electric Merchandise company of Chicago, made a splendid showing of its apparatus in its parlor in the hotel. The exhibit included all varieties of supplies for overhead construction. Among the devices shown which attracted the special attention of electric railway men were the Stevens' positive gravity switch, a new fuse box, new trolley head, rawhide gearing. The company was represented by W. R. Mason and J. S. Gustin.

Emmet Bros. of New York City made an exhibit of their electric railway device. The display included pole tops, insulator switches of all sorts, and a great number of small devices designed for overhead construction. The firm was represented W. L. R. Emmet, who has been connected with one of the largest construction companies. Many of the devices shown were the results of his practical experience.

The J. G. Brill company made an extensive exhibit of its truck and apparatus for street railways. In its parlor were located two handsomely finished models of the No. 6 and No. 7 trucks. Several trucks were also shown in Arcade hall. An interesting device shown by the company was an automatic equalizer. It consists of two pairs of compound levers, having their fulcrums supported on the axle box frame, the short arms connected vertically by swinging links, and the long arms pivoted on plates which slide longitudinally on transverse portions of the upper frame. When used in connection with horse car running gear, the lever fulcrums are carried on axle bearings, and the long arms of the levers are pivoted on sliding plates on end sills of the car body. A heavy load on one platform, or a downward impulse caused by rough track, is transmitted by means of these levers to the opposite end of the car, distributing the load equally on all journal box springs, and keeping the car body parallel with the rails. It can be applied to electric trucks. The Brill company was represented by J. G. Brill, J. A. Hanna and Payson Andrews.

C. J. Field of the Field Engineering company of New York was among the attendants at the convention. The company builds electric railways complete with the exception of track-laying. Mr. Field is just now busy with construction in Buffalo. The Buffalo street car lines are to be consolidated and Mr. Field's company is converting thirty miles of the system into an electric road. Eventually 100 miles of street railway will be operated by electricity in Buffalo, The company which ownf all the lines will expend between three and four millions in equipping the several roads. Just what system is to be adopted has not yet been determined. Mr. Field has planned the construction so that it will be adapted to any system. Work on the power house for the portions of the system to be equipped this fall is well under way. Babcock & Wilcox boilers will be used and six 300-horse power compound condensing Ball engines built especially for the Buffalo road will be installed. Mr. Field says that the owners of the Buffalo system propose to have as good construction as can be had and will spare no money to make their roads perfect. J. B. Craven is the superintendent of work for the Field company in Buffalo.

The Indurated Fiber company of New York was represented by G. C. Collingwood, who showed a number of the tubes manufactured by the company. The tubes are employed by a number of electric railway companies in running their feeders underground.

The North American Construction company of Buffalo which represents the Westinghouse company made an elaborate exhibit, principally of lighting apparatus, though the company also installs electric railways. The several sizes of Sawyer-Man lamps were shown as were the new alternating current arc lamps of the Westinghouse company. The incandescent lamps surrounded by handsome globes made an effective showing. The Shallenberger meter was shown in operation. The case was removed so that the interior construction of the device could be seen. The company was represented by W. L. Adams and R. J. Mercur.

The New York Insulated Wire company was represented by J. W. Godfrey. He showed a full line of wires made by his company, designed especially for the use of electric railway companies. The visitors were especially interested in the high grade insulated wire designed for underground feeders.

R. Hoffeld & Co. of Buffalo, had on exhibition a belt made for the Brush Electric Light company of Cincinnati. It was 140 feet in length and 48 inches in width.

The Aenchbacker Railway Truck company of New Orleans, La, exhibited the Aenchbacker truck. The truck comprises many features which the representatives of the company say make it well adapted for all kinds of street car service. The company was represented by G. A. Aenchbacker and Ben. K. Curtis.

The Berlin Iron Bridge company of East Berlin, Conn. was represented by F. K. Field, and made an exhibit showing the construction work done by the company.

F. O. Rusling represented the Connecticut Motor company of Plantsville, Conn. In Arcade Hall two of the constant potential motors of the company were exhibited.

The Wightman Electric Manufacturing company of Scranton, Pa, was represented by Merle J. Wightman, who exhibited a line of samples of goods designed for use on electric railways.

The New York Car Wheel Works of Buffalo, N. Y. exhibited several of their machined car wheels to which the representatives of the company called the attention of those contemplating the use of electric power.

F. A. Magee represented the E. S. Greeley & Co. of New York.

The Jewel Belting company of Hartford, Conn., was represented by Mr. Newton.

Elmer A. Sperry of Chicago represented the firm of Elmer A. Sperry & Co. and looked out for the interests of the Sperry electric street railway system.

George L. Wiley represented the Standard Underground Cable company of Pittsburg and showed to the street car men samples of cables suitable for electric railway construction.

W. S. Loutitt, representing the Pullman company, had a splendid exhibit in the shape of the car which was equipped with two Westinghouse motors. The car is one of the handsomest ever constructed by the Pullman company. A description of it appeared in the last number of the WESTERN ELECTRICIAN. It is finished in the most elaborate style without regard to expense.

The Steam Gauge and Lantern company of Syracuse, N. Y., exhibited several of its new electric headlights. Several of the electric cars shown at Buffalo were equipped with these lights, which are handsome in design and well adapted for the purpose. The company was represented by E. C. Sawyer.

George C. Bailey and F. A C. Perrine of the John A. Roebling's Sons company exhibited wires and cables suitable for electric railway work.

Clift Wise, who designed much of the work on the Minneapolis and St. Paul roads, was an attendant at the convention.

Thomas Larbig represented Holmes, Booth & Hayden of New York.

Nothing is of greater interest to electric railway men than the heating of cars by the electric current. C. B. Hanna of the Carpenter-Nevens Electro Heating company of Minneapolis described to the delegates the system which the company proposes to employ.

Lemuel W. Serrell of New York exhibited a model of the Milliken electric railway poles. It is stated that over 6000 poles have been ordered within the last three months. The poles are ornamental but substantial.

The Maguire Manufacturing company of Chicago was represented by its vice-president, W. J. Cooke. The Westinghouse car, which was operated so successfully at the convention, was equipped with the trucks made by the Maguire company. The company's latest style of truck has a pressed steel frame.

C. R. Field represented the Habirshaw Wire company of New York City.

The Buffalo street railroad companies furnished the delegates with memorandum books containing twenty tickets, good on Buffalo lines.

Charles R. Barnes, city electrician of Rochester, N. Y., was in attendance at the convention.

O. D. Cotton of Chicago represented the Murphy Iron Works of Detroit, the manufacturer of the Murphy furnace.

The Belding Manufacturing and Motor company of Chicago exhibited a car equipped with one of its new street car motors. The company uses a single motor of large capacity. The armature shaft lies at right angles to the car axles. Rope transmission is used. The armature runs continuously and a new form of clutching device is used. Three levers are used for controlling the machinery. The car equipped with the Belding standard motor was built by the Gilbert company. It was vestibuled, painted outside in yellow and blue and handsomely finished. The Belding company was represented by Harold P. Brown.

The Westinghouse car which was exhibited was equipped with the Sessions air brake, manufactured by the Pullman company. Their operation on the car was entirely successful. The air brake was in charge of Charles Higgins. The electrical work on the car was done under the super-

[illegible] E. A. [illegible] of the Westinghouse company, Chicago. The electric headlights used on the Westinghouse motor car were made by the Star Headlight company of Rochester, N. Y.

The [illegible] Trolley Wire Holder company of Buffalo showed an assortment of trolley wire fixtures.

[illegible] superintendent of the Westinghouse electric railway department, Pittsburg, was an attendant at the convention.

The [illegible] Watson company of Boston showed a line of [illegible] insulators.

[illegible] of Cleveland, O., exhibited one of its transfer tables which are adapted for electric cars. A. C. Hathaway represented the firm.

The Simplex Wire company of Boston was represented by Dr. A. T. Mason.

James Goodmark represented Wallace & Sons of New York.

The *Street Railway Gazette* of Chicago distributed as a souvenir of the convention an extremely handsome little book containing portraits of the most prominent street railway men in the country.

The John Stephenson Company of New York was represented by D. W. Pugh and John A. Tackaberry.

Charles A. Schieren & Co. of New York were represented by F. E. Atkinson. Samples of the belting made by the firm were shown.

The Eureka Tempered Copper company of North East, Pennsylvania, had on exhibition a sample board at the hall. A. L. Daniels was the representative of the company.

G. H. Fisher represented the American Leather Link Belt company of New York.

R. T. Waite of Boston had on exhibition in Arcade Hall a full line of the street railway supplies which he manufactures and was kept busy explaining the merits of his various inventions. His chair rails and apparatus for elevated and surface roads were exhibited. Models of his elevated road and cable road were well shown.

That enterprising paper, the *Street Railway Journal*, issued a daily bulletin at the convention. It was a sizable sheet of forty pages and contained a report of the proceedings of the meeting and a vast deal of information of value to the visitors.

F. H. Johnson of the Interior Conduit Insulating company of New York said at the convention: "I desire to call your attention to the fact that the gradual development of the overhead electric system has become such that in many of the larger cities it is now becoming imperative that the conductor should be placed underground. In a city where fifty to one hundred cars are operated there is at least 95 per cent. of the wire on poles overhead which may with advantage to the company be placed underground. It is not necessary to have them overhead, the trolley wire being the only thing that is necessary to have overhead, it follows that all the feeder wires, special mains, etc., may be placed underground. The question is can the wires be placed underground with less investment and can the insulation of the wires be maintained underground with less charge for repairs, and if so, how? Our company is prepared to lay down the wires underground and guarantee their efficiency for a number of years. Until it is commercially successful, I propose to put the feeder wires underground, leaving the trolley wire to remain overhead. The tubes are paper, treated with special asphaltic compound to insulate them and placed in a trench, and then filled with the insulating compound."

The Central Lighting Station as an Investment.[1]

By B. E. Sunny.

The central lighting station has been the subject of many lectures. It has been discussed from an electrical, mechanical and geographical standpoint until there is not much left to say about it.

Everybody knows now what kind of apparatus to use, what steam plant to put in, and where he had better locate his central station. If he don't know, all that he need do is to tell the editor of his local newspaper that he is thinking about embarking in the electric lighting business, with strict injunctions as to secrecy, and before he knows what has happened he will be surrounded with a galaxy of dapper young electricians from the nearest big city, all brimming with wise suggestions and advice. If he escapes them—well, there is no use of discussing improbabilities.

Central stations, from an investor's standpoint, have not been discussed to any extent, however, and as I have had the opportunity of knowing the financial side of many of them, I may be able to make a few suggestions of interest.

While both the arc and incandescent light are young, they are old enough to give an account of themselves as money makers. They are not in their "infancy," as so many suggest, but are almost ten years old, and should stand or fall by the record that they have made during that period.

It may not be amiss to refer at this time, and in a brief way, to the introduction of these two forms of light to commercial and domestic use.

The arc lamp found a clear field, with practically no competition for outdoor and store lighting, and was immediately installed in all large cities to permanently replace the gas and oil lamps that for so many years had quite indifferently performed the service. The additional cost at that time charged for arc lights as compared with gas was very great, but only in proportion, however, to the increased amount of light. Price was of secondary importance as compared with the great demand for a means of making the stores and thoroughfares as bright by night as they were by day. The arc lamp became at once a popular and permanent adjunct in the service of the community, and as years have come and gone, it has become more firmly intrenched, so that it is now indispensable. While there are a few small towns in the country that have escaped the vigilance or resisted the wiles of the electric light man, history fails to record a single instance where the arc lamp has been discarded, and the old methods of lighting substituted.

When we consider what the arc lamp is, it is obvious beyond all doubt that it is the best light that has ever been known. Brilliant, steady, noiseless, absolutely reliable, and at the same time cheap, it is permanent, and notwithstanding the inventive age in which we live, it will shine on for years into the future. There is no possible substitute for it as it is used now, and while we hear of the prospective betterment of this thing and that, how seldom we hear any one suggest that there is soon to be a better light than the first-class arc lamp of to-day. The experimental stage has been passed, except as to minor details, and what we have now will stand the scrutiny, and defy the inventive genius of the next decade.

The incandescent light has had a hard fight for a position in the commercial and domestic world. Coming after the arc light, it has met the latter in competition for store lighting, and has felt the opposition of cheap gas and cheaper oil, in many instances difficult to overcome, especially in house lighting in a community where a small difference in price determined the choice of illuminants. Notwithstanding the fierce competition the incandescent light has become a fixed factor, with a future before it that its most enthusiastic admirer is more than likely to underestimate. Safe, clean, beautiful, and, above all, free from the injurious effects to health that are induced by the use of gas and oil as illuminants, there is only the incidental competition of gas and oil, that will be less and less as the years go by, to retard it in its march to supremacy in the lighting world.

It seems an inflexible and unvarying rule of the universe that we shall suffer injury to a greater or less extent, to persons and property through the imperfections of several great agencies in the service of the community. Every means by which a large mass of people are benefited calls for tribute in the shape of annoyance, loss and injury because of its failure to do that for which it is designed, uninterruptedly, reliably and perfectly. If we will go over the list of public corporations and analyze the advantages and disadvantages growing out of the service they perform, we will find this true in every instance.

The waterworks is a priceless boon, an indispensable public servant, but how often is the water so generously distributed, contaminated with impurities that cause epidemics and frightful mortality. It is only a short time since that the water furnished in this city was the subject of bitter complaint by the press and the people, notwithstanding we have the greatest sheet of pure water in the world by our side.

The gas works perform a service of equal importance with the waterworks, but its imperfections are evidenced in the blackened walls and ceilings, the vitiated atmosphere, the suffocating of ignorant or careless users, and the dangers of fire.

The sewerage system, so vitally necessary and important, frequently fails in its work of doing good always, and turns its attention to decimating the population.

The telegraph and telephone, the great time savers in this age where time is precious, vex us to the soul with their shortcomings seemingly beyond the power of man to prevent or cure.

The steam railway, performing the greatest public service, furnishes a column of disasters in the daily papers, and even the slow going street car, with plenty of time to be perfect in the performance of its duty, is imperfect in that it kills so much time in doing its work. If its sanguinary exploits ended in killing time alone, it would not be so bad, but it occasionally extends its field of operations to children and old ladies.

So it goes through the whole list, and we can contemplate with the greatest satisfaction the almost perfect service of the electric light, and its greater freedom from the annoyances and losses to those whom it serves than the agencies enumerated. True, it has contributed to a small extent, in comparison with its large work, to the fatalities and losses that the community must suffer for employing these public servants, but the circumstances in each case of injury or mortality have invariably been of an extraordinary character, and capable of permanent correction.

In connection with the success and permanency of the electric light, it can be said that no one recognizes the future of electric lighting more than our friends in the gas companies, more than 300 of whom are operating electric lights in connection with their gas works. The Gas directory says that the gas companies are operating 32,000 arc lights and 140,000 incandescent lamps. If it could be known in how many instances the individual owners of the gas property are also the owners of the electric light plant, it would be found that the number of electric lights in control of the gas companies is double the number shown.

In one year, from March, 1889 to 1890, the gas companies increased their ownership in electric lights to the extent of almost 50 per cent., indicating their faith in a most gratifying way in the earning power and permanency of the electric light.

If statistics showing the growth of the gas business during the last five years were available, I think it could be shown that the increase in gas consumption is nominal as compared with the growth in population, and that aside from the large cities, where the difficulty in stringing wires has retarded the electric light, the gas business has only changed with respect to the adoption of cheaper methods of manufacture so as to compete with electricity. In the smaller cities, towns and villages the electric light is available for every store and home, however remote, because of the inexpensive means that can be used for complete distribution.

The number of electric light companies operating in the United States is, according to recent reports, 1,483 against 968 gas plants. This great difference is owing to the large original outlay for a gas company as compared with an electric lighting plant. The former, with its heavy iron pipes buried in the earth, subject to heavy leakage and frequent expenditures for repairs, can only cover a limited territory, and yet calls for an investment five fold greater than the electric plant. The electric plant because of the great saving in the original investment, is invariably given the preference by investors, as is also the same with the electric railway as compared with the cable railway. Recent figures show 238 electric railways as against 44 cable railways in operation in the United States, while the latter has been in practical operation six years, and the electric railway half that time.

It is a self-evident fact, therefore, that the electric light is an absolutely permanent and growing investment; that it has taken its place in the large cities side by side with the great public corporations, contributing its quota to the general service and comfort.

By the excellent methods developed with such speed and skill, the individual is served with light or power, regardless of quantity—little or much and just as his convenience may dictate. It is under perfect control, is readily adapted to the varying conditions of the demands, and on the whole, calls for no extraordinary skill to operate.

Above all, the price at which it can be produced, and that at which it can be sold, leave a margin of profit that ought to be satisfactory.

So far then, we find that the electric light is, first, a commercial success; second, that it is permanently installed in the service of the public; third, that its imperfections are less than those attached to any public service.

I have gone over the condition of the business quite fully for the purpose of impressing you with the fact of its indisputable permanency. It is firmly lodged among the commercial enterprises, and has been for seven or more years. Now the important thing to get at is how does its record read from the investor's standpoint? Does it rank with the waterworks, the gas-works, the telegraph and the steam railway as a producer of dividends? Unquestionably it does. All who are familiar with the operations of lighting plants can bear testimony to the fact, notwithstanding the grave mistakes that have been made in planning for, and furnishing the service, and which have materially lessened the net financial results. With the one possible exception of the telephone the future of no business has been more greatly underestimated than the electric light. The telephone people, and I was with them for several years, blundered on the growth of the business with the greatest unanimity, and built everything too small. The electric light people did the same thing, and now the face of the earth is dotted with lighting properties, which were poorly planned, badly built, and indifferently managed. I have classed the lighting station with the waterworks, the gas plant and other quasi public institutions, in the importance of the service rendered, and as to financial results, but in the matter of construction I am sorry to say that the average lighting station is inferior. Where do we ever find a pumping station in other than a neat substantial brick building, rather than in a frame shell, covered with tar paper or tin? True, there are many lighting stations expensively and durably constructed but we can all point out a long list located in cellars, basements, abandoned barns and cheap wooden structures, with the usual and customary trimmings of second hand boilers, an engine too old for service in a saw-mill, and underwriter's wire. Of course such a plant is a cheap one and it is within the means of almost any man to start one, but with what results? Excessive running expenses and a succession of break-downs and repair bills, until the profits are eaten up, and there is nothing left for the owners but to abandon the property or sell out to some one who will reconstruct the plant on a proper basis.

This is one type of non-dividend paying lighting stations. Another is the station that is well built of brick or stone, with good steam plant and electrical apparatus, and starts off on its career with the applause of its projectors and patrons. It is a great success and the patrons increase until the fact is brought home to the owners that they have left no room for more boilers, more engines and electrical apparatus, and that to meet the additional wants they must add to the building and machinery; put up another stack and reinforce their pole line. Then begins the work that ends in the central station becoming an exhibition of engineering gymnastics. Engines of various makes are crowded in space too small for them, high speed and low speed, big boilers and little ones, until the station takes on so many peculiarities that a change of engineers is apt to shut it down until the new men can unravel the awful mystery. The remarkable thing about such a station is that it generally pays good dividends for the reason that every boiler, engine and dynamo is worked to its fullest capacity, and consequently under economical conditions. So long as the machinery stands the strain, the stockholders will have cause to rejoice, and it is at this juncture that they would be glad to have the demand for lights cease. In the nature of things, however, it is just at this point where the demand becomes particularly pressing, and the stockholders are confronted with the necessity of rebuilding in its entirety a station but two or three years old, too small for the reasonable demands made upon it. The rebuilding means the throwing away of the old station in many instances; selling at a great sacrifice the smaller engines and boilers to make room for larger types, and the absolute loss of the labor and material in foundation setting, steam fitting, etc. The shares of the stock representing the cost of the property abandoned continue however, to be an obligation upon which dividends must be paid. Then during the transition period, while part of the work is being performed from the old station, and part from the new, the increase in the operating expenses caused by two sets of men, and the disorganized condition of affairs, is very marked. It generally happens, too, that in their desire to make the new one a model station, the manager or

[1] Read before the Chicago Electric Club, Oct. 20, 1890.

superintendent devotes all of his time and attention to that work, and leaves the old station to the boys to run, with the usual results.

This is the type of station that changes from a good dividend payer to one that for a time at least, quits paying, and then resumes, or if its capital is increased, to take care of the rebuilding, it can continue its dividends during rebuilding, but on a smaller basis, because of the additional number of shares. There are but few central stations in the country that have not already, or must within a short time, go through with such an experience.

The remedy is old and naturally occurs to any one of moderate experience. It involves at the outset the selection of a larger lot and the construction of a larger building than we can at the time see any possible use for. There seems to be no reasonable limit to the demands that may be made for facilities, so that reasonable methods of planning do not seem applicable. A larger lot and building does not call for an excessive increase in cost over what a smaller property would cost. In fact, the real estate and building are generally the smaller items in the original expenditure. If, then, the boiler room, engine and dynamo rooms are planned for indefinite extension, according to the generous proportions of the building, not with reference to the growth of the next three or four years, but of the next fifteen or twenty years, and the machinery selected be of a standard type and capable of duplication from year to year, the sacrificing of original investments would stop. There are some who calculate the depreciation on the machinery of a lighting station at 10 per cent., but many will agree that the estimate is excessive. There is no reason why boilers, engines and dynamos with reasonable care, and the occasional renewal of parts subjected to heavy wear, should not last twenty years. I refer to standard apparatus of course, and do not include experimental types, that are, or ought to be, thrown out after a brief use because of their inefficiency. Now, if we start out right with plenty of room, with standard machinery, and the territory that we have is good, the increase is sure to come, and can be cared for gradually, by the addition of a boiler, an engine or a dynamo, without throwing away any part of the original investment until it is worn out. The whole secret of dividend paying enterprises is in their ability to run reliably, every day and every year, without subjecting the machinery to excessive and abnormal demands and in the avoidance of rebuilding or abandoning the original investment. There is no lighting property to day that cannot pay a regular dividend and earn enough above it to add to the plant as the demand may require.

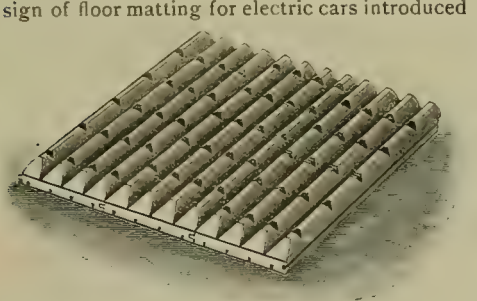
There is no fixed rule as to the dimensions of a station building that will serve the wants of its patrons, present and prospective The growth of the business has heretofore been beyond the calculations of the most enthusiastic. The same statement is true with the telegraph and telephone. The Western Union officials are building additions on their already mammoth structure in New York, that will increase the facilities four fold. The great telephone building on Cortland street, designed four years ago to furnish all the service below Canal street, is inadequate to meet the demands. The telephone building in Chicago, but three years old, is badly crowded, while in the electric light branch of the service, the Arc Light & Power company and the Edison company in Chicago have, after two years' operations, exhausted their facilities for extending in their present quarters. Rebuilding is in process or under consideration at Omaha, Denver, Milwaukee and other cities in the West.

We cannot complain of this most prosperous condition of affairs. Rather do we congratulate ourselves on the increasing growth in population, which does not come to the large cities only, but to the small ones, and to the towns and villages all over the greatest nation that the world ever knew.

With the increased number of people comes the increased demand for everything, and what more than light, and the electric light at that? Is it not wise, therefore, to pattern after the most substantial and permanent institutions of the time, and build not for the present and the immediate future, but for twenty-five or more years ahead of us? What is now standard may be obsolete ten years hence, but at the same time standards are slow to change, and with the economical and efficient boilers, engines and electrical apparatus of to-day, we are safe to embark in great and important investments, and leave the almost impossible task of improving on what we now have, to take care of itself.

Floor Mat for Electric Cars.

In the accompanying cut is shown a new design of floor matting for electric cars introduced



FLOOR MATS FOR ELECTRIC CARS.

by J. A. Hood of Chicago. This matting is made from clear, white hard maple, in strips ⅞ in. thick by 3⅜ inches face and 12 to 16 feet in length, tongued and grooved. It can easily be put down on top of any car floor, old or new, by simply beveling or chamfering the ends at the door entrance. It can also be laid crosswise in open cars Openings may be cut through for trap doors so as to give access to the motors in electric cars.

Pullman Palace Car Company.

The annual meeting of the stockholders o tha Pullman Palace Car company was held at the Pullman building, Chicago, last week. The capital stock of the company is $25,000,000, and of this amount $18,000,000 was represented at the meeting. The usually quarterly dividend of $2 per share from net earnings was declared, payable Nov. 15, to stockholders of record at the close of the business Nov. 1, 1890. Transfer books close Nov. 1 and reopen Nov. 17. The present value of Pullman stock is $215, and it was thought that a big dividend would be declared at this meeting. The failure of the company to do this is by some ascribed to the proposed co-operation of the Pullman-Westinghouse interests in the electric railway line. According to the splendid financial showing the Pullman company could pay 17 per cent. In the president's address it was stated that the average number of names on the pay-rolls at Pullman for the year was 4,582, and wages paid $2,733,019.27, making an average for each person employed of $596.46, against $579.06 for the previous year. The total number of persons in the employ of the company in its manufacturing and operating departments is 12,367; wages paid during the year, $6,249,891.65. The number of employes for the previous year was 11,063, and wages paid $5,770,345.26.

There was no change made in the Board of Directors. George M. Pullman, Marshall Field, J. W. Doane, Norman Williams and O. S. A. Sprague of Chicago, Henry C. Hulbert of New York and Henry H. Reed of Boston were re-elected. At a subsequent meeting of the board President Pullman was re-elected for the ensuing year.

The Government and the Telegraph.

Postmaster-General Wanamaker has written a letter to Chairman Bingham of the House committee, which has been investigating the question of postal telegraphy. In the course of this communication the postmaster-general says:

I am more than ever convinced of the wisdom and practicability of restoring the telegraph to the postal service and making it what it was originally intended to be—a part of the postal system. I say this after closely studying the arguments against the bill made so vigorously by the great Telegraph company which is now its only visible opponent. I do not believe it possible to argue this question down. There is a deep and far-reaching conviction among the people that the telegraph service is by right a part of the postal service. To carry the postal system from pony riders to stage coach and on to railroad service, and stop all further progress because 3,000 owners of telegraph stock oppose it, is not in accord with the genius of our people or the spirit of the times.

Mr. Wanamaker says the attorney-general has confirmed the opinion that the proposed bill is constitutional. The postmaster-general believes that those who are opposed to the bill, on the ground that it is unconstitutional are either paid attorneys of the telegraph companies or cranks who fear the constitution would be in danger if they were sick a day. He continues: "The courts of highest appeal have settled this question. Congress has settled it, in advance of judicial action, by making the United States the owner, and the postoffice department the manager of the first line of wire constructed for commercial and public uses. The old government telegraph schemes were constitutional. What shall be said, then, of the limited telegraph plan, which I have been somewhat criticised for bringing forward? There is no doubt that it is constitutional. The constitution permits the general government to transmit intelligence for the people. The postoffice department has been doing this, with the money and the improvements at its disposal, for one hundred years. It is preposterous to argue that the telegraph ought not to be utilized for the cheaper, speedier and more accurate transmission of messages."

The postmaster-general adds: "The limited postal telegraph bill is not a proposition to take money from the treasury or to employ additional civil servants, it is not a proposition to put any power whatever in the hands of the government, which is not at present greater and more dangerous where it is. It is a proposition simply to dovetail together two great machines, so that one shall do business equally well and make more money, which shall be willingly accorded to it by the people, the other to utilize its present skilled and faithful energy to help supply the people with still better means of communication, furnished still more cheaply. It is proposed incidentally to quicken the telegraph service by encouraging all the members of the operators' craft to realize that they are the better off the more they are able to devote themselves to one thing and are permitted to see some results from their inventive genius. It is not a proposition to buy the railroads or the coal mines, or the saw-mills or the bake-shops of the country. It is not a confession that American ingenuity is incapable of keeping up with the march of mercantile and industrial progress. If others speak out for the telegraph stockholders, some one must stand for the people in the interest of the cheaper telegraphy that they want. I believe that it belongs to this department to take this stand, and I propose intelligently and persistently to keep this subject before you, in strong confidence that it will not be long before your committee will take steps to give the people the relief prayed for."

The Death Penalty.[1]

By George F. Shrady, A. M., M. D.

The execution by electricity which has recently taken place has brought to the surface of general discussion a subject of the greatest concern to society at large. Upon the electric chair at Auburn was focused the high light of a world-wide interest. It was promised that the new method of getting rid of a murderer should be an improvement upon all others. History must now record its failure from many points of view. When the harrowing details of the death chamber were tingled along the telegraph wires of the country, and their impulses were throbbed through the cable, the entire civilized world viewed the scene with astonished horror. The criminal became a martyr, and the manner of his execution was anathematized by the daily press as a disgrace to civilization. He came to it submissively, trusting to an easy death, but was killed like a writhing dog. He kept his promise to do as well as he could, and the only mercy was that he was rendered unconscious from the first. Viewed even as a scientific operation, however, it transcended in apparent brutality anything that can be imagined. And yet this was claimed to be the true and improved way of doing it. This, too, after all the discussion by expert electricians, after all the experiments upon the lower animals, after the careful examination of the power of different machines, the accurate measurement of volts, the elaborate estimation of resistance to currents, and the exhaustive study of the generating power of different dynamos. It was the first dreadful trial on a human being to measure the terrible force of quickly repeated lightning strokes against his vital tenacity. Seemingly every precaution had been taken to make the result a certainty, when exactly the opposite was proved.

As now shown there was no accurate and reliable way of determining positively when real death occurred. None of the experts dared examine the victim while the deadly current was coursing through its circuit. No one could go near to feel the pulse, or to listen to the heart beat. All the chances were taken upon the actual number of seconds required to make life extinct. That there was an error of judgment in that regard was shown in the respiratory struggles of the criminal after the first shock was administered. Although there was no more pain or agony during these efforts than if the man had been under the influences of an anæsthetic and had been undergoing a severe surgical operation, there was scarcely less doubt, under such conditions, that he might not have rallied if the shock had not been repeated. Viewed from such standpoints it can hardly be claimed that the first use of electricity as a means of producing death easily, quickly, and as some have claimed, "pleasantly," was, by any means, a success. All this was done for the sake of making an improvement upon the other forms of execution. When, however we compare electricide with these, we are forced to admit that it utterly failed to meet the extravagant claims of its advocates. The scene in the death chamber was well calculated to impress any impartial observer with this fact. For the poor victim's sake we are glad to believe that he suffered no pain, but at the first stroke he was simply shocked, not killed, then after a torturingly long interval the shock was repeated and continued, until the burning flesh of his back demonstrated that the sacrifice had been complete From the administration of the first stroke until the second circuit was finally interrupted, five minutes and twenty-eight seconds elapsed. In view of these facts it can hardly be said that the execution was a speedy one, certainly not as quick as lightning. That the murderer suffered nothing is no argument in favor of the apparent brutality of failing to kill him at the first blow, then striking him again and accidentally roasting him afterward The start was well enough, perhaps, but who can contemplate the finish without a shudder. The only comfort those can take who have advocated the new plan, is that the first current was a stunning one. But in the other methods of inflicting the death penalty is there more suffering?

Excepting perhaps the Russian plan of execution by the

[1] From the Arena, October

...beating the life out of the victim with a loaded lash—the question of element of pain to the individual is hardly worthy of consideration. The guillotine is certainly very rapid in its action, and, as far as can be judged by analogy with similar phenomena, all sensation is abolished on the instant of the stroke. The communication with the brain centers is at once cut off, and the sensation current is instantly interrupted. The only revolting part of the proceeding is the necessary shedding of blood; but this, scripturally speaking, should render the killing contract more valid. As to rapidity and effectiveness the same thing is done with the heavy Japenese sword, and with scarcely less precision. The Spanish garrotte crushes the cervical spine and upper spinal cord by means of a screw quickly working through the back of an iron collar. Death here is practically instantaneous. The same may be said also of hanging. The instant the noose tightens its choking grip, consciousness is gone. The contorting spasms of the larger muscles are merely involuntary movements that have no connection with appreciable pain. At least, this is the testimony of men who have been cut down while insensible from attempted suicide by such means, or who have been similarly rescued from accidental hanging. When there has been bungling, the rope should not be blamed. Even the electric chair may not have had its chance.

The objection to hanging on the grounds of simple humanity has been that some moments must elapse before actual death can be a certainty. When the neck is not broken (and this is the rule), the heart continues to beat in a more or less irregular manner for several minutes after the suspension. But if the hanging is properly done, death is always sure and there are never any attempts, reflex or otherwise, at respiration. The victim, free from pain and absolutely unconscious after the first convulsive throes, swings motionless in midair, a limpid nothing of humanity. Unconsciousness and consequent loss of sensation are in such instances evidently due to the combined effects of the shock of the fall and of the congestive brain pressure caused by the grip of the noose.

In studying the technique of executions it is interesting to note a desire on the part of those who believe in these forms of punishment, to inflict as little suffering as possible upon the condemned one. This is as it should be and is so far a credit to our present civilization. Those who hold a contrary view are happily in the very small minority. There is only pity for such as claim that the more severe, revolting, and cruel we make an execution, the better it will serve its purpose. It is to be regretted, in this age of enlightenment, liberality and progress, that even clergymen should be found among the stanch advocates of this obnoxious doctrine. By their training and mission it would be quite reasonable to expect from them something in advance of the religion of the fire and the sword. Thinking men now ask a better argument for revenge than the quotation of a text or the literal interpretation of a scriptural injunction. Strange to say in a newspaper column of personal interviews representing the opinions of scores of leading preachers there was scarcely a man among them who was not in favor of some form of capital punishment, and not one who was not willing to advise it as a last and effectual remedy for murder. Such conclusions are, to say the least, sorry comments upon a gospel which for nearly nineteen centuries has lent its best efforts toward Christ a...izing humanity.

Thomson - Houston Electric Railway Work.

During the past two months the Thomson-Houston Electric company has been actively engaged in completing the construction of, and has put in operation, electric railways at Concord, N. H.; Shreveport, La.; Newark, N. J.; St. Paul, Minn.; Memphis, Tenn.; Anaconda, Mont.; Helena, Mont. These motors comprise 50 motor cars and 33 54 miles of track. The St. Paul road was put in operation on October 8 1890, and has been running satisfactorily ever since. The Concord Horse Railroad, N. H., eight cars and seven miles of track, was started October 8, the trial cars having on board the officials of the road, and invited guests. Everything in the working of the system was excellent, and the best of results are anticipated by the officials of the road. The road of the Shreveport Land and Improvement company, Shreveport, La., four cars and 5.25 miles of track, was put in operation October 4, and opens up for residence a large territory owned by the Shreveport Land company. The initial run was made without an accident of any kind, every car being utilized, and working to the entire satisfaction of all present. The City and Suburban railway, Memphis, Tenn., five cars and five miles of track, was formally opened at 5 A.M. on Oct. 6, in the presence of about five hundred people The cars all worked well and their operation on daily schedule time of starting has convinced the residents of Memphis that the benefits of rapid transit have in no sense been exaggerated. On October 4, the city of Newark turned its back on horse car traction and inaugurated a new system which is working to the entire satisfaction of those interested in the road, and the public as well. The trial trip was a complete success, none of the evil forebodings of the past happening to jar upon the gratifying experience of the day. The company has equipped 5.75 miles of track, and have twenty cars in operation. The people are very enthusiastic over the new method of transit and predict a grand success for the electric cars in the future.

On August 2, 1890, the Thomson-Houston Electric company commenced the equipment of the Alamo Street Railway, San Antonio, Texas, and on September 25, 1890, in less than two months, had laid ten miles of track, put up the overhead construtions, and had ten cars in operation to the entire satisfaction of all parties concerned.

An electric lamp for miners, weighing only three pounds including the battery, has been in use in English mines for some time with excellent results. The battery which is used has a capacity of ten hours. L. Bristol is the inventor.

CORRESPONDENCE.

New York Notes.

NEW YORK, Oct. 18 —The cost of electric lighting and the subway question is again being agitated by the electric companies. They accuse the subway company of charging a higher rate per mile for rental of subway ducts than is paid in any other city. Suits have been commenced against the Consolidated Telegraph & Electrical Subway company by several of the lighting companies to fix, if possible, the amount of rental the subway company has a right to charge, and also to restrain the subway company from interfering with the electric cables and other property of the lighting companies. Temporary injunctions have been granted restraining the subway company from interfering with the cables, and next Tuesday arguments will be heard to make the injunctions permanent.

The electric lighting companies claim that the Consolidated Telegraph & Electrical Subway company has had a monopoly of building subways through its contract with the Board of Electrical Control. Protests have been filed with the board by some of the electric lighting companies to the effect that the rental was illegal and unfair, and asked a report as to the cost of the subway in order to determine a fair rate for rental. No attention has been given this demand of the lighting companies by the Board of Electrical Control, but matters were brought to a crisis by the subway company refusing to allow any company to occupy a new duct unless rental at the rate prescribed was paid yearly in advance. The subway company also served notices on the electric lighting companies that unless payment was made before last Thursday it would cut and remove the cables of the lighting companies from the subways. These notices gave the electric lighting companies an opportunity to obtain temporary injunctions against the subway company. The subway company substantially denies the charges which the electric lighting companies are making, and the fight promises to be a lively one.

The New York Telegraphers' Club gave its second annual ball at the Central Opera House, Tuesday evening. The members were out in full force and spent a very jolly evening in feasting, dancing and merrymaking. An interesting prelude to the programme of the evening was the presentation of the prize given by the Hon. James D. Reid, United States Consul at Dumfermline, Scotland, to Miss Kitty Stephenson, the winner of the first prize in the ladies' class in the fast sending tournament of last April.

The incorporation of the Aerial Conduit company, limited, with a capital stock of $35,000, is announced. The object of the concern is the manufacture and sale of conduits and tubing for electrical conductors and wires, and for other purposes, and posts and other supports, together with supports for electric lights and wires, and insulated wires and cables and other material in the city of New York. The incorporators are John F. Gibley and Frank W. Rennell, of New York City, and James Craig, Fred H. Smith and Austin Gallagher of Brooklyn.

A certificate incorporating the Broadway Railway company was filed to operate the present Broadway surface railway from the Battery to Union Square in New York City, and will be operated in conjunction with its present connections for a single fare of five cents. The new company is capitalized at $1,000,000, and has as its directors Daniel S. Lamont, Thomas F. Ryan, Henry Thompson and Charles F. Frothingham of New York City, Charles E. Warren, Daniel H. Hasbrouck of Brooklyn, and William J. Ramsey of Newark.

Frank E. Brown, electrician of the Board of Electrical Control of this city, and Miss Laura Lycitt were married at the residence of the bride's parents, 415 West Fifty-fourth street Thursday evening.

The Edison General Electric company of Schenectady, has been purchasing considerable land in the vicinity of its works. The deeds have been filed in the county clerk's office and they show that many important transfers have been made.

An interesting case of lightning stroke is reported to-day. During a thunderstorm a police officer attempted to report from a patrol box to the police headquarters. He was opening the box when lightning struck the wires near the box. Without a cry or even a tremor of the limbs, he dropped in front of the box, to all appearances struck dead. He was carried into an adjoining house, where a physician examined him and detected feeble signs of life. Powerful restoratives were immediately applied, in a few minutes respiration was restored, and soon after he recovered consciousness. He complained of a numbness in the legs, and on attempting to rise found that he was completely paralyzed from the waist down. He suffered no pain, and no marks of burning were anywhere visible on his body. The doctor hopes that he will recover the use of his limbs.

W. H. T.

Kansas City, Mo.

KANSAS CITY, Oct. 18.—At a recent meeting of the council a resolution was introduced by Councilman J. W. Humphrey relating to the subject of economically lighting the city He said: "Our present annual appropriation for street lighting is $95,000, and that buys us approximately 125 arc lights, 1,525 gas lamps and 1,400 gasoline lamps. While we may be getting value received for our money, I am confident that the city can have more and better lights for much less money by operating its own electric plant.

"The very first section of the first article of our charter empowers the city among other things to acquire by purchase, or otherwise, land or other property, for gas works, or other means of lighting to supply the city with light."

The resolution provides for the issuance of bonds to purchase the plant. Continuing, he said: "Such a plant as is provided for in the estimate will save the city $52 437 every year, and will, therefore pay for itself in four years, besides enabling the city to light its streets more perfectly. In estimating the cost of a plant with a capacity of 200 arc lights and 3,000 incandescent lights, and the cost of maintenance of the same, I have not relied wholly upon my own investigation of the subject, but have had the valuable aid of a practical electrician."

The estimated cost of the plant would be $198,500. The cost of maintenance and interest on investment are estimated at $42,563.. Mr. Humphrey said: "The cost of maintenance is based on an estimate that the plant will be operated, on an average, nine hours each night and every night in the year. Our present annual appropriation for lights is $95,000, the total cost, interest included, of operating this plant would be $42,563. The city would, therefore, save annually $52,437, enough to pay for the plant in four years, would have 200 arc lamps instead of 125, and 3,000 16-candle power incandescent lights in the place of 2,925 unsatisfactory gas and gasoline lamps.

"That is not all, however. The plant could be given a doubled capacity at an added cost of $61,250. The additional cost of operating would be $20,675, and in computing the cost of maintenance, full allowance has been made for the burning out of the incandescent lamps, repairs and all other items of that character. Under the foregoing estimate the city would have 400 arc lamps and 6,000 incandescent for $63,238 a year, where it now pays $95,000 a year for but 125 arc lights and 2,925 gas and gasoline lamps, and even then it would save $31,762 annually, paying for the plant in less than seven years.

"But suppose the city uses only 200 of the arc lights and 3,000 of the incandescent, sufficient to light the city much better than it is now lighted, and rented the remaining 200 arc lights and 3,000 incandescent for commercial purposes. The net gain to the city would be $11,162.

"The city would have 200 arc lights and 3,000 incandescent lamps, lighting its streets at no cost to itself and make $11,162 a year besides saving to the treasury the $95,000 it now expends annually for its lights, making a total annual saving of $106,162, or enough to fully pay for the duplicate plant in less than three years. When the plant was paid for the interest on the bonds, amounting to $15,675, and which is included in the foregoing estimate of expenses, would of course, be stricken from the account."

The several telegraph and electric light companies are reluctant in these days to make application to the Board of Public Works for permission to erect poles in even those streets over which they claim that their several franchises extend. This unwonted hesitation has been induced by the receipt by each of the companies of a communication from the Board of Public Works, requesting them to file with the Board copies of the clauses in their franchises under which they claim the right to erect poles. The trenchant part of the communication is concealed in a request to the companies to take notice "that where poles are to be used by other lines it must be stated."

The attention of the Board of Public Works was first directed to the question by the action of the Kansas City Electric Light company in erecting poles on Eighth street. The Postal Telegraph company has a line of poles on Twelfth street, which the electric light company was desirous of using, and as the latter company's franchise permitted it to erect poles on Eighth street, and as it was a matter of indifference to the telegraph company by what street entrance to the city might be gained, a little trade was proposed Thereupon the Board issued its communication which has been succeeded by silence.

It seems that there has never been any adequate supervision of the various companies that from time to time have been given authority to erect poles on certain specified streets, and the actions of the companies have been subjected only to such restraint as their interests might dictate. The board has assumed full control of the situation and is now engaged in an investigation of the actual rights of the companies under their franchises.

The Northeast Street Railway company has begun the

erection of its new car barn at the northwest corner of St. John and Elmwood avenues, and hopes to have it completed by November 1. The capacity of the power house was wholly insufficient to accommodate the twelve cars of the company. The location is the eastern terminus of the line. The offices of the company and the repair shops will also be located in the new building. The summer cars and equipments will be stored in the present barn. The new one will have a capacity for twenty cars.

The Consolidated E ectric Light company, Kansas City, Kan., has filed with the register of deeds a deed of trust of $175,000 in favor of Clarence A. Parks, trustee. The instrument states that the money is to be used in erecting buildings for a plant.

The council of Independence, Mo., at its last meeting had the matter of lighting the city streets up for consideration again. The contract was let to the Citizens' Electric Light company for $7.50 per arc light and twenty lights are to be used. The terms of the contract call for lighting the streets from twilight until midnight, and from 5 o'clock in the morning, until daybreak.

Col. D. B. Dyer, an old resident of Kansas City, but now president of the Augusta Electric Railway company of Augusta, Ga., is in the city on a week's visit. Col. Dyer while in Kanaas City, was a prominent business man, and afterward became the first mayor of Guthrie, Oklahoma, when that town was organized. For the past year he has been in Augusta at the head of the eiectric railway system of that city. The Jarvis-Conklin Mortgage Trust company of this city forms the financial backing of the enterprise, and it has been a success from the start. There are seventeen miles of road now in operation, and eight miles more nearly ready for business. Colonel Dyer says he is considering a scheme to operate the entire system by electricity, generated by water power, thus greatly reducing operating expenses.

"Augusta," says Colonel Dyer, "has as fine facilities for water power as any city on earth. About seven miles above the city and above the rapids of the Savannah River a canal begins, which is cut directly through the city and furnishes a 14,000 horse-power. The canal was built at a cost of $1,750,000. It is paying for itself, however, and making Augusta rich. It is lined with cotton mills and her manufacturing concerns." P.

Minneapolis, Minn.

MINNEAPOLIS, Oct. 18.—The St. Paul capitalists who are interested in the project of equipping the city of Winnipeg, Manitoba, with a complete electric street railway system were a little surprised the other day when a local paper published a telegram from that city giving an outline of their alleged attempt to corrupt the city council of Winnipeg to secure the desired franchise. Some time since citizens of Winnipeg, operating in conjunction with capitalists of St. Paul, applied for a charter extending the privilege of constructing, equipping and operating electric lines in that city, and the matter was supposed to have been favorably considered. The Winnipeg capitalists made a visit to the Twin cities for the purpose of investigating methods of construction employed here and securing estimates on the cost, and no difficulty was apprehended in regard to the successful initiation of the enterprise. It is now stated, however, that a very bitter feeling has been engendered against the new company by local interests with which the proposed enterprise conflicts, and that this feeling has been enhanced by the fact that the bulk of the capital to be employed is American. At a meeting of the council two months ago two petitions for franchise were simultaneously submitted and since that time the controversy has been waged with varying prospects. The opponents of the enterprise make charges of wholesale bribery. A long Manitoba winter is before the Winnipeg council, and they will have abundant time to decide on the corporation which shall be allowed to put in the first Manitoba electric street railway.

The Minneapolis city council has ordered the city wires buried. The wires of the fire-alarm telegraph system are now nearly all underground and the connections will soon be established. Inside of Fifteenth avenue south, and Fourth street they have all been buried, about forty miles of single wire cables, or seven miles of standard 6-wire cables, being laid in conduits. The distribution box, through which all the cables of the city pass, is at the corner of Washington and Nicollet avenues. Firemen did the bulk of the work. The North American Telegraph company has just made the announcement that it will place its wires underground at the earliest possible moment. Supt. Tuttle of the line is now in Chicago negotiating for a satisfactory cable. The Dorsett conduit will be used In a short time the Western Union Telegraph company will be the only one in the city with its wires overhead. Supt. McMichael of this company has stated that the Western Union may possibly use the overhead cable system in Minneapolis.

E. L. Randall of Kansas City, Mo., is in Minneapolis for the purpose of organizing a lodge of the Brotherhood of Telegraphers. He has had satisfactory results thus far and believes he will be able to get nearly every operator in the city into membership and sympathy with the order. The railroad operators are particularly enthusiastic and are especially pleased with the insurances feature of the Brotherhood. E. L. Randall, the organizer, is the man who has a suit pending against the Rock Island road for $75,000 damages for blacklisting him in the strike of 1883.

Public dissatisfaction over the torn up condition of the street railway in both cities is beginning to take the form of public meetings. Two of these have been held during the week, one in each city. The Fairview Heights Citizens' Union in St. Paul instructed its aldermen to vote against any extension of time to the street railway company if its lines were not all in operation by Nov. 1. This action is so radical as to be ridiculous, as the street railway company, notwithstanding the wonderful rapidity of its work, has been too much delayed in getting material to be able to finish all its lines this fall. The North Minneapolis Improvement association met Monday evening to publicly insist on the completion of the Twentieth avenue line. The street railway company is paving Twentieth avenue with its own money in order to be able to lay its track and trusts to the city council to reimburse it next year. As a rule both St. Paul and Minneapolis people are satisfied with the progress of work on the new lines, and delighted with the success of the electric power on the lines that are in operation.

The only hitch yet encountered in the operation of the new lines occurred this week. A heated journal on the big engine at the Third avenue power house necessitated a shut down for two hours, leaving heavily laden cars standing in darkness and rain. The Fourth avenue line, receiving its power from another station, was not affected.

Barnard Bros. & Cope, the Minneapolis Furniture company, and McLeod & Smith, have each installed electric lighting plants in their factories. The Brush Electric company furnishes the first named concern 134 incandescent lamps. The Thomson Houston company installed the plant from which the others are lighted, 275 incandescent lamps being used C.

THE ELECTRIC LIGHT.

Bids for lighting the streets of Seattle, Wash., have been received from both of the electric lighting companies, but the contract has not yet been awarded.

At the annual meeting of the stockholders of the Schuyler Electric company, Thursday, Oct. 9, the following gentlemen were chosen directors: S H. Butler, John N. Camp, Walter S. Hubbard and C. E. Jackson of Middletown, Conn., C. N Wayland and C L. Buckingham of New York and Chas E. Dustin of Hartford. A meeting of the board of directors was held immediately after, and officers for the ensuing year were elected, as follows: President, Chas E. Dustin; vice-president, S. H. Butler; treasurer, Jos. T. Elliott; secretary, D. J. Glazier.

The Brush Electric company of Baltimore, Md., is now making improvements and additions to its already very extensive alternating current electric lighting plant, which will give it a total capacity of 20,000 16-candle power lamps, and thereby the Baltimore central station plant will become one of the largest alternating current incandescent lighting plants in the United States. It was in the early part of 1887, a little over three years ago, that the Brush company made the first contract with the Westinghouse Electric company for the installation of alternating current apparatus aggregating a capacity of 5,000 lights. The demand for the new light grew at an enormous rate, and before long the company was compelled to increase its plant. The Westinghouse company was called on for an additional apparatus of 3,000 lights' capacity. But even this did not long satisfy the demand, and twice again the company increased its capacity by 3,000 lights, until at the beginning of the present year the central station plant of the Brush Electric company of Baltimore City had a total capacity of 14,000 alternating current incandescent lights. This last addition has again been necessitated on account of the demand which has been made on the Baltimore plant, and when the installation shall have been completed there will be but two cities in the country with larger capacities of alternating current incandescent lighting apparatus—Pittsburg with 60,000 lights, and New York with 50,000.

The Thomson-Houston Electric company, Western isolated lighting department, reports the following list of sales of isolated electric light plants: W. C. Ritchie & Co., Chicago, 200 incandescent; Jno. Kranz, Chicago, 300 incandescent, Calumet Distilling company (increase) Chicago, 26 incandescent; Baker & Yauter, Chicago, 100 incandescent and electro plating machine; Elite Furniture and Lumber company, Argenta, Ark., 30 arc; Academy of Music, Chicago, 18 arc; National Forge & Iron company, East Chicago, Ind., 20 arc; A. H. Andrews & company, 600 incandescent; Consolidated Piedment Cable company, Oakland, Cal., 30 arc; Citizens' Street Railway company, Indianapolis, Ind., 30 arc; Dernberg, Glick & Horner, Chicago, 45 arc; Mountain Ice & Cold Storage company, Salt Lake City, Utah, 50 incandescent; Illinois Steel company, South Chicago, Ills., 30 arc; D. D. Wilder, Santa Cruz, Cal., 100 incandescent; Ira C. Darling & Co., Stock Yards, Chicago, 150 incandescent; Shailer & Schiglau, for Lake View Tunnel Crib & Water company, 75 incandescent and one 1-horse power moter; Crocker Chair company, Sheboygan, Wis., 500 incandescent; Wright & Hills Linseed Oil company, Chicago, 150 incandescent; Goetz & Brada Manufacturing company, 18 Michigan street, Chicago, 12 arc; C. T. Roenitz Leather company, Sheboygan, Wis., 150 incandescent; Huntington, Hopkins, San Francisco, Cal., 300 incandescent; Hanson Furniture company Janesville, Mo., 75 incandescent; City of Chicago, Hyde Park & Lake Water Works, increase 30 incandescent; H. A. Foster & Co., Prentice, Ill., 100 incandescent. The plant for the Lake View water tunnel, water works and crib, will be unique in some respects, as the dynamo will not only supply electric lights at the works on shore but will also be used to run the motor at the crib for rigning a fog bell, and the same dynamo will supply a number of incandescent lamps in the lighthouse on the crib, to take the place of the ordinary light-house oil lamps.

A word to the wise when the "wise" are "electrical" editors on daily newspapers, may be sufficient. At any rate this may set them thinking: There was a curious scene in Paris the other day just outside the Opera House, according to a correspondent of the London *Daily News*. Traffic was in full swing, when a lady who was crossing the street and had got on to one of the refuges sunk to the ground with a scream. She had put her foot on a large metal plaque, and immediately felt an electric shock. The usual crowd collected and the usual police arrived. But the cause was clear to all. Quite close to the scene of the accident was a standard of clustered electric lights, and the wire which supplied the current passed close to the metal plate. With great presence of mind the police sent for several electricians, keeping a cordon in the meantime round the plaque. The experts went to work quickly and cautiously. The metal plate itself was raised. It communicated with one of the subterranean passages that lead to the drainage system of the city. Then at last the cause of the accident was discovered. A workman employed in the drains wanted to emerge, and happened to push up the plate at the moment the lady's foot was on it. Hence the earthquake and the shock. Thereupon the crowd dispersed, the electricians went home, the police preserved impenetrable silence, and the lady, who really showed considerable imagination, decided to say as little as possible about the accident.

THE ELECTRIC MOTOR.

A belt line electric road is contemplated at Los Angeles, Cal. The trustees have granted a franchise to B. A. Cart.

A contract has just been closed by the Detroit Electrical Works for the full electrical equipment of a street railway in Nashville, Tenn., with a Rae system.

The entire San Antonio, Tex., street railway system has been converted into an electric rapid transit line. The new cars have been running with entirely satisfactory results. Mules have been in use for ten years. A few of the old cars will be kept on in case of emergency, but in a month's time there will not be a mule on any San Antonio track. The city now has three electric roads, all completed within the past week.

The Rochester, N. Y., Street Railway company has placed a Brush railway generator in the Brush Electric Light company's station. It is expected that eight electric cars will be operated immediately on the Lake avenue and South St. Paul street route, the equipment of which has been finished. The span wires are fastened to the walls of the buildings on Main and Exchange streets, thus enabling the company to dispense with poles.

A recent London cablegram says: "The steamer Silvertown, belonging to the India Rubber, Gutta Percha and Telegraph Works company (limited) of London, having on board 1,750 miles of cable for the Central & South American Telegraph company of New York, passed Dover at 5 P. M. on the 11th, inst en route for Valparaiso. This cable is to be laid between Chorrilos, Peru, and Valparaiso, Chili, touching at Iquique, as an extension of the American line via Galveston."

A new electric road has been constructed at Anaconda, Mont. The Thomson-Houston system is employed. The road is four miles long and four motor cars and four trailers are operated. Power is furnished by two 40,000 watt generators. The company is now constructing a power house that will accommodate the electric lighting plant as well as the street railway generators. Apparatus for 180 arc lights and 3,000 incandescent lamps will be installed. Water power will be employed.

It is a good thing for a town to have capitalists build street railroads, but a franchise for a road is often of considerable value, and boards of trustees and supervisors should exercise great care in granting them, says the *Pacific Electrician*. There are always parties without means who are ready to speculate in franchises, and instances have happened more than once where improvements are kept back because some irresponsible party holds a franchise and keeps others out. No franchises should be granted except to parties who can prove that they mean business.

Ten electric cars, the conductors say, are the greatest number run yet at one time over the Fourth avenue line, although the company owns some fourteeen in all, and John Stephenson is at present turning out others for the same storage system. Just now only three or four of these cars are run, and the way people crowd into them as evening draws on, and their clear, strong electric lights flame out, testifies public appreciation of the slightest effort on the part of the carrying corporations to increase the comfort of the traveling public. The vile, sooty old lamps in

the P cars, which might easily be made as efficient as the lights in the vestibule railroad trains at least, are as often as not these rainy evenings only half lighted, and by no means half cleaned.—*New York World.*

A London contemporary calls attention to the fact that the trend for small machines in England has not been developed. Enumerating some of the uses to which these machines could be put it says: "A small motor that could be switched on or off could be made to drive boot brushes, and any visitor could have his boots brushed at any time." Machines of this kind have long been in use in this country. It is amusing to Americans to find Englishmen awakening at this late day to the advantage of the electric motor.

A Cincinnati exchange says: "Suit was filed in the Circuit Court at Newport by H. J. Browning against the Western Union Telegraph company for $500. Mr. Browning alleges that on the fourth day of the present month he was in Buffalo, N. Y., and hearing that his wife was ill telegraphed her with instructions for her to answer as to the condition of her health. He never received the telegram and getting no answer came on to Newport, thereby neglecting his business and losing the amount named on account of his absence from Buffalo."

Electric motors operate all the machinery in the establisnment of the Allgemeine Elektricitats Gesellschaft, Berlin. *Kohl's German Trade Review* describes the plant as follows: Two compound steam engines of 100 horse power each are coupled direct to suitable large dynamos of 110 volts pressure, which supply the electrical current both for lighting purposes and for the electric motors. There is no need for belting or any other form of mechanical transmission. A network of cables supplies the energy in the smallest and otherwise quite inaccessible corners and renders it possible to alter the position of the different machines according to the special purpose. This is of great advantage for very heavy and large pieces to be shaped or worked at, since the tool may be brought to the work piece and not vice versa. Although part of the energy expended is wasted in the primary dynamos and in the electromotors it is stated that this waste is far below the loss that would be caused by a mechanical transmission plant requisite for this factory. There is besides, another drawback of mechanical transmission. The plan of the building is, to some extent, dependent upon the general disposition of the belts and pulleys, while with the electric transmission of power every space of the building, no matter how this was designed, can be easily reached without complicated belting, friction and cog-wheel apparatus, and the control of the bearings couplings and the dangerous management of belting is entirely avoided. As to the working expenses it must not be overlooked that as each motor may be used independently from the others, considerable saving of running power can be obtained, because it never occurs, as with the mechanical transmission, that for only one small working machine a very heavy countershaft, with all its supplements, must be run idle. The lighting of the workshops is interesting and it is obtained by eighty five arc lamps and 300 16-candle lamps; the former are suspended only 7 feet from the ground, but inclosed below by a parabolic reflector, which throws the rays up against the white washed ceiling and walls, so there is a very splendid day like illumination, and no workman is compelled, in order to see the details of his job to approach the lamps.

Miscellaneous Notes.

A. W. Rippy, an employe of the Pullman company, has perfected an electric air brake, it is claimed, for use on railroad trains. The device, it is said, is so constructed that the air chambers can be recharged, whether the brake is in operation or not.

Timing horse races by electricity is familiar to horsemen throughout the country and the excellent results thus obtained have no doubt served to encourage those interested in athletic sports to perfect an apparatus for timing sprinting contests. Recent trials of these devices have demonstrated their value in close contests, where accuracy is the most desirable feature.

An effort is being made in Chicago to organize a "Practical Science Institute," to be managed after the plan of the Franklin Institute of Philadelphia. The chief object of the institute is to interest practical artisans in practical sciences. H. Haupt, Jr., room 606 Rialto building, is the promoter and originator of the scheme, and he is now at work interesting others in the subject.

Personal Mention.

George K. Scrugham, electrician of the Bell Electric Line company Lexington, Ky., was married to Miss Sallie Antoinette McConnell, Oct. 22.

Business Mention.

The National Electric company, Philadelphia, is exploiting the Warrell fuse block, which is made of vitrified porcelain. The company makes strong claims for this device and asserts that it has proved its advantages in practice.

The Writing telegraph is the subject of an interesting pamphlet devoted to an explanation of this device and the uses to which it can be put in commercial work. The Writing Telegraph company, New York, capital $500,000, is exploiting the system.

The annunciators, guest calls, and similar apparatus in use in the Chicago Auditorium, were designed by Chas. G. Armstrong, now with the Great Western Electric Supply company, which now has the contract for additional apparatus. It will furnish a set of electric floor indicators for the elevators, and will probably be the first one operated by electrical means. The Great Western Electric Supply company has also sold large quantities of Cutter's E. L. insulators, and report a growing demand for "those tin shades that need no holder."

The increase in business of the Fletcher & Fletcher Electric company, Cleveland, Ohio, has necessitated additions to the works which now extend from South Water street through to the Big Four railway tracks in their rear. Their specialties are annunciators, bells, pushes, switches, and they have won a large trade among progressive bell hangers in Canada and South America, as well as in this country.

The Accumulator company has just closed a contract with the Dubuque Street Railway company, Dubuque, Iowa, for six Edco cars, operated by the Accumulator system. This contract was made after President Rhomberg of the Dubuque Street Railway company, had made an exhaustive test of the system for three months. It is the intention of Mr. Rhomberg to equip his whole road with accumulator cars.

The American Electrical Supply company has been organized in Buffalo to handle general electrical supplies. The company states that it will have the most complete assortment of electrical goods between Chicago and New York. The company is exclusive agent for Western New York and Northwestern Pennsylvania for the C. & C. Motor company of New York. It will also represent the Electrical Merchandise company of Chicago. The officers are C. M. Proctor, president; S. C. Baynes, vice-president and treasurer; W. L. Adams, secretary and manager.

Electrical Patents.

Issued Oct. 14, 1890.

438,134. Electric Arc Lamp. Alfred Apps, London, England.

438,145. Regulation and Control of Storage Batteries. Stanley C. C. Currie, Philadelphia, Pa.

438,167. Circuit Closer. Thomas Marcher, Neumarkt, near Nuremberg, Germany.

438,174. Coin Actuated Box. James W. Patterson, New York, N. Y.

438,192. Electric Motor Car. Jabea F. Shawhan, Detroit, Mich.

438,204. Electric Motor. Elihu Thomson, Lynn, Mass.

438,211. Support or Hanger for Trolley Wires. Herbert C. Wirt, Boston, Mass.

438,219. Trolley Pole. Johan M. Andersen, Boston, Mass.

438,226. Apparatus for Measuring the Strength of Electric Currents. Stanley C. C. Currie, Philadelphia, Pa.

438,233. Telegraph Instrument. John Geary, Philadelphia, Pa.

438,234. Circuit Closer. John Geary, Philadelphia, Pa.

438,236. Electric Safe Lock. William H. Hollar, Elizabeth, N. J., and Frederick S. Holmes, Malden, Mass.

438,260. Electric Switch. Charles W. Smith and Cornelius J. Lyons, Boston, Mass.

438,262. Electric Railway Conduit System. Malone Wheless, Nashville, Tenn.

438,293. Electric Railway System. Frank J. Sprague, New York, N. Y.
The last claim reads as follows:
"12. In an electric railway system, the combination of two tracks, each having an intermediate rail, the traffic rails and intermediate rail of each track forming a set of working conductors, and a common source of supply for both said sets."

438,298. Manufacture of Incandescent Electric Lamps. Thomas A. Edison, Menlo Park, N. J.

438,299. Manufacture of Carbon Filaments. Thomas A. Edison, Menlo Park, N. J.

438,300. Gauge for Testing Fibers for Incandescent Lamp Carbons. Thomas A. Edison, Menlo Park, N. J.

438,301. System of Electric Lighting. Thomas A. Edison, Menlo Park, N. J.
The inventor employs, preferably, a differential electro-maguet in connection with each lamp or group of lamps which it may be desirable to cut out of circuit at any time.

438,302. Commutator for Dynamo Electric Machines. Thomas A. Edison, Menlo Park, N. J.
The invention consists in the combination with the cylinder having longitudinal grooves, of the conducting strips, the insulating material held by such grooves and extending between said strips, and the layer of insulating material between said cylinder and said conducting strips.

438,303. Arc Lamp. Thomas A. Edison, Menlo Park, N. J.

438,304. Electric Signaling Apparatus. Thomas A. Edison, Menlo Park, N. J.
A circuit controller is employed in this invention which by a single movement causes several makes and breaks in the circuit, said makes and breaks being of different number and rate from that required to operate the vibrating receivers.

438,305. Fuse Block. Thomas A. Edison, Menlo Park, N. J.
The second claim follows:
"The combination, with a receptacle having one or more external flanges, of a safety catch supported therein and conducting caps at either end of the receptacle to which said catch is connected."

438,306. Telephone. Thomas A. Edison, Menlo Park, N. J.
Claim 1 reads:
"In a telephone, the combination, with a diaphragm and an electrode carried thereby, of a loosely supported electrode and a limiting stop therefor rigidly connected with the diaphragm.

438,307. Manufacture of Incandescent Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J.

438,308. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.

438,309. Method of Insulating Electrical Conductors. Thomas A. Edison, Llewellyn Park, N. J.

438,310. Lamp Base. Thomas A. Edison, Orange, N. J.

438,311. Composition of Matter for Making Cells or Retaining Vessels. Oscar A. Enholm, New York, N. Y.

438,312. Acid Proof Retaining Vessel. Oscar A. Enholm, New York, N. Y.

438,313. Composition for Cells or Retaining Vessels. Oscar A. Enholm, New York, N. Y.

438,314. Synchronizer for Clocks. Adolphus Gipperich, Richmond, Va.

438,326. Automatic Cut-out. George W. Richardson, Philadelphia, Pa.

438,344. Circuit Interrupter. Nico Chaize, St. Etienne, France.

438,357. Method of and Apparatus for Magnetic Separation of Ores. John M. McMahan, New York, N. Y.

438,359. Trolley Wheel for Electrically Propelled Vehicles. Louis Pfingst, Boston, Mass.

438,361. Police Patrol Signal Box. Charles Plumb, Buffalo, N. Y.

438,390. Annunciator. Arthur F. Stanley, New York, N. Y.

438,394. Thermal Cut-out. William R. White, Hartford, Conn.

438,400. Connector for Electric Conductors. George J. Brennen, Lynn, Mass.

438,404. Contact for Overhead Electric Railways. Albert H. Chadbourne, Philadelphia, Pa.

438,406. Method of Utilizing Electricity in the Formation of Sheet Metal Articles. Mark W. Dewey, Syracuse, N. Y.

438,407. Apparatus for Forming or Shaping Sheet Metal Electrically. Mark W. Dewey, Syracuse, N. Y.

438,408. Apparatus for Forming or Shaping Sheet Metal Electrically. Mark W. Dewey, Syracuse, N. Y.

438,409. Method of Utilizing Electricity in the Formation of Metallic Cartridge Cases. Mark W. Dewey, Syracuse, N. Y.
The process consists in forming the case by drawing or stamping the same from thin metal and electrically heating the case during its formation.

438,419. Electric Light Shield. Alfred A. McCreary, New York, N. Y.

438,431. Incandescent Electric Lamp Socket. James W. Collier, New York, N. Y.

438,434. Magneto Generator. Noel B. Ginochio, New York, N. Y.
The first claim follows:
"A magneto generator in which the magnets are made up of a series of permanent ring-shaped pieces connected to pole pieces, the pole pieces being provided with projections conforming to the shape of the ends of the magnets."

438,452. Electric Railway Brake. Charles J. Van Depoele, Lynn, Mass.

438,495. Insulating Joint. Sidney H. Short, Cleveland, Ohio.

438,525. Method of and Apparatus for Working Metals by Electricity. George D. Burton, Boston, Mass.
The method consists in forming a blank of a determinate size for the forging to be produced, then softening said blank by passing an electric current therethrough, then withdrawing the electric current from the prepared blank, and then subjecting said blank to a forging operation.

438,530. Telegraph Key. Charles H. Crockett and Lansing C. Dedrick, Schenectady, N. Y.

438,532. Insulating Appliance for Electric Batteries. Stanley C. C. Currie, Philadelphia, Pa.

438,552. Transmitting Motor. Hiram D. Layman and Charles E. Rice, Little Rock, Ark.

438,564. Electric Railway. Horace E. Swift, Boston, Mass.

438,579. Electric Means for Preventing Boiler Incrustation. Albert B. Faunce, Quincy, Ill., and Samuel G. Cabell, Washington, D. C.

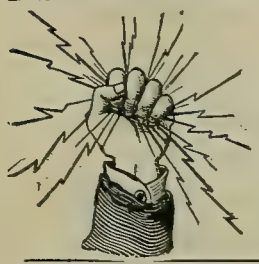
438,586. Galvanic Battery. John E. Murphy, St. Louis, Mo.

438,590. Automatic Safety Cut-out for Electric Circuits. Granville T. Woods, Cincinnati, Ohio.
The invention consists in the combination, with the main generator, outer circuit, and cut-out device, of a local battery and signal circuit connected at opposite sides of the outer line conductor by a two point switch.

438,592. Electric Wire Distributing Box. William H. Eckert, New York, and William H. Gregory, Brooklyn, N. Y.
Of the nine claims the sixth is given:
"In a distributing box the combination of a series of conduits, each of which consists of a group of tubes formed of insulating material, said tubes being separated from each other by thick party walls, a separate conductor placed within each tube of the series, a series of compartments within said box equal in number to the tubes of each conduit, a common conductor within each compartment, and electrical connections, substantially as described, whereby corresponding conductors are joined together within separate apartments."

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

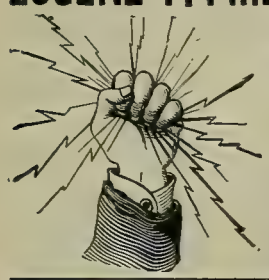
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

—MANUFACTURERS OF—

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate*, *oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

---

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

Cheaper than Overhead Wires,

MORE THAN TEN TIMES AS DURABLE.

Guaranteed to stand a pressure of 100,000 volts when used for Electric Light Mains. Write for Estimates to the

Brooks Underground Telegraph Co., 207 Walnut Place, Room 5, Philadelphia.

THE TURNER BRASS WORKS
4 LASALLE AVE
MAKE ANYTHING IN BRASS CHICAGO.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

FRANK T. BROWN, Late

PRINCIPAL EXAMINER ELECTRICITY,

U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

---

BUSINESS CHANCE.

WANTED.

To place, at a bargain for buyer, within 30 days, a Steam Engine and Boiler plant. No real estate.

Address,

"CODAC,"

Care of WESTERN ELECTRICIAN.

DO YOU USE

THE LAW BATTERY?

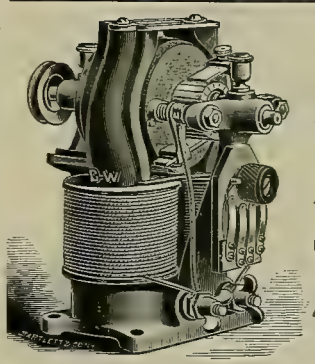
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

Binders FOR THE Western Electrician $1.00.



THE **CROCKER-WHEELER**

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base-Self-Oiling Bearings Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

NO LOSS OF CANDLE POWER.

FOR PARTICULARS WRITE

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue **1--66** of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

OKONITE TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL **OKONITE COMPANY, Limited, - - 13 Park Row, NEW YORK.**

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

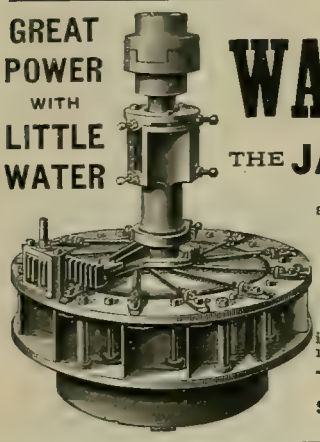
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

GREAT POWER WITH LITTLE WATER



JAMES LEFFEL

WATER WHEELS

BUILT BY

THE **JAMES LEFFEL & CO.**

Nearly 30 Years Business

affords every convenience for making Wheels of highest excellence and

Specially Adapted to All Situations.

Among the Wheels in operation may be found the

Largest and Smallest Wheels

in greatest variety of form, style and finish under the

Highest and Lowest Heads

in this country. Write, stating head, size of stream, kind of mill. We will send our fine pamphlet, and advise you.

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO.

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FOR SALE.

One 15-light	50	volt	Dynamo
One 25-light	50	volt	Dynamo
One 50-light	50	volt	Dynamo
One 75-light	110	volt	Dynamo
One 100-light	110	volt	Dynamo
One 150-light	110	volt	Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

ELECTRIC MERCHANDISE CO.

Standard Devices for all Systems.

11 Adams St., CHICAGO

CATALOGUES FURNISHED.

W. R. MASON, General Manager.

ELECTRIC RAILWAY SUPPLIES.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE BARD PORCELAIN.

NEW IDEAS DEVELOPED,

Experimental, Electrical and Model Work. Contractors for Light Manufacturing.

E. D. STIFF & CO.,

67 S. Canal St., Chicago

INCANDESCENT and ARC LIGHTING and MOTORS.

Isolated Lighting a Specialty.

H. H. HUMPHREY,

1034 New York Life Building.

Contracting and Consulting Electrical Engineer. **OMAHA, NEB.**

C., M. & ST. P. R. R.

The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

GEORGE P. BARTON,

LAW OFFICE,

225 DEARBORN STREET,

CHICAGO, ILL.

Patent and Trademark Cases

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.

G. W. GRIFFIN, Superintendent of Construction.

THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

Laminated Field Magnets

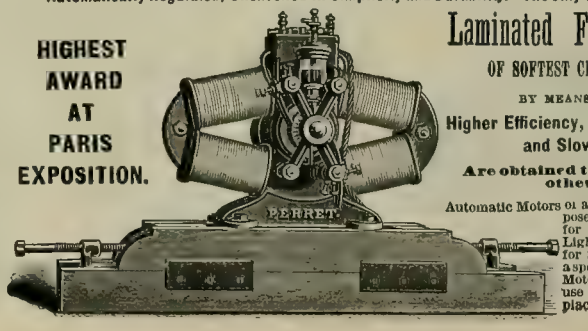
OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

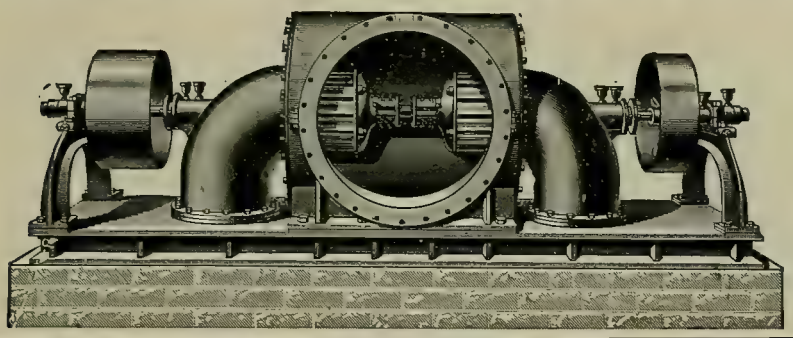
Are obtained than is possible otherwise.

HIGHEST AWARD AT PARIS EXPOSITION.



Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting, Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

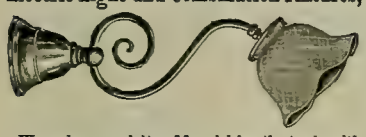
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

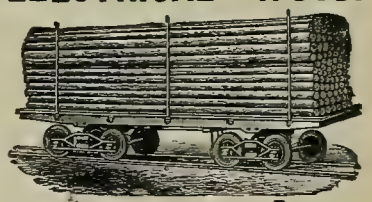
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.

Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

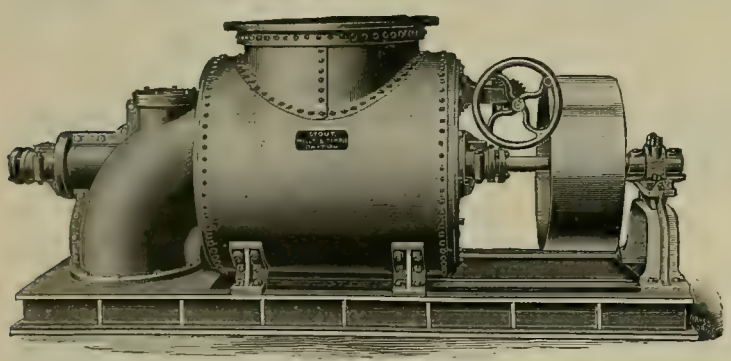
Correspondence regarding Underground and Overhead Cables, Insulated Wires, Electric Lights, Telegraph Instruments, House Goods, and other electrical apparatus solicited. Our new Illustrated General Catalogue will be furnished to the trade on application.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

STANDARD ELECTRICAL WORKS, Agents, CINCINNATI, OHIO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

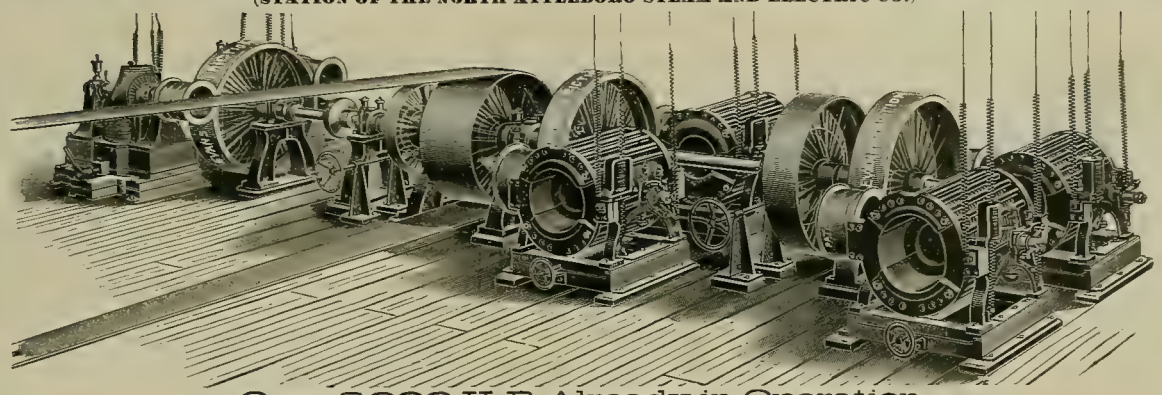
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

(STATION OF THE NORTH ATTLEBORO STEAM AND ELECTRIC CO.)

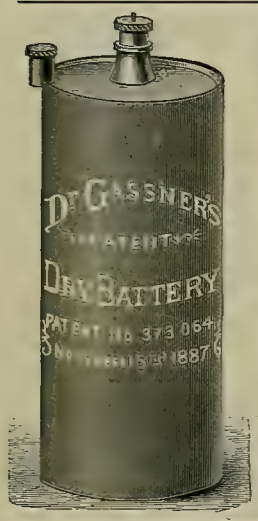
This Station has been in Successful Operation Since March, 1890.



Write for Full Particulars and List of Parties who are Using.

Over 3,000 H. P. Already in Operation.

Send for Catalogue "D" to THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.



DR. GASSNER'S DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3¼ in.
17.	"	7½ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.

ELECTRICAL BOOKS OF ALL KINDS.

Send for New and Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO, ILL.

DYNAMO TENDER' HANDBOOK.—By F. B. BADT.

100 pages; 70 illustrations flexible cloth binding; size of type page, 6x3 inches. Designed for Dynamo Tenders and Linemen; Stationary and Marine Engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language. Price, postage prepaid to any address in the United States or Canada, $1.00.

Address ELECTRICIAN PUBLISHING CO., 6 Lakeside Bldg., Chicago.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable **RUBBER INSULATED WIRE** none has been so successful as that of the **SAFETY INSULATED WIRE.** Investigate the merits of this **WIRE** and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.
FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

THE UNDERGROUND FEEDERS

For the Buffalo Street Railway are being laid with the

NATIONAL CONDUIT MFG. CO.'S

CEMENT-LINED PIPE.

Go see the work now being done by the Field Engineering Co., then write to us.

THE NATIONAL CONDUIT MFG. CO.,

Times Building, NEW YORK.

OKONITE
TRADE MARK.

Okonite and Candee
WIRES.
Okonite and Manson
TAPES.

PRICES TALK.

WRITE TO US FOR THEM.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

E-D-I S-O-N

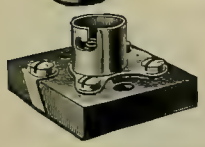
Miniature Incandescent

ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,

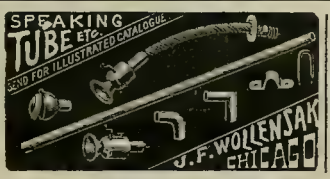
Which shows prices of, and experiments with Edison Lamps, and gives directions

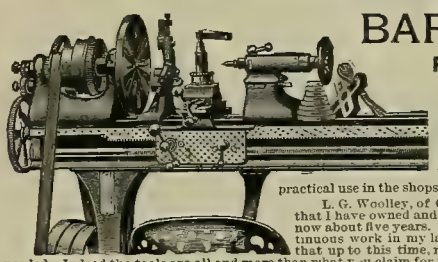


How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.





BARNES' FOOT
POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators Electric Railway and Electric Lighting Supplies of all descriptions.

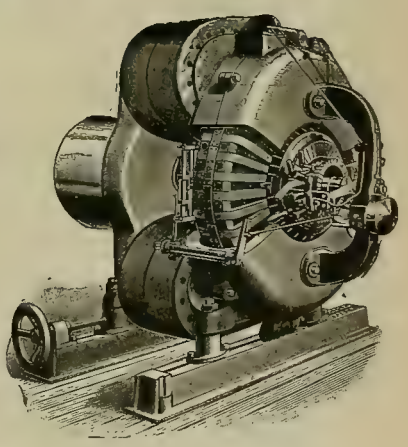
WRITE FOR QUOTATIONS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)

MANUFACTURERS OF

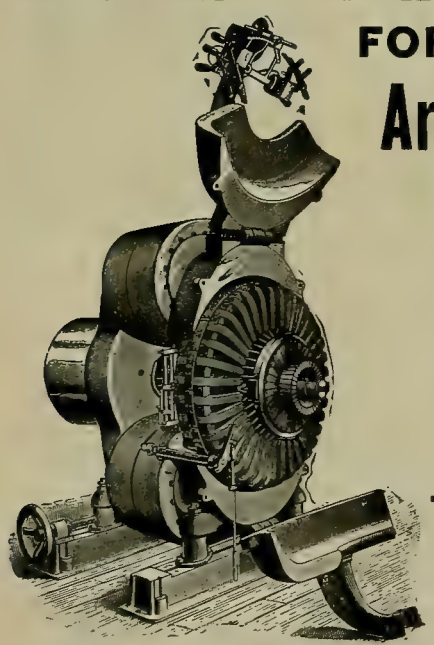
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

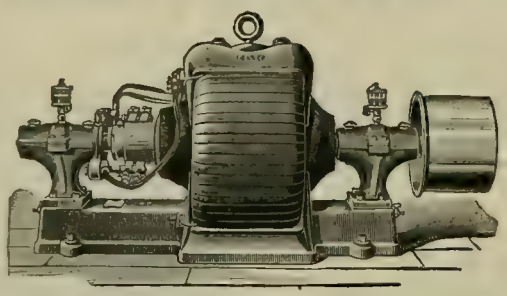
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

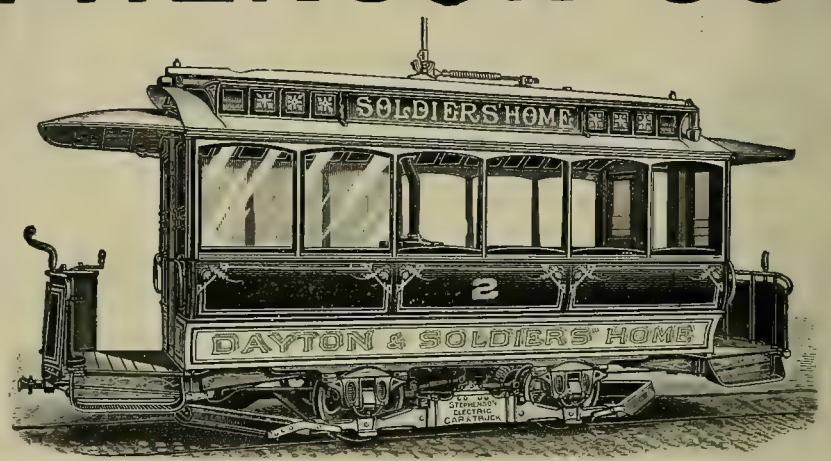
NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.



EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP

and 1914 Olive

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

THE MILLIKEN PATENT Electric Railway Pole.

MANUFACTURED BY

MILLIKEN BROS.,

NO. 55 LIBERTY STREET, NEW YORK.

Standard Side, Center & "Pull Off" Poles.

Special Poles of any Required Length, or to stand any Strain, made to order.

OVER 6,000 SOLD IN THE LAST THREE MONTHS.

In use in Newark, Jersey City, Paterson, Troy, Buffalo, Pittsburgh, Hamilton, O., and many other cities.

WESTERN AGENCY,

MILLIKEN & CO., 59 Dearborn St., CHICAGO.

BRANCHES: 164 Summer St., Boston, Mass; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St Louis, Mo.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,

MANUFACTURING ELECTRICIAN,

Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N Y.

COMPLETE PLANTS FOR SMALL STORES.

Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

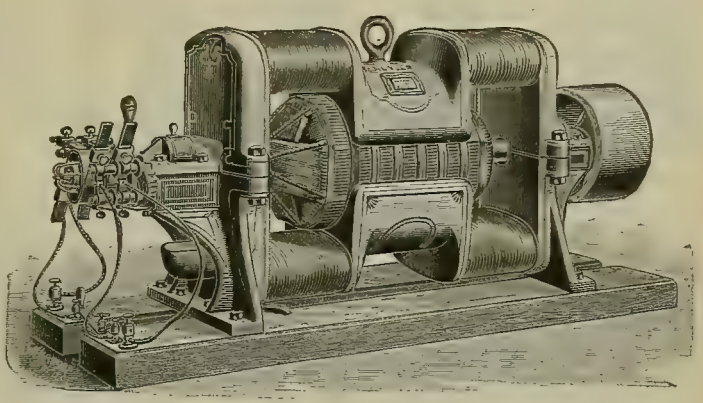
These Batteries are in practical use, and giving perfect satisfaction.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

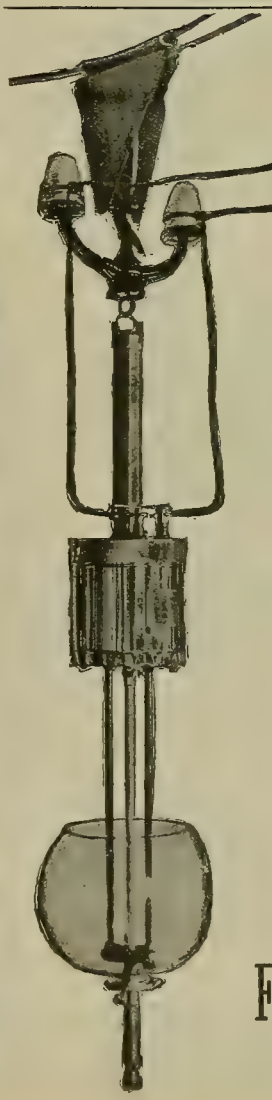
Self-Lubricating Boxes.

Ventilated Armature. proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,



THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

Ease of operation.

Low price

MANUFACTURED BY

Forest City Electric Works.

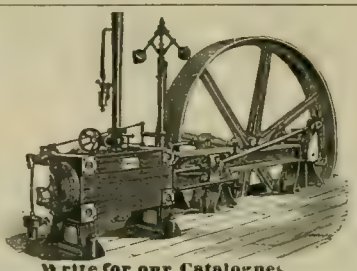
GENEVA, O.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues.

SOLE BUILDERS

EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

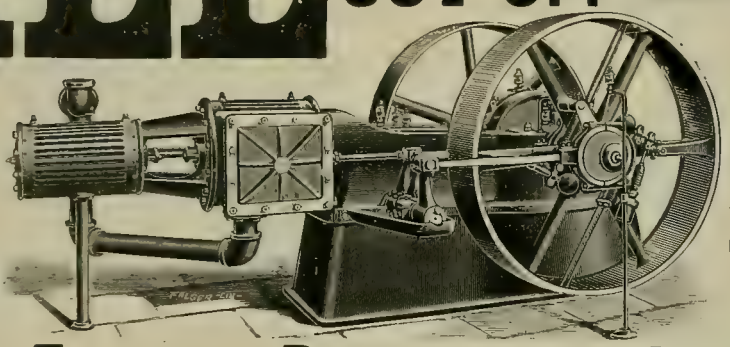
BALL AUTOMATIC CUT OFF ENGINE

Standard.

Cross Compound.

Triple Expansion.

Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER.
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Building, CHICAGO, ILL

WILLIAM T. BONNER,
618 New York Life Insurance Building,
OMAHA, NEB.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

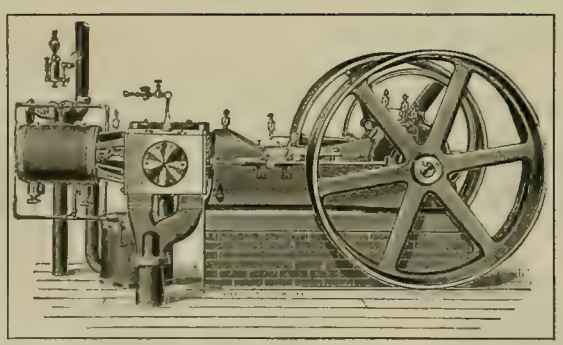
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

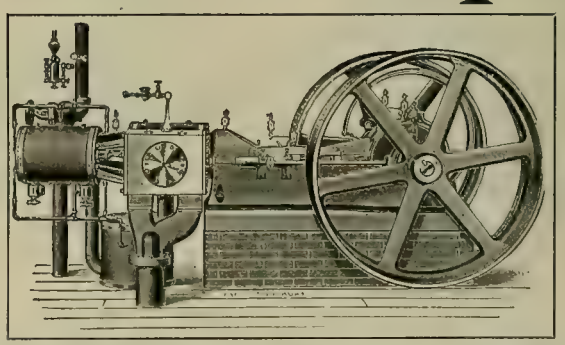
SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

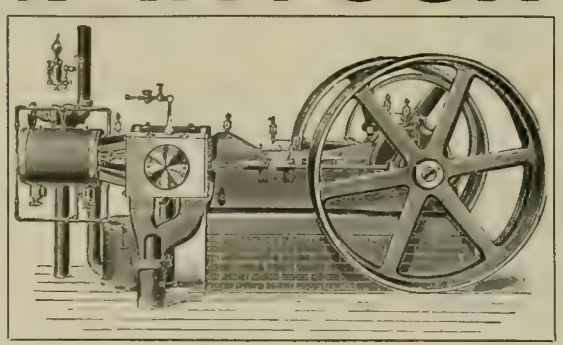
None so Good, None to Equal.



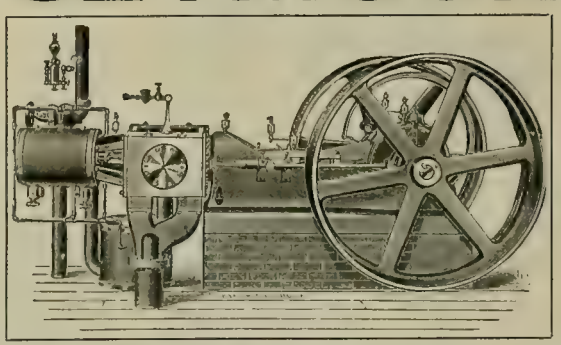
TANDEM



McINTOSH & SEYMOUR.



COMPOUND

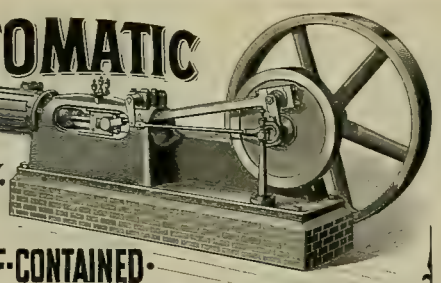


WESTERN POWER CONSTRUCTION CO.,

CORRESPONDENCE SOLICITED.

144 ADAMS ST., CHICAGO.

THE RICE AUTOMATIC



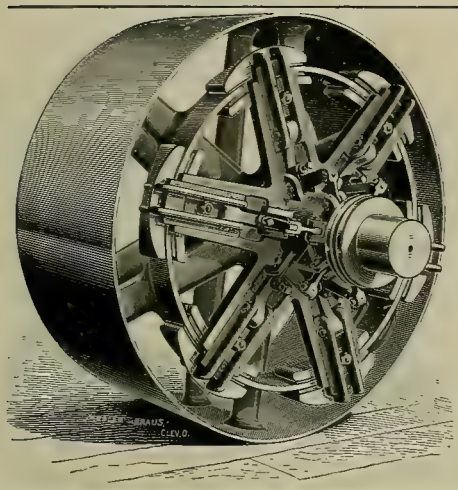
GUARANTEED ECONOMY · REGULATION · DURABILITY · SIMPLICITY · SELF-CONTAINED ·

8 TO 300 H.P. PAIR & TANDEM COMPOUNDS · THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

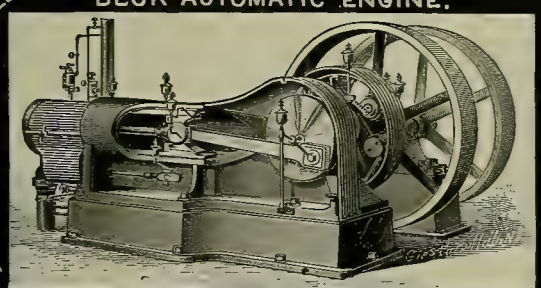
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

MATERIAL AND WORKMANSHIP OF THE BEST.

BECK AUTOMATIC ENGINE.

ECONOMY UNEXCELLED · REGULATION PERFECT · HOT BEARINGS UNKNOWN · PRICES MODERATE



TAYLOR MFG CO. CHAMBERSBURG, PA.

COMPLETE STEAM PLANTS A SPECIALTY

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't. J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

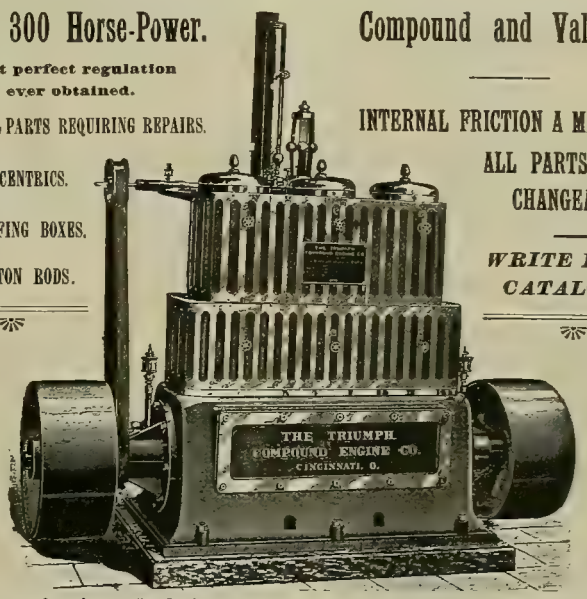
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

THE TRIPP ELECTRIC TRUCK.

Substantial, Durable, and with Plenty of Room for the Application of Motors, and Electrical Apparatus.

OFFICERS:
ALBERT A. FOLSOM, President.
CONVERSE J. SMITH, Vice-Pres. and Gen. Mgr.
JOHN E. BLAKEMORE, Treasurer.
SAMUEL A. RANDALL, Superintendent.

AGENTS:
STANNARD & DILLON, Chicago, Ill.
FAIRBANKS, MORSE & CO., St. Louis, Mo.
GEO. W. STORER, Philadelphia, Pa.
JAMES BEGGS & CO., New York.
GREEN & BOULDING, London, England.
H. C. RUSSELL & CO., Montreal, Canada.
CHARLES POWER & CO., Seattle, Wash.
ROBINSON & CARY CO., St. Paul, Minn.
J. & E. R. BARBOUR, Portland, Me.

Equipped with TRIPP'S ANTI-FRICTION JOURNAL BEARINGS, which are absolutely dust-proof, saving in power over ordinary bearings of from 30 to 70 per cent.

EVERY DESCRIPTION OF TRUCKS FOR ELECTRIC, CABLE AND STEAM CARS.

— MANUFACTURED BY —

TRIPP MANUFACTURING CO., 180 Summer St., Boston, Mass.

SEE MODEL OF ABOVE TRUCK AT STREET RAILWAY CONVENTION.

THE

THOMSON-HOUSTON ELECTRIC CO.'S

RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

Companies desiring Centre Pole Construction should see the Indianapolis Plant, illustrated below. Also Washington, D. C., Rochester and Brooklyn, N. Y.

Citizens' Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

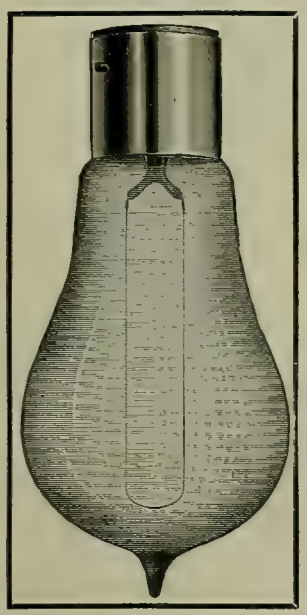
PRINCIPAL OFFICES:

BOSTON,
620 Atlantic Ave.

CHICAGO,
148 Michigan Ave.

ST. PAUL,
408 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

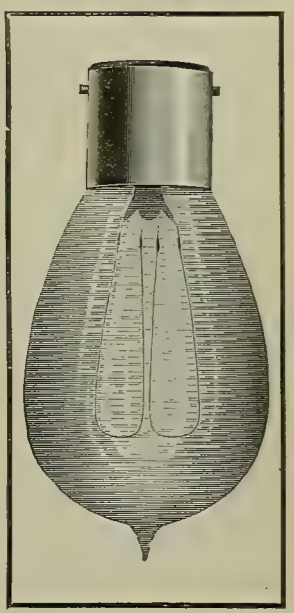
THE

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

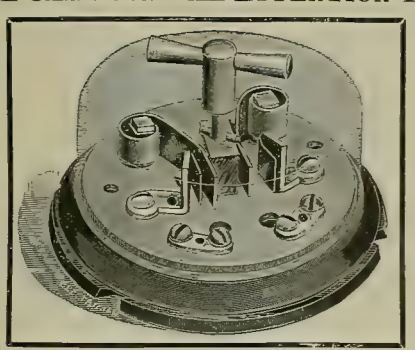
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

WE CALL SPECIAL ATTENTION TO

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

—FOR—

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.

Ten Years' Experience.

Experienced Workmen.

Improved Machinery.

Thorough Knowledge of the requirements of this business.

Enable us to supply your wants with best materials at least cost.

OUR FACTORY.

Our factory exists —not on paper only— We manufacture—not merely in imagination, but in reality. A word to the wise: Buy direct, and save your money.

Shield Brand Moisture-proof Line Wire

THE BEST WEATHERPROOF AND ONLY MOISTURE-PROOF LINE WIRE.

Has a better record than any other line wire.

Has stood tests where all other line wires have failed.

Is better and more carefully made than any other line wire.

BUY THE BEST. BUY THE BEST. BUY THE BEST.

HABIRSHAW WIRES, CABLES AND CORES.

The Habirshaw insulation fulfills all requirements in places demanding the "BEST" and in that field finds no successful competitors.

Read our advertisements in the following numbers of this paper:
August 30, September 6, 13, 20, 27, October 4.

FUSE WIRE. FUSE WIRE,

Accurately determined.

FULL STOCK OF ALL SIZES CONSTANTLY ON HAND.

ELECTRIC RAILROADS.

We are manufacturing a full line WIRE, SUPPLIES, and Special Tools needed for your work. Write for particulars.

ELECTRIC RAILROADS.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

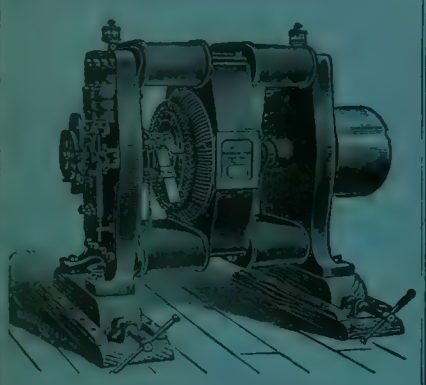
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



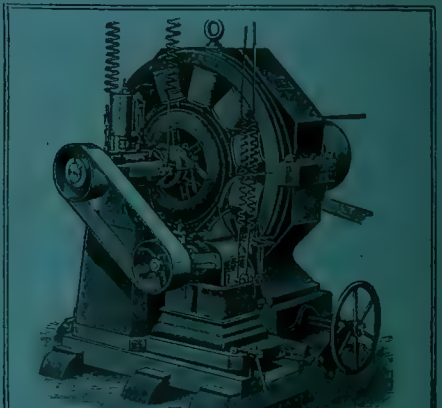
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK,	115 Broadway.
CHICAGO,	185 Dearborn St.
PHILADELPHIA,	907 Filbert St.
PITTSBURGH,	533 Wood St.
DETROIT, MICH.,	57 Gratiot Ave.
SAN FRANCISCO,	35 New Montgomery St.
TORONTO, CAN.,	138 King St. W.
DALLAS, TEX.,	McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



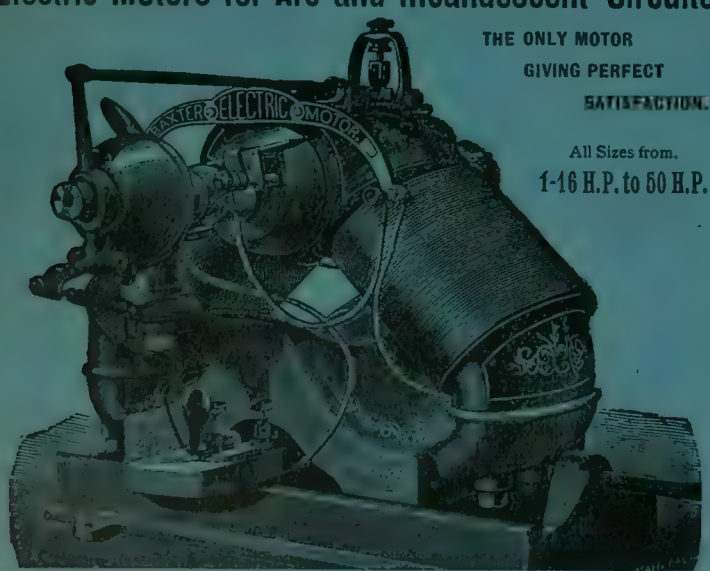
SLATTERY ALTERNATING DYNAMO.

To Arc and Incandescent POWER COMPANIES.

THE BAXTER ELECTRIC MOTOR CO.,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits.



THE ONLY MOTOR GIVING PERFECT SATISFACTION.

All Sizes from.
1-16 H.P. to 50 H.P.

The supremacy of "THE BAXTER MOTOR" over all others has been thoroughly established, and we are now prepared to fill orders promptly.

—— Every Motor is Guaranteed. ——

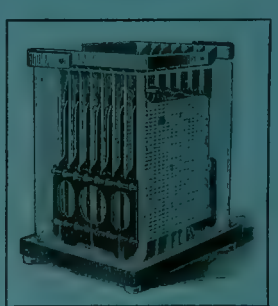
Send for Price Lists and Testimonials. Address,

THE BAXTER ELECTRIC MOTOR CO.,

Office and Works, Biddle, Chester and Chase Sts., and Collington Ave.,
BALTIMORE, MD.
CHAS. H. CONE, Western Agent, 103 Adams St., Room 8, Chicago, Ill.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



- Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
- Central Station and Isolated Lighting.
- Portable Lighting or Power.
- Portable Electric Lanterns.
- Electric Power for Motors.
- Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR CO.,

44 Broadway, NEW YORK.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 Carler Street, Philadelphia, Pa.
CHICAGO AGENCY:—239 La Salle St. SAN FRANCISCO:—220 Sutter St.
BOSTON:—HOLTZER-CABOT ELECTRIC CO. 111 Arch Street.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, NOVEMBER 1, 1890. No. 18

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin' ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4⅞-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

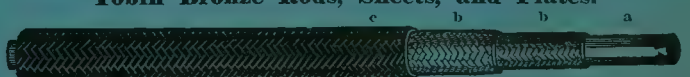
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.



CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

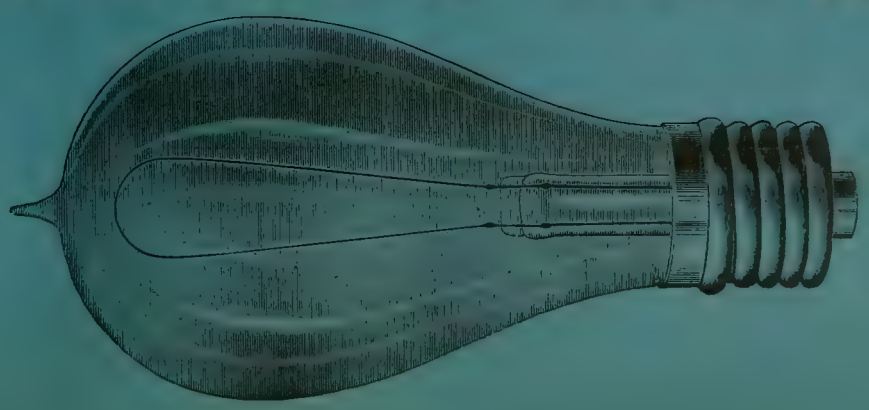
Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

Edison



Lamps.

FOR PRICES

SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave., Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	285
Waterhouse	222	.....	222
Heisler	.....	500	500
Remington	159	.....	459
Sperry	130	.....	130
Excelsior	90	.....	90
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

*Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System.	Arc	Inc.
Thomson-Houston	16,927	45,055
Brush	6,090	4,259
Westinghouse	321	49,067
Edison	..	13,853
American	1,537	.....
United States	632	6,141
Schuyler	1,166	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	3,815
Remington	129	.....
Sperry	160	.....
Excelsior	205	30
Hochhausen	70	.....
Weston	138	.....
Fuller	10	.....
Reliance	30	.....
National	.....	1,000
Bernstein	.....	.....
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 3-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co. —
Abendroth & Root Mfg. Co. xv
Alexander, Barney & Chapin. xii
Allis, E. P. & Co. xxiv
American Electrical Works. xv
Ansonia Brass & Copper Co. i
Automatic Switch Co. vii
Baggot, E. xvi
Bain, Foree. xiii, xvi
Ball Engine Co. xvi
Barnes, W. F. & Jno. xxi
Barton, Geo. P. xxiii
Baxter Electric Motor Co. xx
Bernstein Electric Co. xxi
Bleckert & Nelson. xvii
Brown, Frank T. xv
Brooks Underground Tel. Co. xv
Brush Electric Co. xxix
Bunnell & Co., J. H. xiv
Butler Hard Rubber Co. xx
C. B. & Q. R. R. —
C. & C. Electric Motor Co. xxii
Central Electric Co. xi
Cleverly Electrical Works. xxiv
Colburn & Co., I. W. xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co. xix
Consolidated Electric Storage Co. xxx
Continental Dynamo Co. iv
Cowles Electric Smelting and Aluminum Co. xvi
Crocker-Wheeler Motor Co. xv
Crosby Electric Co. iv
Curtis Regulator Co. vii
Day's Kerite Insulation Co. i
Dayton Globe Iron Works Co. xviii
Eastern Electric Cable Co. xv
Eddy, Henry C. xv
Edison Mfg. Co. xxii
Edison General Electric Co., Lighting Dept. viii
Edison General Electric Co., Lamp Dept. i
Edison Lamp Co. i, xxiii
Electric Construction & Sup. Co iv
Electric Merchandise Co. xvi
Electrician Publishing Comp'y xxiii
Electrical Supply Co. xxviii
Elektron Mfg. Co. xvi
Empire City Electric Co. xviii
Empire China Works. xvi
English, Morse & Co. xvii
Eureka Tempered Copper Co. xvii
Evans Friction Cone Co. xix
Excelsior Electric Co. xxi
Fibrone Mfg. Co. xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works. xxv
Fort Wayne Electric Co. xxx
For Sale. xv
Gibson Gas Fixture Works. xviii
Globe Carbon Co. xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S. xvi
Harmount, G. A. vii
Hawkeye Electric Mfg. Co. iv
Hazelton Tripod Boiler Co. xvi
Heisler Electric Light Co. xxiii
Hill Clutch Works. xxvii
Holmes, Booth & Haydens. xvii
Holmes & Co., C. H. xvii
Holtzer-Cabot Electric Co. i
Humphrey, H. H. xviii
Ide, A. L. & Son. xv
Illinois Electric Material Co. xiv
India Rubber & Gutta Percha Insulating Co. i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L. i
Jewell Belting Co. xv
Jones Bros. Electric Co. xxiv
Knapp Electrical Works. xxvii
Laminar Fibre Goods Co. xvii
Law Telephone Co. xv
Leclanche Battery Co. xxv
Leffel & Co., James. xviii
Magnolia Anti-Friction Metal Co i
Mason, James H. xxiv
Monitor Electric Co. vii
Munsell & Co., Eug. xv
Munson Belting Co., Chas. xiv
National Carbon Co. iv
National Conduit Mfg. Co. xxii
National Electric Mfg. Co. x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T. —
N. Y. Belting & Packing Co. xiv
Okonite Co. xv
Ostrander & Co., W. R. xviii
Page Belting Co. xvi
Paiste, H. T. xiv
Peckham Street-Car Wheel & Axle Co. vii
Partrick & Carter xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co. xx
Pond Engineering Co. vii
Powell Co., Wm. —
Pumpelly Storage Battery Co. vii
Queen & Co. xvi
River & Rail Elec. Light Co. xi
Roeblings' Sons Co., Jno. A. xix
Sawyer-Man Electric Co. xii
Schieren & Co., Chas. A. xiv
Schoverling, A. xxi
Schuyler Electric Co. xxv
Shultz Belting Co. —
Southern Electrical Supply Co. xxi
Sperry Electric Co. xviii
Standard Electrical Works. xvi
Standard Paint Co. xiv
Standard Underground Cable Co. i
Standard Carbon Co. xx
Stanley & Hall. xiv
Star Electrix Co. ix
Stephenson & Co., Jno. xxii
Stiff, E. D. & Co. xviii
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xxi
Sunbeam Incandescent Lamp Co. xv
Taussig, S. xvi
Taylor Mfg. Co. xxiv
Thomson-Houston Electric Co. Lighting department. ii
Thomson-Houston Electric Co., Railway department. xxvi
Triumph Compound Engine Co xxv
Tripp Mfg. Co. —
Turner Brass Works. xv
Union Hardware Co. xiv
United Electric Traction Co. xxv
United States Electric Lighting Co. xv
Van Nuis C. S. i
Wanted. xv
Western Electric Co. xviii
Western Electrician. xvi
Western Power Construction Co. xxiv
Westinghouse Electric Co. xiii
Weston Electrical Instrument Co. —
White, R. T. iv
Wollensak, J. F. xxi
Woodbridge & Turner. xvii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Aluminum.
Cowles Electric Smelting & Refining Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Excelsior Electric Co.
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Brooks Underground Telegraph Co.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.
National Conduit Mfg. Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brooks Underground Telegraph Co.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
River & Rail Electric Light Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
White, R. T.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Eddy Electric Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
River & Rail Electric Light Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Excelsior Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Eugine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.

Lamps, Incandescent—Con td
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Excelsior Electric Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
Tripp Mfg. Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co, James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

DAISY CHAIR

For T Girder or Rail, having a T Form of Base.

R. T. WHITE,

PATENTED MATERIAL FOR

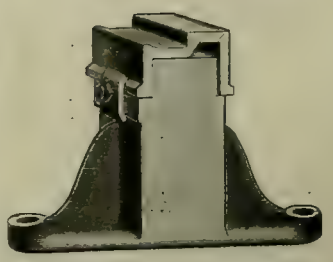
STREET RAILWAY ROAD-BEDS

Also **Cable, Electric and Elevated Railways,**

12 PEARL STREET, Rooms 6 and 7, BOSTON, MASS.

NEW YORK OFFICE, 52 Wall Street, Room 41.

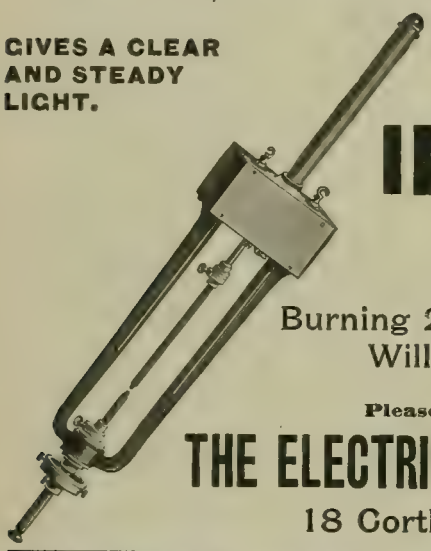
Patented January 28, 1890—No. 420,135. *CORRESPONDENCE SOLICITED.*



EUREKA CHAIR

For Channel Iron Form of Rail.

GIVES A CLEAR AND STEADY LIGHT.



THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT,
CLEAN,
EFFECTIVE,
SIMPLE,
COMPACT,
PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

87 and 89 South Fifth Avenue, - - NEW YORK.

THE HAWKEYE

ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station

AND

ISOLATED PLANTS,

ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps,*** Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190-192 Fifth Avenue, CHICAGO.

DESIGNERS
—OF—
Electric Railway Specialties.

MAKERS
—OF—
Choice Electric Supplies.

DEALERS
—IN—
Standard Electrical Goods.

POLES

Of Extra Strength in all Sizes and Styles.

PLAIN WOOD POLES:

GET OUR PRICES.

OCTAGONAL WOOD POLES.

NEAT AND LOW PRICED.

POLES

ANGLE-IRON POLES

Superior to pipe poles at about half the cost.

Our 28-foot pole will stand a strain of 3,000 pounds without deflection.

LATTICED CORNER POLES.

Extra strong and stiff. Will stand all strains met in practice without appreciable deflection.

BRACKETS

Of angle iron. Stronger and neater than those made of piping. Maintain their shape perfectly.

Try us on

BRACKETS AND POLES.

IF YOU WANT MATERIALS

That have the greatest strength,
That give the highest practical insulation,
That pay best in the end:

TRY US FOR YOUR SUPPLIES.

TREBLE CURVE INSULATOR.

Gives the Greatest Strength and the Highest Insulation. Try it and you will use no other.

RESISTS ABRASION AND GIVES THE HIGHEST LINE INSULATION.

SIMPLEX WIRE.

THE WIRE THAT PAYS BEST IN THE LONG RUN.

Try it for mains and you will always use it.

For lines in mines or among trees it is unequaled.

SEND FOR A SAMPLE.

ALL-COPPER RAILBONDS.

SEND FOR A SAMPLE.

Have practically no resistance. Are quickly and cheaply applied. Will not oxidize.

WATCH FOR NEW ADDITIONS TO OUR

Electric Railway Specialties.

We insist on having only the very best, and that at figures which will command your orders.

ALL OF OUR

SPECIALTIES

WEAR WELL.

Prove it for yourself by trying them.

Our place at 190-192 FIFTH AVENUE is the

HEADQUARTERS

For Electric Railway Supplies

In any quantity,
For any system,
And to meet any circumstance.

WHAT'S THE MATTER

WITH YOUR DYNAMO?

IS THE ARMATURE BURNED OUT?

SEND IT TO THE REPAIR DEPARTMENT OF THE

NORTHWEST THOMSON-HOUSTON ELECTRIC COMPANY,

401 FIRST ST, SOUTH, MINNEAPOLIS, MINN.

REMEMBER, We Repair Everything ELECTRICAL,

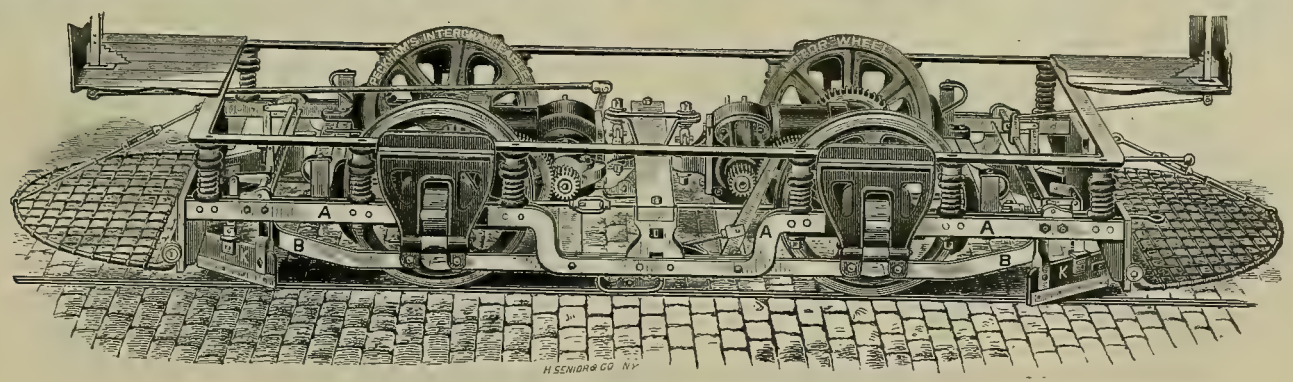
It Matters Not What System You Use.

If anything is out of order, send to us and we will repair and return quicker and in better order than any one else in the Northwest.

GIVE US A CALL.

We Always Please Our Customers.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

Pumpelly Storage Batteries

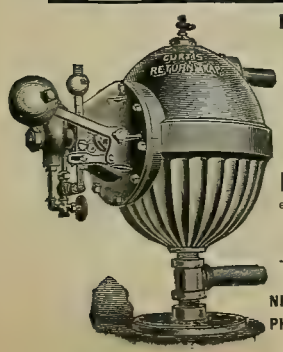
For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,
BALTIMORE, MD., U. S. A.
Sole Manufacturers of the
WHITTINGHAM
AUTOMATIC SWITCH.
The only reliable protector to the Armature of an Electric Motor.
Applicable to Constant Potential Motors of all sizes and patterns.
SEND FOR CATALOGUE.



THE CURTIS
PATENT RETURN STEAM TRAP.
IT is noiseless, positive, rapid, will return all condensation back into the boiler, and works equally well in connection with reduced pressure or exhaust steam, also when the return is below the water line of the boiler.
THE CURTIS REGULATOR COMPANY,
90 BEVERLY ST., BOSTON, MASS.
GENERAL AGENCIES.
NEW YORK, 109 Liberty st. CHICAGO, 218 Lake st.
PHILADELPHIA, 2035 N. Front st. MINNEAPOLIS 210 N. Third st.

POND ENGINEERING CO.,
ST. LOUIS, CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.
ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.
COMPLETE STEAM PLANTS CONTRACTED FOR.
ERECTED READY FOR SERVICE.
SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.
Send to the Nearest Office for Latest Catalogue.

EDISON LAMPS

16 C. P. - - 44 CENTS EACH.

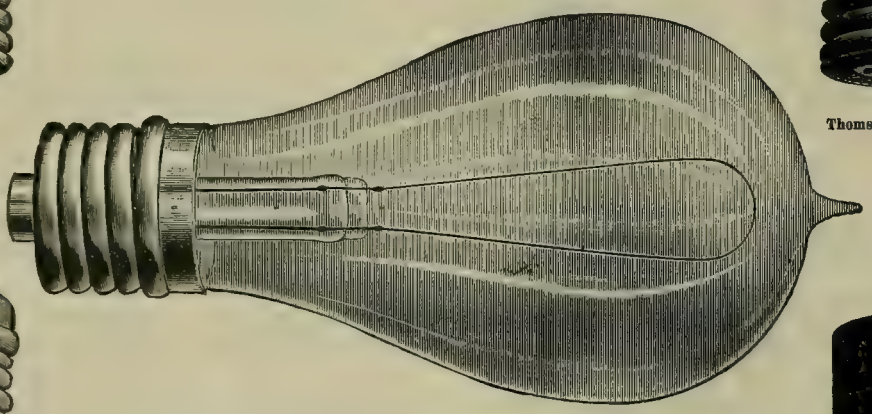
PRICE REDUCED ONE-THIRD!!!

16 C. P. Lamps. 12 to the H. P. 600 Hours Average Life.

No. 1, Edison Base.

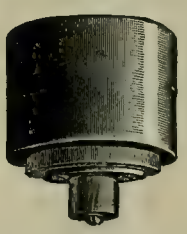
The Edison Incandescent Lamp.

No. 2, Thomson-Houston Base.



No. 3, Westinghouse Base.

Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge.



No. 4, United States Base.

From Nov. 1st, 1890, Subject to Change Without Notice.

16 C. P. Lamps, List Price, 80 Cents Each.	Net Price.	Discounts for Larger Lots Quoted on Application.
Discount in Lots of 25 to 150,.....45%	44 cents each.	
" " 150 to 500,.....47½%	42 " "	
" " 500.....50%	40 " "	

Allowance for Old Bases, $1.35 per 100, f. o. b., Newark, N. J.

Write for Circulars and Price List to Nearest District Office or any Electrical Supply House.

EDISON GENERAL ELECTRIC COMPANY.

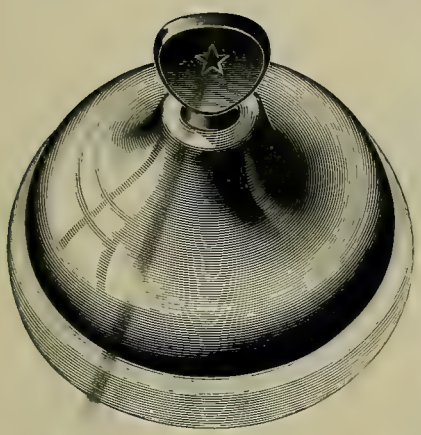
MAIN DISTRICT OFFICES.

Eastern District, 16 & 18 Broad Street, New York.
Central District, Rialto Building, Chicago, Ill.
Southern District, Cotton Ex. Bldg., New Orleans, La.
Mountain District, 730 Seventeenth St., Denver Col.
Pacific Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Northwestern District, Fleischner Bldg., Portland, Ore.
New England District, 38 Pearl Street, Boston, Mass.
Canadian District, Bank of Commerce Bldg., Toronto, Can.

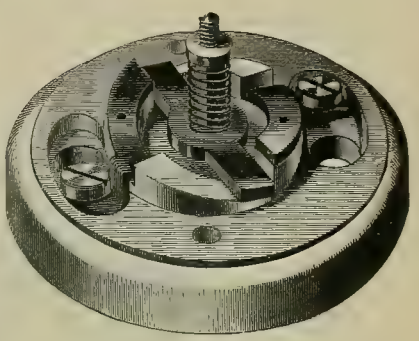
ELECTRIX

ELECTRIX stands for the latest and best line of electrical supplies up to date. Try the "**ELECTRIX**" specialties and you will never use any other.

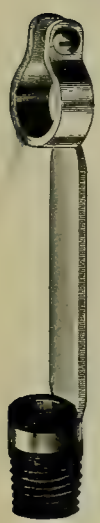
NOW READY



The ***ELECTRIX*** double break single pole switch, 5 and 10 Ampere. Simple and artistic in design. Contacts of soft metal. Uninjured by heat; make and break instantaneous. No rivets or hinged joints to get hot. Made in all colors of porcelain and metal.



THE ELECTRIX GAS ATTACHMENT.



No unscrewing of burners. The "Electrix" attachment is instantly and rigidly fastened by simply slipping over the burner and tightening the clasp. Can be bent any number of times without breaking. Made entirely of metal or with insulating bushing.

In a few weeks we shall have a full line of specialties: Insulating joints, ceiling cut-outs, double pole switches, branch and main line cut-outs, etc., etc. Fully covered by Patents. Dealers hold your orders until you get our prices. Our agent will go West next week—Look out for him.

Prices and discounts on application. Correspondence invited.

THE STAR ELECTRIX COMPANY.,

1320 Wallace St., PHILADELPHIA, PA.

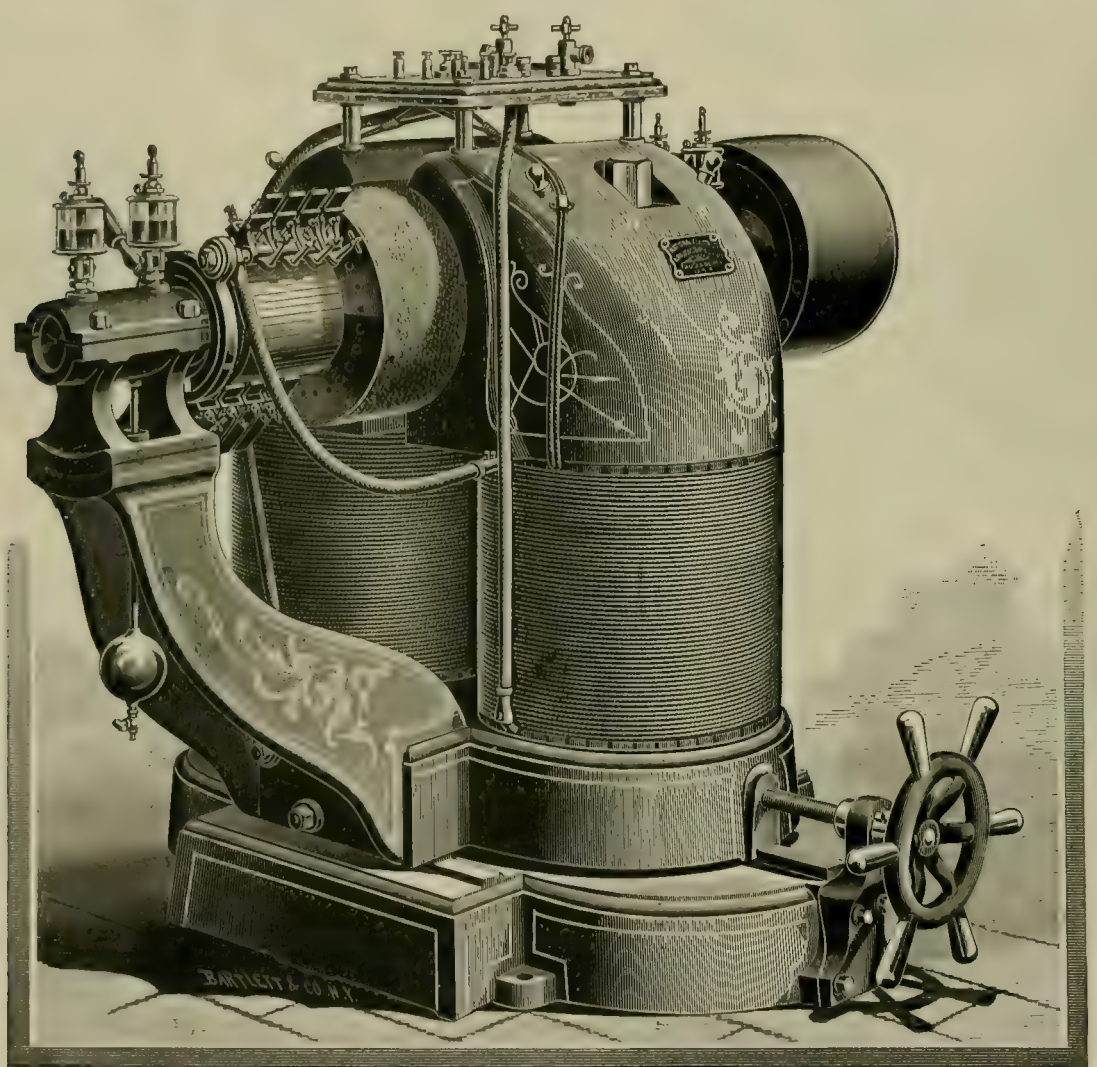
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMO ,CAPACITY 500 16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Ag'ts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building. St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BLDG.,
20 Cortlandt St.,

TRADE A.B.C. MARK

NEW YORK.

A NEW LAMP.

THE A. B. C.,

An Incandescent Electric Lamp made to fit any socket. Any Candle Power manufactured under new and improved processes.

EDISON LAMPS AT EDISON PRICES.

ELECTRIC RAILWAY SUPPLIES,
THOMSON-HOUSTON and EDISON.

GENERAL ELECTRICAL SUPPLIES.
BOOKS on ELECTRICAL SUBJECTS.

SAWYER-MAN LAMPS,

Any Candle Power,

To Fit Any Socket.

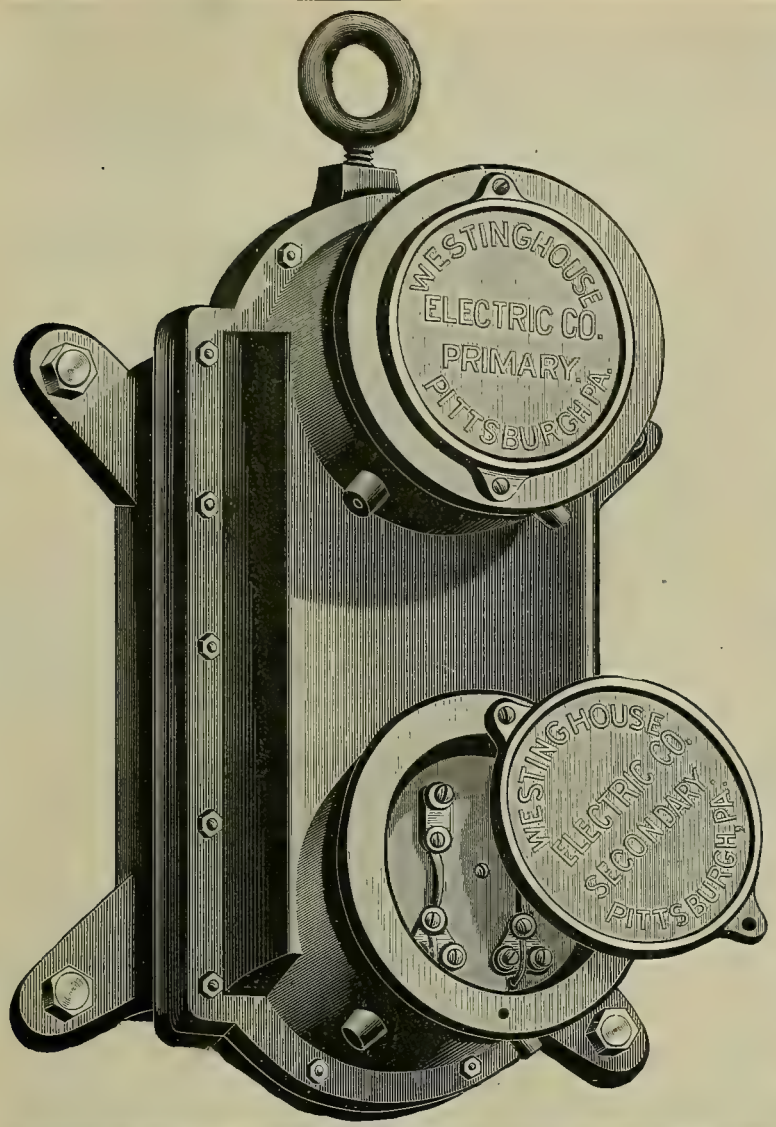
NEW SERIES LAMP AND SOCKET FOR

ARC CIRCUITS.

SAWYER-MAN ELECTRIC CO.,

510-534 WEST 23d ST., NEW YORK.

Send for Catalogue.



CONVERTER EFFICIENCIES

It will Pay You to Throw Out Your Present Converters, and Substitute Our Make.

COMPARISON OF CONVERTERS.

	Total Efficiency.	*Converter Capacity Tested.*
THOMSON-HOUSTON,	**87.50 Per Cent.**	**25.**
FT. WAYNE JENNEY,	**87.**	**25.**
NATIONAL,	**88.**	**20.**
WESTINGHOUSE,	**95.**	**20.**

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

INCANDESCENT ALTERNATING CURRENT

Dynamos, Converters, Meters, Motors.

325 CENTRAL STATIONS and 600,000 LAMPS.

Alternating Current Arc Lighting Apparatus.
Lamps burn 40 hours without renewal of carbon.
Arc Lighting revolutionized.

SEND FOR SPECIAL CIRCULAR.

55 Plants and 5,000 Lamps Sold Within a Few Months.

CORRESPONDENCE SOLICITED.

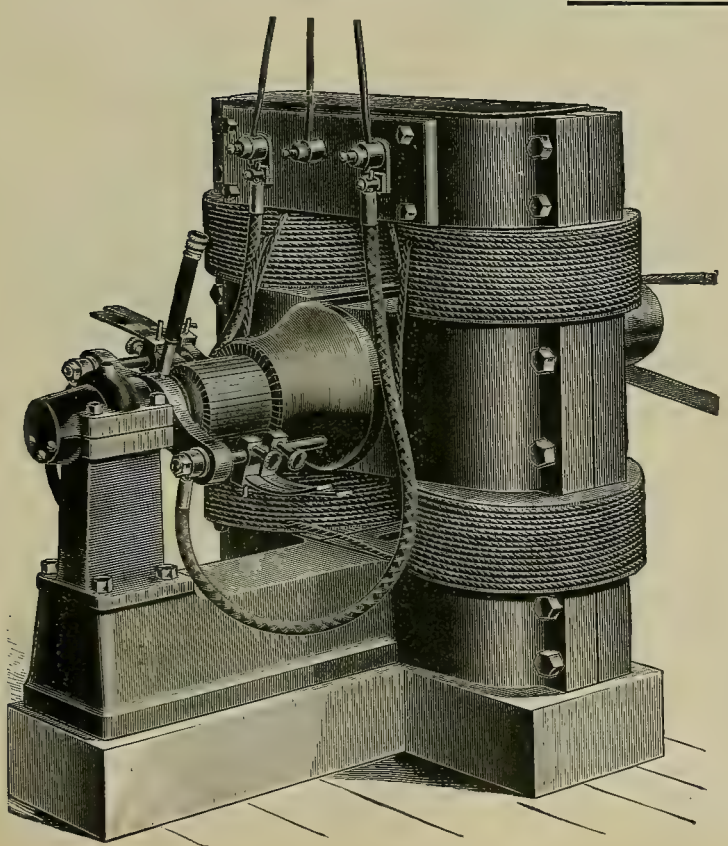
WESTINGHOUSE ELECTRIC AND MFG. COMPANY,

Pittsburgh, Pa., U. S. A.

Boston, New York, Chicago, Cincinnati, St. Louis, San Francisco, Portland.

FOREE BAIN,

ELECTRICAL EXPERT AND MANUFACTURER.



I have more Electric Motors in Practical Operation in Coal Mines than all other manufacturers combined. They aggregate over

350 H. P. to Date.

These installations are not experimental—the Motors are in actual service cutting coal; some of them have been working

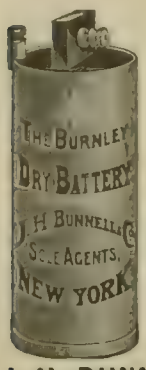
20 Hours Per Day

for more than one year, and during this time not one of them has required repairing.

NO SHORT CIRCUITS. NO BURN-OUTS.

I have secured patents on a full and complete system of Mining by Electricity. Contracts solicited.

84 Market St., - CHICAGO.



BURNLEY DRY BATTERY

PATENTED January, 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:--Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO. ILL.

DUST-PROOF BELLS.

None Genuine Without the Washer.

STANLEY & HALL,

(Formerly HAZAZER & STANLEY,)

32 and 34 Frankfort St.,

NEW YORK.

NEW YORK BELTING & PACKING CO

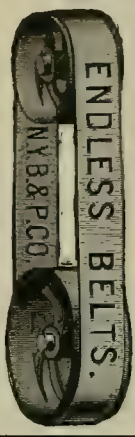
JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.



ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
ST. LOUIS, 616 Locust St.

THE THING for Electric Railways. "CANVAS JACKET" FEEDER WIRES.

INDESTRUCTIBLE PATENT WOVEN INSULATION.

POLES. POLES.

ELECTRIC LIGHT SUPPLIES ELECTRIC RAILWAY.

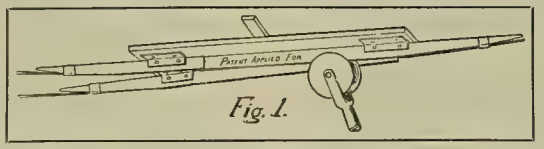


Fig. 1.

MURRAY OVERHEAD TROLLEY SWITCH.

CUSTOMERS REPORT:
"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."

Send for descriptive circulars, THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.

ARE ESPECIALLY APPLICABLE TO
ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.
Edw. H. Johnson, President.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.

TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co

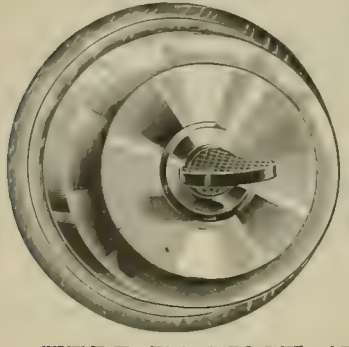
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH



FOR INCANDESCENT WORK

Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,

12th and Market Sts.,

Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

GET THE BEST!

P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE. INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

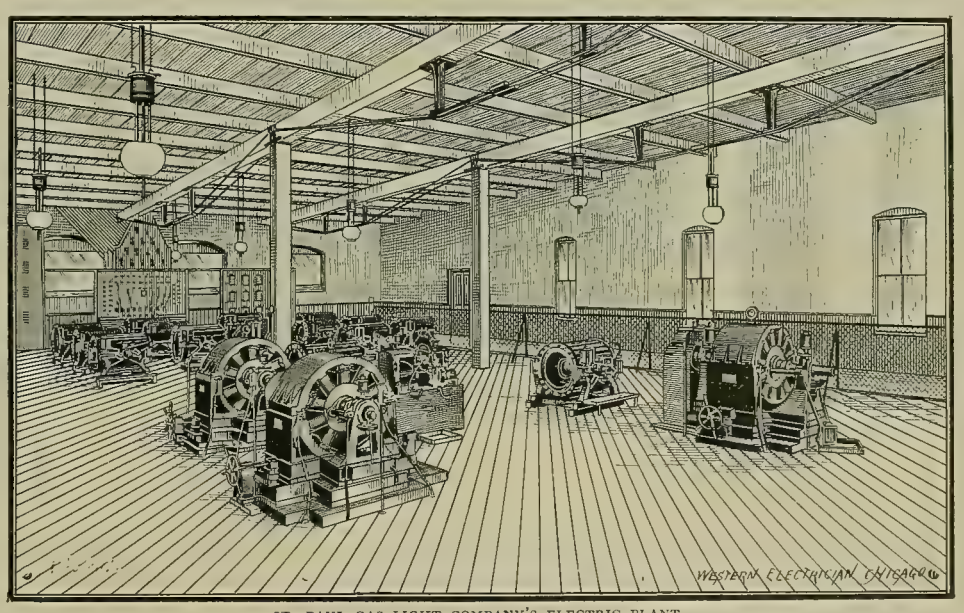
Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, NOVEMBER 1, 1890. No. 18

St. Paul, Minn., Gas Light Company's Electric Plant.

The accompanying cuts illustrate the dynamo room of the St. Paul Gas Light company's electric light plant. This company entered the electric lighting field in 1884, establishing at that time a temporary plant consisting of two 25-light arc machines of the Fuller type. It was believed at that time that the plant would meet the demands for electric lighting for many years, as little faith was placed in the rapid development predicted by exploiters of electrical apparatus. The necessity of increasing the capacity of the plant soon impressed the company, and temporary makeshifts were resorted to until 1886, when, after several extensions, it was decided to construct a power house and install a plant with a view of supplying all future demands. Even this provision was found insufficient, and two years later an addition was constructed. The building is a substantial stone structure, 120 feet square, well lighted and ventilated. When these improvements were decided upon it was determin to install a new plant throughout. The contract was awarded the Northwest Thomson-Houston company of St. Paul. The entire electrical equipment was furnished by that company.



ST. PAUL GAS LIGHT COMPANY'S ELECTRIC PLANT.

By reference to the cuts it will be seen that there are two lighting equipments, though they are both in the same room. The arc lighting plant consists of sixteen Thomson-Houston dynamos of 50 lights' capacity each while the incandescent plant comprises three Westinghouse alternating dynamos, aggregating 4,200 lights. There is also a temporary plant of three 80-horse power Thomson-Houston generators for furnishing current to the street railway line, which is operated by electricity. This plant was also installed by the Northwest Thomson-Houston company of St. Paul, which is equipping the road. This generating plant is only a temporary arrangement, however, as the street railway company is building an immense power house adjoining the power station of the St. Paul Gas Light company. When this is completed the generators will be transferred to the new building.

The engine room is directly below the dynamo room of the electric light plant. It contains one Hamilton condensing engine, 600 horse power; one 400 horse power Harris' condensing engine and two Buckeyes, one 135 horse power, the other 100 horse power. The steam plant consists of 11 tubular boilers, 80 horse power each. Six of these are fitted up for crude oil and the remaining 5 for coal. Under the present conditions the company finds it to its advantage to burn oil, and it will probably equip the entire plant with oil burners. The Minneapolis burner has been adopted, but in St. Paul it retains the name of the Vulcan burner.

The company has been extending its plant gradually, and has now 60 miles of circuit. Of this, 40 miles is in the arc system and 20 in the incandescent. This covers the principal business streets. The circuits are all overhead. Okonite wire is largely used in the system.

The company supplies 50 arc lamps to the city, and about 600 commercial lamps are operated from this station. There are also 20 arc motors on its lines, aggregating 20 horse power. The alternating incandescent system has proved very popular, and the company now has 3,400 lights in use. The capacity of the feeders is 4,200 lamps, and at present it looks as if this number would soon be reached. The growth of this branch of the business has been very gratifying to the company. In June, 1888, the average load was 1,200 lights; one year later the number was increased to 1,500, but this year the growth has been phenomenal, reaching 3,400 lights. The meter system is used exclusively. There has been a steady growth in the arc service during the same period.

The officers of the company are H. H. Sibley, president; C. Livingston, vice-president and general manager; Morgan Brooks, secretary and treasurer; B. F. Ellison, general superintendent. The electrical plant is in charge of Superintendent Snow, a thoroughly practical electrician, and to his personal efforts is largely due the excellent standard which the company has maintained.

Chicago Electric Club Notes.

At the meeting of the Chicago Electric club next Monday evening, Nov. 3, F. E. Degenhardt and Theo. P. Bailey will read papers. The former will discuss underground electrical work and the latter will speak of electric street railways. Both gentlemen are thoroughly conversant with the topics which they will treat, and doubtless there will be a large attendance at the club on Monday evening.

The club is starting out with a new policy as far as the character of papers is concerned. Fewer papers relating to purely technical subjects have been secured. A large number have been promised by those whose connection with electrical work makes them appreciate thoroughly the practical aspect of the business. It is not the intention by any means to slight technical electrical subjects, but by securing several which may be called thoroughly practical, the committees think the literary meetings will be even more interesting and profitable than ever before.

The club enters upon its winter work with a larger membership than ever before, and there is every reason to believe that the number will be materially increased during the fall and winter months. Among the members recently admitted are Prof. Elisha Gray, the inventor; Prof. J. P. Barrett, city electrician of Chicago; Col. R. C. Clowry, vice-president of the Western Union Telegraph company; W. J. Chalmers, the head of Frazer & Chalmers, dealers in mining machinery; E. R. Gilman, president of the Northwest Thomson-Houston company of St. Paul, and many others prominent in the electrical field.

At a recent meeting several amendments were presented, among which was one proposing that the initiation fee and annual dues be materially increased.

It is the intention of the members to set a higher standard for the club and make it serve even better the interests of those belonging to the organization.

The following appointments have been made: F. B. Badt, chairman of literary committee; F. W. Cushing, chairman of the library committee; B. E. Sunny, chairman of the committee on new quarters.

It is understood that there is under discussion the appointment of a committee to act for the club in all matters relating to the world's fair. The club has an important duty to perform in connection with the world's fair, and will doubtless have an opportunity to aid materially in making the electrical department successful.

Municipal Lighting in Chicago.

Mayor Cregier of Chicago has heretofore advocated the establishment by the city of electric and gas plants for commercial service, and he now reiterates his plea in a message to the city council proposing the inauguration of several important public improvements. The mayor is anxious to have the city in holiday attire when the world's fair attracts thousands of visitors from all parts of the world, and in order to accomplish this he believes many needed improvements in the city service should be made. The mayor's first recommendation follows:

"1. To avoid the almost daily tearing up of our principal streets, the roadways should be formed into subways by excavating from curb to curb, in which should be placed all the city's work, and the balance of space rented to any corporation entitled to use the same."

The numerous advantages of such a system

are obvious, but as the project would entail the most lavish expenditure of public funds it is hardly possible that anything will be done right away. Next in importance the mayor deems the establishment by the city of several systems of public service which have heretofore been conducted as private enterprises. His suggestion in brief is:

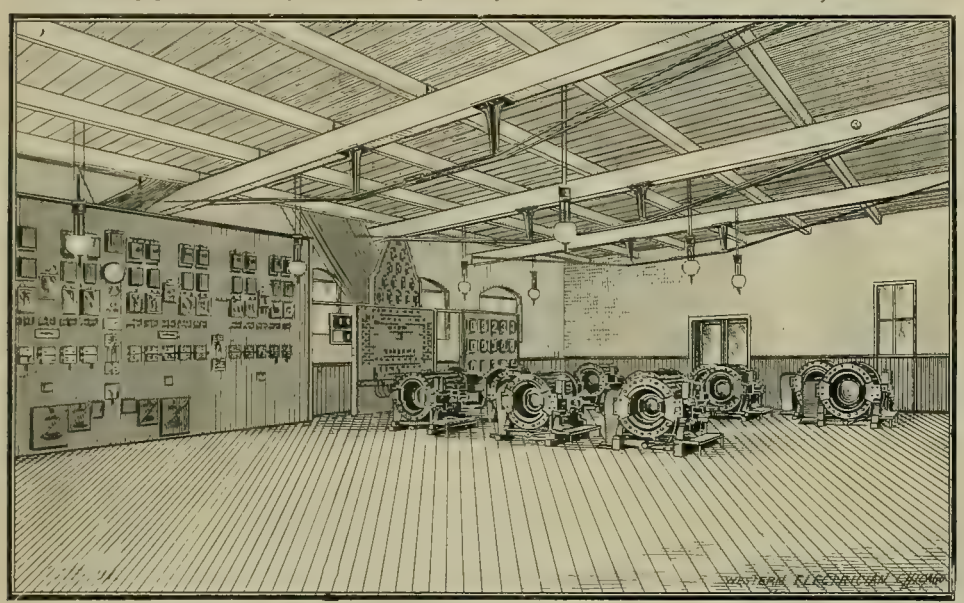
"2 The city should provide a system of public heating, public electric or gas lighting, or both, for streets and house service, and also a system of pneumatic tubes for mail and other service, and possibly underground ducts for smoke."

It is hardly necessary to say that the proposition, so far as it relates to the establishment of plants for commercial lighting, will be bitterly opposed. It will be necessary for the city of Chicago to secure the enactment of a bill by the legislature authorizing the city to go into the gas and electric lighting business, and should the advocates of the measure secure the passage of such a bill, it is not improbable that they may find their path beset by legal difficulties that may require years of litigation to remove, if indeed it should be found that cities can set up in business as competitors of taxpayers.

There is another feature of the question that may cause the mayor no little trouble. A measure of this kind originating with a democratic city administration, is not as liable to receive the sanction and support of a republican legislature, as many persons unacquainted with practical politics might think. In fact, it is safe to say that should a democratic city administration petition the republican legislature to enact an enabling bill, the state authorities would certainly find some technical point on which to base their refusal. One political party will do everything in its power to thwart the plans of the other, and it is not likely that the republicans will assist their democratic brethren to the patronage which the establishment of such works would entail.

The city council authorized the appointment of a committee to be composed of the mayor, comptroller, corporation counsel, chairman of the judiciary and finance committees of the city council, and four citizens to be selected by the mayor, to consider this matter and report to the council the form of amendments to the municipal charter and code which might be deemed necessary and expedient.

City Electrician Barrett has been called upon to report on the proposed extension of the city electric light plant so as to include commercial service within its scope. This is not the first time the question has been brought up. Prof. Barrett not long ago made an exhaustive study of the question. At his request the law department made an investigation of the matter and the corporation counsel declared the city had no right to engage in commercial lighting, and in order to secure the necessary power special legislation would be required. Prof. Barrett, although a warm advocate of municipal lighting, does not believe in the city engaging in competition with legitimate enterprises already established. Prof. Barrett said: "I would not advocate interference on the part of the city in commercial work, but if such a course is decided upon I would advise the city to purchase the commercial plants or allow the companies to continue until the expiration of the terms of their franchises. It would be unjust to do otherwise. The city cannot afford to deal unfairly by men who invest their capital in Chicago enterprises."



ST. PAUL'S GAS LIGHT COMPANY'S ELECTRIC LIGHT PLANT—DYNAMO ROOM.

Electrical Department of the World's Fair.

A communication was received at World Fair headquarters last week from Gardner C. Sims, chairman of the committee on electricity and electrical appliances. Mr. Sims has been figuring on his department and wants to see it a grand success. His communication is briefly as follows:

From a practical point of view our committee has in mind four things of vital importance: First, to prevent loss of life; second, to prevent injury to person or creature; third, to prevent the destruction of property by fire; and lastly, to make an unqualified and satisfactory success of our department which we hope the committee on classifications will make separate and distinct.

I would respectfully submit the following suggestions to the executive committee: It is my purpose to show the advanced state of the art of transmitting power from the Centennial of 1876 to the present time. There are many smoke-consuming furnaces and practical devices for the consumption of smoke that could be used, and if a competitive trial was demanded it could easily be accorded the many representatives, allowing the general public to constitute itself a jury of award, judging by the amount of solid matter that will leave the various smoke chimneys, to deposit itself, in a measure, in every house in Chicago Let it be said that the Exposition does not contribute to this objection and assist in injuring the exhibits of our guests that kindly favor us.

From the power and electrical generating stations the electrical current should be taken and distributed to its objective point by an underground system or systems, and then by concealed insulated wires to motors that are to drive the various machines.

In contemplating such a gigantic undertaking it is not to be expected that electric corporations could contribute more than their special exhibits, for which motive power must be furnished gratuitously; yet, by adopting an advanced plan of transmitting power, you would save, let us say, $750,000 by the absence of shafting, belts, etc. This amount could be invested in electrical equipment by the Exposition, which they would sell for about 75 per cent. of its cost, while the Exposition was officially open, to be delivered to the purchaser where it stood, within ten days after its close, for strict cash.

The plan for transmitting motive power cannot be carried out in its entirety, as isolated cases will arise which will prevent. It will also meet with some opposition from the builders of steam engines, yet it will have the approval of those advanced ideas, as it does of many of my associates who have kindly given their indorsement.

All railways for the transportation of passengers should be electrical and elevated, with frequent stations. The excess of revenue derived will equalize the deficiency of other departments of our bureau which can not be made self-sustaining.

A demand will be made that it will be necessary to have special steam engines and dynamos in the electrical building for special exhibits. This we will cheerfully accede to. The engines, however, must be made to run without steam, which can easily be done by electricity, so as to avoid the smell of oil and radiation of heat from steam and exhaust pipes, which would make our building unbearable to multitudes, even were the temperature not to be compared with June and July weather of this year.

We would also like to practically illustrate the manner in which a ship that had met with injury to its hull could be temporarily, and possibly permanently, repaired without going into a dry dock, beaching, or on launching ways, or in mid-ocean, weather permitting, by the aid of electrical and mechanical appliances, of which every ship should have an outfit.

Glass Switch-Board for Telephone Exchanges.

The rapid increase in the number of subscribers is bringing the telephone companies in larger cities to a realization that it will not be a long time before an effort will have to be made to increase the capacity of the present switch-board equipment. In the most improved telephone systems a single operator has within reach one section, or 4,000 lines, each line being represented on the switch-board by one hole. The space taken up by the plug holes for the 4,000 lines is about 2x6 feet. This area of board gives an operator all she can do when properly connecting subscribers. In order therefore, to place under the control of one operator a greater number of lines and at the same time not increase the labor of making connections, it would be necessary to have a single section contain a greater number of plug-holes. As the boards are now constructed it is a practical impossibility to lessen to any great extent the distance between the plug holes. A radical change in all probability will have to be made and various schemes will be proposed. Among the plans now offered in solution of this knotty problem, the one illustrated herewith presents some interesting features. J. J. O'Connell of the Chicago Telephone company proposes to make switch-boards entirely of glass. His plan is to form the entire board of glass plates or sections, each containing, say, 100 plug sockets. The board will be arranged horizontally. The plates will be moulded as shown in Fig. 1 with the wires imbedded as indicated in Fig 2. Each hole will be partially filled with mercury which will make a practically dust-proof contact. By this arrangement the inventor claims that 24,000 metallic circuits may be handled on a section measuring 5 feet by 5 feet. The lines will be disposed in banks of 100 each and a set of 100 line terminals will be contained in one glass plate, 3x3 inches, including a space for numbers. The placing of the board in a horizontal position is necessitated by the use of mercurial contacts. In the metallic system in which it is proposed to employ the glass switch-board no annunciators are to be used. The orders will be taken directly by the operator without any preliminary signaling. In other words her ear will be, so to speak, always on the telephone line. No special "order" wire will be employed in this system.

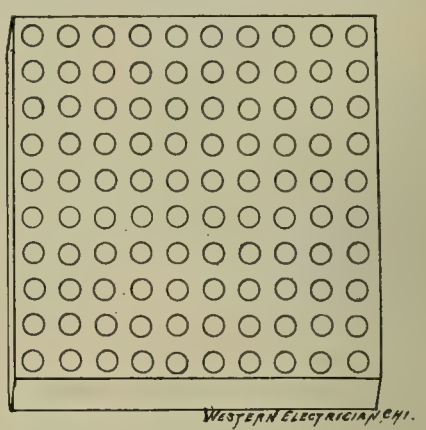


FIG. 1. GLASS SWITCH-BOARD FOR TELEPHONE EXCHANGES.

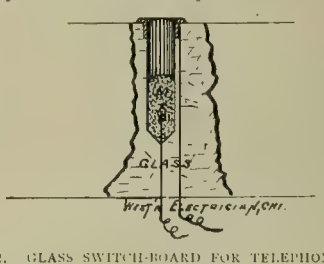
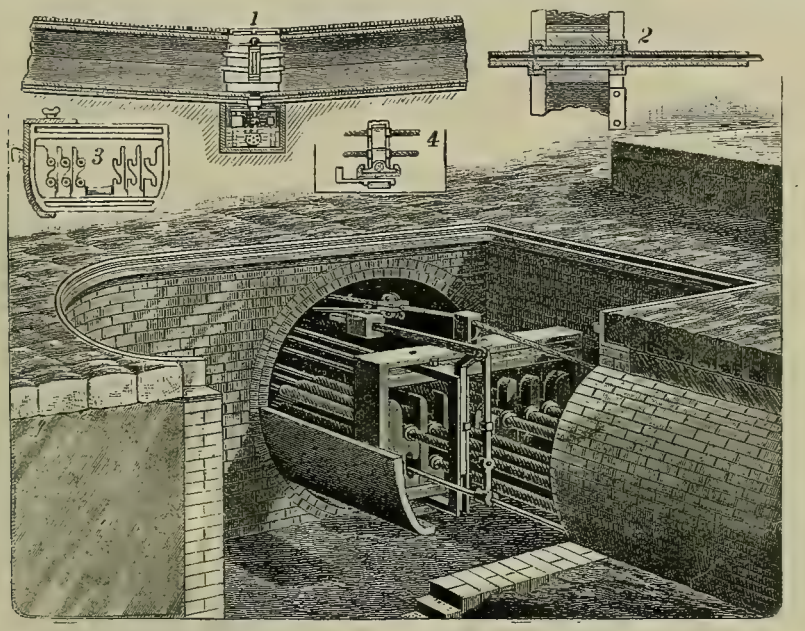


FIG. 2. GLASS SWITCH-BOARD FOR TELEPHONE EXCHANGES.

Loth Conduit System.

The conduit system illustrated in the engraving was designed by C. Edward Loth of Troy, N. Y. The special object of the inventor was to design a conduit which would facilitate the laying and adjusting of the wires, and for cheapening the construction of the lines, by doing away with the necessity of insulation except at or near the points of support. The system provides means of gathering and removing water which may accumulate. At suitable intervals along the conduit are arranged manholes like that shown in the engraving, in which are placed supports for receiving the conductors. These supports are placed in a frame held in a vertical position in the manhole. They are capable of being moved in the frame to permit of introducing or arranging the wires, which are drawn through the conduit by means of the cable shown in the larger view. The cable carries a clamp for receiving the end of the wire. As the cable reaches the roller on the top of the frame in the manhole, the clamp is detached from the cable, the wire is passed through the frame, when the clamp is again attached to the cable upon the opposite side of the frame, and the wire is drawn forward as before until the next manhole is reached, when the operation is repeated.

It is desirable to maintain a certain tension on



LOTH CONDUIT SYSTEM.

the wires during the operation of introducing them into the conduit, and for this purpose a right-angled lever is provided, having on its vertical arm a clamp for receiving the wire, and on its horizontal arm a weight for giving the wire the requisite tension. The wire is provided with an insulating covering for a short distance on opposite sides of the supporting frame in the manhole, and is furnished with a sleeve which rests in the support and serves to retain the wire in its position and under proper tension. The sections of the conduit incline toward the manhole, and each manhole is provided with a pipe leading to the suction pipe of the pump, several of the manholes being connected with a single pump. It will be noticed that the pits for receiving the water at the ends of the sections are enlarged laterally to give them increased capacity. These pits are furnished with benches or platforms upon which the linemen may stand while adjusting the wires.

Fig. 1 shows the inclination of the conduit, section of the water pit, and the float valve for closing the suction of the drainage pipe as the water is removed, so that the pump may act upon the water in the other pit. Fig. 2 is a sectional view of the fastening device for holding the wire in the support. Fig. 3 is a side elevation of the frame and the wire supports, and Fig. 4 shows a support provided with a roller over which the wire is drawn while it is being introduced into the conduit. The cut is reproduced from the *Scientific American*.

Hyde Park Electric Company, Chicago.

Hyde Park, Chicago's finest residence district, has lacked only one essential feature of an ideal locality for the palatial residences it contains—a central station for incandescent lighting. This has been provided in the installation of the Hyde Park Electric company's plant at Fifty-third street which was opened last week. The company was incorporated recently and began operations shortly afterward. It is capitalized at $100,000, and the officers are: President, J. W. Brooks; vice-president, H. N. Hubbard; secretary and treasurer, E. C. Wood. The directors are: C. B. Bouton, F. E. Spooner, O. F. Lindman, J. H. Ware and the officers already mentioned.

The new power station is at Fifty-third street near the Illinois Central tracks and is admirably arranged. It is designed for a capacity of 10,000 lamps. At present there are two 1,300-light alternators of the Thomson-Houston type and two 25 arc machines. Power is furnished by two 180-horse power McIntosh & Seymour engines. The company has already constructed twenty-five miles of circuits, using simplex wire. Most of the poles are thirty-five feet high but there are many sixty-five feet high. The company has no opposition whatever, though when the franchise was secured from the Hyde Park board before the district was annexed to Chicago, it was anticipated that much trouble would be experienced as the company wanted to establish an overhead system. The city authorities opposed the project, but the law department ruled that the permit must be issued. Instead of erecting the poles in the streets, the company secured permission from the property owners to put the poles in the back yards where they were entirely out of sight from the street. This removed the last opposition to the project, and since then there has been no trouble whatever.

A New Constant Current Motor.

Prof. Elihu Thomson is apparently an indefatigable worker in the electrical field. Almost weekly the records show the issue to him of at least one patent. One of his latest productions is the novel form of constant current motor illustrated in the cuts. The special feature of the machine is its governing apparatus. The governor is constructed with the object of controlling the speed by variations in the magnetism of the fields produced by magnetically short-circuiting the poles.

In order to understand the operation of the motor it will be necessary to refer to the illustrations. In Fig. 1 *A* is the armature and *PP* the field magnet pole pieces. The field magnet is magnetized in the usual manner by the coils *DD*. These field coils are in series with the armature.

Coils of wire upon a bar *S*, to be presently described, are connected in the same circuit as the armature and coils *DD*, that is, in series with either or both. The coils on *S* are of high or low resistance, as may be required by the particular arrangement employed. Connecting the poles *PP* by a sort of magnetic bridge is a bar of iron wound with wire and indicated at *S*. Such an arrangement would short-circuit the magnetism were it not that a current is maintained in the coils *S* of just sufficient strength to depolarize the iron which it surrounds and

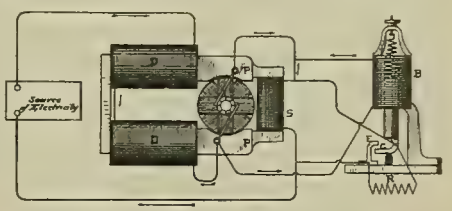
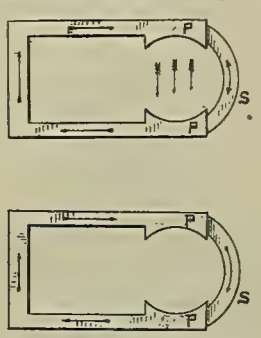


FIG. 1. NEW CONSTANT CURRENT MOTOR.

effectually oppose the inductive action from *P* to *P* through it. It is evident, therefore, that while current is maintained in *S* the bar in its axis is inert as a carrier of magnetism. This is illustrated in Fig 2, where the opposed arrows at *S* show the opposition of the tendencies of the magnetizing forces applied to *S*. In this manner the magnetism of the poles *PP* is left free to act upon the armature space, as indicated. In Fig 3 the current is supposed to have been cut off from the coil at *S*, Fig 1, when at once a short circuit of magnetism of the field takes place at *S*, Fig 3, almost annihilating the effect of the field upon the armature space. To render these actions dependent upon the speed



FIGS. 2 AND 3. NEW CONSTANT CURRENT MOTOR.

of running, Prof. Thomson utilizes the variations of counter electromotive force on the armature in the manner shown in Fig 1. In this diagram *B* is an electro-magnet whose coil is of high resistance, and is placed in shunt to the armature, as indicated. As thus arranged the electromagnet *B* acquires an increased power when there is increased counter electromotive force developed in the armature through an increase in its speed of rotation. The movable core is therefore raised, making a contact between *C* and *E*. These contacts *C E* are in a shunt around the coil at *S*, and when closed by the increased speed of the armature, effectually divert current from coil at *S*. By this action

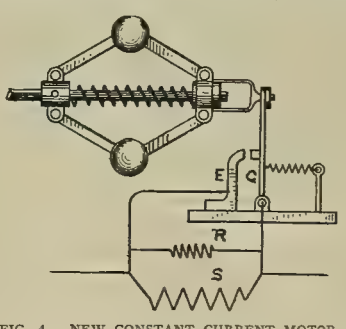


FIG. 4. NEW CONSTANT CURRENT MOTOR.

the short-circuiting bar is made to lose its restraining power. This action, therefore, weakens the field and lowers the force of rotation of the armature. In practice, if the motor is not overloaded, an intermittent closure and opening of the contacts may be expected. The opening of the contacts restores current to *S*, and the field polarity of *PP* is regained in consequence of the restored effect of *S* in preventing the short-circuiting of the magnetism.

In order to lessen the spark at the contacts a resistance, *R*, is placed in shunt as shown. It

may be stated that the above method of controlling the magnetic action of the bar *S* is not the only one employed by Prof. Thomson. Instead of using the differences of counter e. m. f. in the armature as a controlling agency, a centrifugal governor may be employed as represented in Fig. 4.

The Westinghouse Electric Railway at Greensburg, Pa.

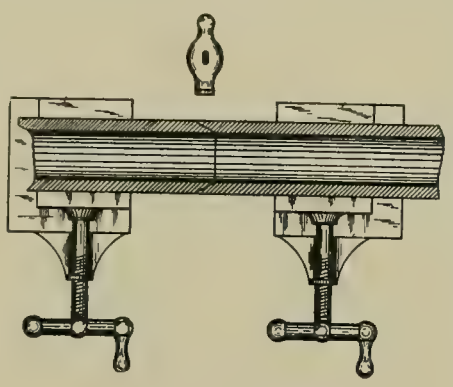
Last week the Greensburg & Hempfield Electric Railway company of Greensburg, Pa., started the operation of its street car line. The road runs from the Pennsylvania Railroad station through the principal streets of the town to Hempfield, a small suburb of Greensburg, a distance of two and a half miles. Greensburg had previously no street car line of any kind, and the commencement of rapid transit by the electric system was quite an event in the history of the town. All the local papers had made announcements of the event and the hour at which the first car would appear on the streets, and the public came out en masse to witness the trial trip. In covering the distance of 2½ miles the cars had to climb no less than eight hills, and the majority of them present grades of ten per cent. In addition to the hills, however, the line is also peculiar on account of the large number of curves, all of them short ones; indeed there are two of a radius of fifty feet. But in spite of these obstacles to an easy and smooth operation of the motors, they have given excellent service from the moment the first car rolled out of the shed. Owing to the novelty of rapid transit in Greensburg generally, and of electrically propelled cars in particular, the Greensburg residents have taxed the capacity of the cars to their utmost limit. Every car has hitherto been crowded from the starting point to the terminus and return, the cars having carried on the average seventy-five passengers right along. The track is composed partially of the Johnston rail and the T rail. With the exception of a short distance in the business portion of the town, where the tracks are laid on asphalt covered streets, the roadbed has been stone ballasted. The power house is situated near the terminus of the road at the foot of one of the steepest hills along the entire route. It is very comfortably arranged. The car shed and a repair shop are immediately attached to it, everything being situated level with the ground. The motors are placed upon Brill trucks and the body of the car is made by the Chester Car company. The latter is very commodious and handsomely painted. F. Y. Clopper, a well-known Greensburg business man, has charge of the road, and he expresses himself as being in every way satisfied with the equipment of the road, which he intimated could not have been better. The North American Construction company did the construction work on the road.

Electric light plants will be installed in two sawmills at Lake Charles, La.

Wrinkle in Pipe Welding.

In welding together pipes by the electrical method it has been the usual practice to employ internal mandrels to prevent collapse or change of circumferential outline. Prof. Elihu Thomson, however, has recently invented a simple process by means of which the use of internal fixtures is avoided.

The invention is based upon the fact that if



WRINKLE IN PIPE WELDING.

a hollow structure be heated at a certain portion of its length and subjected to an upsetting action it will bulge exteriorly instead of collapsing. The structure will therefore have a larger diameter at the swelled portion. In the present process, where it is applied to the welding of pipes, hammer blows are delivered at the weld or on the side of the pipe and are so graduated as to simply contract this bulging or lateral spreading tendency. The hammering is delivered laterally so as to restore the metal back to its original position on the sides of the pipe. There is no tendency to collapse on account of the bulge of the pipe acting as a sustaining support. The expansion is outward. This arched interior is very important. It permits the blows of a light hammer to be delivered without really collapsing the pipe, but merely restoring it to its original outline. The process is so simple that the illustration is almost unnecessary.

Storage Battery Cars for Chicago.

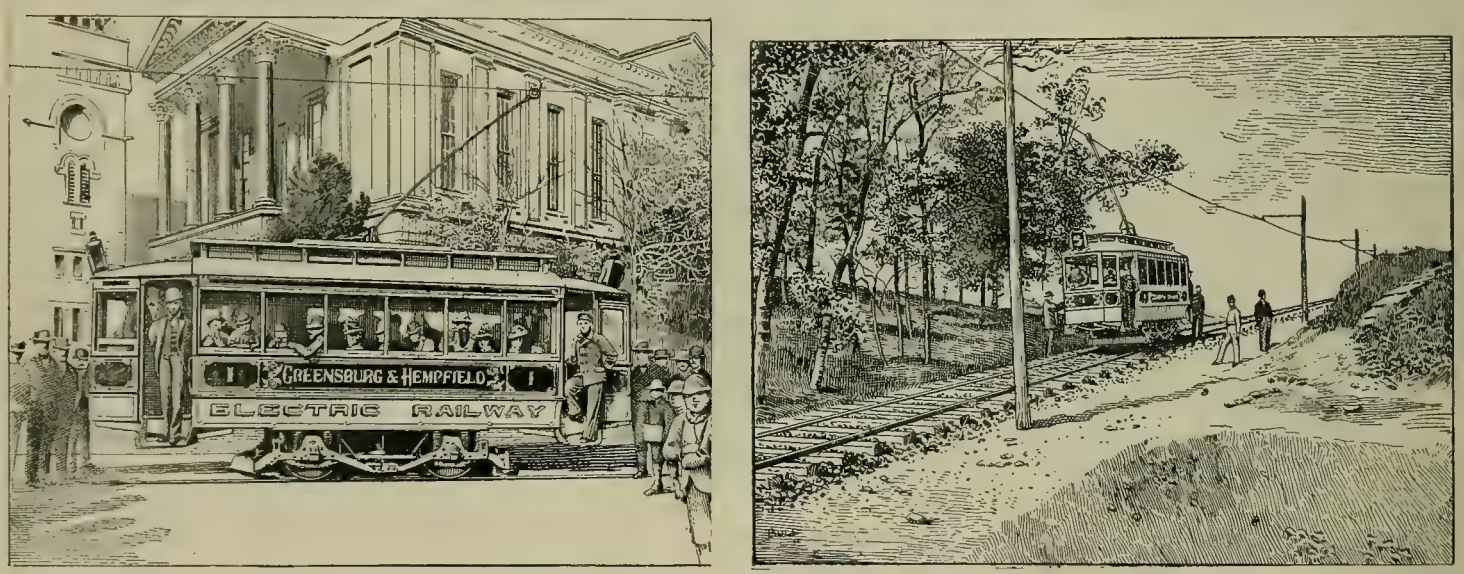
William Hood of Chicago, representing the Accumulator company of New York and the Electro-Dynamic company of Philadelphia, has obtained permission from the North Chicago Street Railway company of Chicago to operate a storage battery car on the Dearborn street route, extending from the Polk street station on the South Side, to the Northwestern station. The car has already been shipped from Buffalo, where it was exhibited during the recent convention of the American Street Railway association, and created a favorable impression among the managers of street railroads.

The car will be exhibited in Chicago long enough to demonstrate the practicability of the system. Those who are interested in the enterprise anticipate great results from the operation of the car in Chicago.

Set-back for the Telegraphers.

As was announced in a recent issue, the telegraph operators of the country have been organizing a brotherhood in which it is proposed to include all branches of the business, both railroad and commercial. The order of railroad telegraphers, it is claimed, cannot resist the opposition of the companies, owing to a clause in the constitution which repudiates the idea of strikes. In view of this fact the organization has been badly crippled in many places. There has been no organization of the commercial operators since the strike which resulted so disastrously to the telegraphers. Now, however, there are indications of a growing sentiment among the operators favorable to an organization that could compel the big companies to grant the demands of the operators or submit to a long fight. This of course, the companies wish to guard against, and they have taken steps to protect themselves. The brotherhood claims that a number of its most prominent organizers in Chicago have been discharged because of their activity in the order. The Western Union and Postal companies will declare war on the order, it is further asserted, and dismiss every man identified with the organization. The men engaged in forming the organization were dismissed owing to their prominence in agitations, it is said, and the telegraph companies look upon all men who associate with them in this organization opposed to their employer's interest; hence the dismissals. Many of the men identified with the new organization were prominent in the old union, and when they returned to their positions they bound themselves to have no further connection with labor organizations of any kind. The fact that the new organization is preparing for an active warfare is evident from the fact that it solicited and received the approval of the Supreme Council of Federated Railway Employes recently. This council represents the Brotherhood of Locomotive Firemen, Brakemen's, Conductors' and Switchmen's Mutual Aid association, and these organizations gave the telegraphers assurance of their support.

Reports from Omaha, Neb., indicate that the telegraph companies have decided to follow the same course in that city that they have in Chicago. Half a dozen men have been discharged and it is claimed the reason for their discharge is found in the fact that they were active members of the brotherhood. The telegraph companies do not admit that they have discharged any of their employes because of their connection with the society, in fact they have refused to give any reason for their action, and the leaders of the brotherhood are endeavoring to find some means of extorting an admission from the officials. One prominent telegraph man when approached said the companies did not recog-



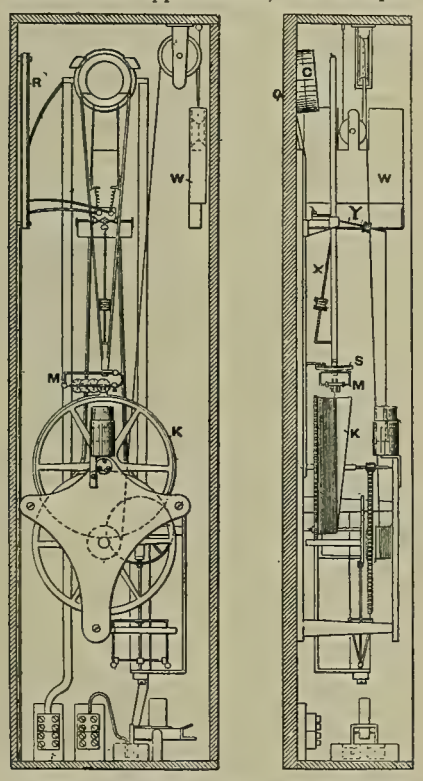
WESTINGHOUSE ELECTRIC RAILWAY AT GREENSBURG, PA.

nize the existence of the brotherhood or any other labor organization.

Despite the claims of the operators that they had no intention of striking, the night force at St. Paul quit work last Monday evening. The strikers claimed that members of their order had been discharged, the superintendent had positively refused to confer with a committee of the brotherhood, though he was willing to treat with the men as employes, and as this seemed to indicate hostility on the part of the company toward the brotherhood, it was determined to quit work. The offices in the Twin cities were therefore in bad shape Monday evening and Tuesday, but the company feared no trouble.

Sir William Thomson's New Electricity Meter.

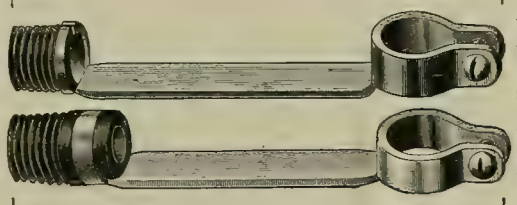
At the recent meeting of the British Association at Leeds, Sir William Thomson's electricity meter, shown in the cut, was described. The instrument forms at once an indicator, by which the strength of current passing at any given instant can be read off on a scale, and a supply meter, by which the amount of current that has passed through the meter during any given time is recorded on a train of counting wheels. The indicator consists of a light aluminium frame, free to turn about a horizontal axis, having at its top end a coil of fine copper wire *C*, and at its lower extremity a train of counting wheels, *M*. The frame is supported on knife edges, and current is conducted into and out of the fine wire coil by two spirals of fine copper wire. The resistance of this coil is about 30 ohms, and it is joined in series with an anti-inductive platinoid resistance *R*, of 970 ohms. When the meter is in action a small current is kept passing through this circuit. The whole current to be measured is conducted through a fixed coil *C* of copper ribbon, which is placed



SIR WILLIAM THOMSON'S NEW ELECTRICITY METER.

with its plane parallel to the plane of the fine wire coil when the latter is in its zero position. A scale *S*, divided to give readings in amperes, is attached to the indicator. The recording apparatus consists of the train of counting wheels mentioned above, and a revolving cam *K*, driven by clockwork, which is kept in motion by a weight *W*. The cam revolves uniformly, and when there is a current at each revolution comes in contact with a trailing wheel attached to the counting train, which it turns, making a record.

The action of the meter may be explained as follows: When no electricity is passing the indicator stands at o on the scale *S*, in which position the trailing wheel on the counter train is quite clear of the cam, so that no record is made. When electricity is passing through the fixed coil the top end of the indicator is repelled *outward*, and the counting train of wheels is brought *inward* towards the cam, to a position depending upon the current, which can be read off on the scale. In this position the trailing



FIGS. 3 AND 4. ELECTRICAL NOVELTIES.

wheel is brought into contact with the surface of the cam, and is turned round proportionally to the current.

Two screwed rods are so attached to the indicator that one, *X*, is vertical, and the other, *Y*, is horizontal when the beam is in its zero position. These rods are provided with adjustable nuts—those on the vertical being to adjust the sensibility of the instrument, while those on the horizontal rod are for the adjustment of the zero. By means of the former the constant of the meter can be quickly varied if found convenient. Thus a meter which is suitable for measurement from 1 to 20 lamps can be altered in a few minutes to suit ranges of from 1 to 50 or from 1 to 100 lamps. This adjustment can be made by an inspector without the use of any auxiliary instrument. All that has to be done is to hang on a weight of a given amount on the knife-edge stirrup at the end of the horizontal arm and raise or lower the nuts on the vertical arm till the indicator shows a given reading on its scale. By this means also the constant of the meter can be checked at any time.

As at present arranged the driving weight needs to be wound up periodically by means of a revolving disc on the front of the case. It is intended that this should be done by the consumer, and an arrangement is made by which the current is automatically cut off from the house when the weight is allowed to run down.

Improvements at Cornell University.

The opening session at Cornell University, Ithaca, N. Y., this year promises unusually well, especially in the electrical engineering department. The entrance class of the mechanical and electrical engineering departments this year is the largest in the history of the institution. The facilities for experimental work and shop practice have been greatly increased. The chemical department has taken possession of its new quarters, a building 60x200 feet, four stories high and having laboratory and lecture room accommodations for 1,000 students, leaving Franklin Hall entirely to the physics and electrical engineering departments.

In addition to this a new dynamo room has been fitted up. This room, the dimensions of which are 60x100 feet, will be the finest of its kind in the country. Within it are located thirty-four dynamos and motors—including six small Westinghouse dynamos, three Weston, six Edison, one Stanley alternating arc machine, one Thomson-Houston direct current incandescent, one Thomson-Houston alternating current incandescent, one Thomson-Houston arc, 30-light machine, one Waterhouse, one Ball, one Mather, one Siemens & Halske, one Gramme, one Brush motor, one Tesla motor, two Sprague motors and six dynamos and motors constructed at the University. Power is furnished by Ide and Straight Line engines and by a water-wheel located in the gorge.

Another great improvement is the new engine room and lighting station of the university. This room has a floor space of about 50x60 feet and when completed will contain the following engines and dynamos, all donated by the respective firms: Two Straight Line engines of 30-horse power each, one Payne engine 25-horse power, a 75-horse power Compound Westinghouse, a 20-horse power Westinghouse and a 60-horse power engine constructed by the Lansing, Mich., Engine company, one 600-light Edison, one Westinghouse alternating current arc, one United States arc and two Westinghouse incandescent dynamos.

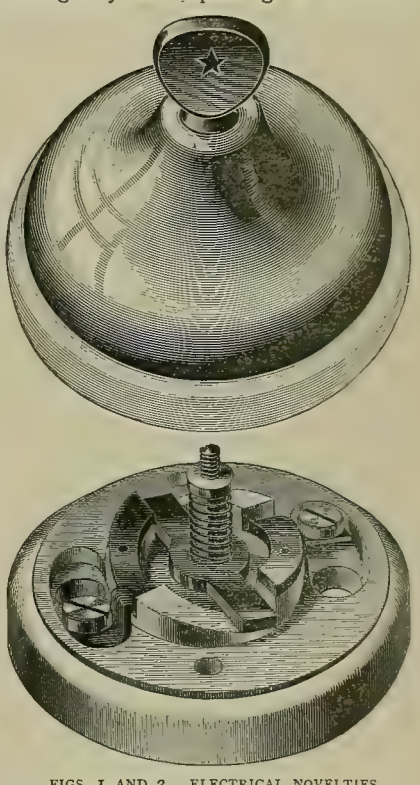
The work-shops have been entirely reconstructed during the summer. The new machine and wood-working shops, each occupying a floor space 50x180 feet, are being fitted up with the latest and most approved machinery. A new building, 45x150 feet, has been erected for the blacksmithing and foundry departments. In the smithy are located twenty-four forges, while in the foundry instruction may be given to 100 students daily.

The capacity of the set of boilers, now 400-horse power, is to be increased. The boiler room is to be made practically air tight and the barometric pressure within is to be increased about one inch of mercury by means of air forced in by a large rotary blower.

George Shepardson, R. G., '89, occupies a position as instructor in electrical engineering and Prof. Carpenter of the University of Michigan has been placed in charge of the mechanical laboratories. Prof. Snow of the electrical engineering department is in Europe. J. S. Loomis and S. B. Fortenbaugh, E. E., '90 are connected with the Brush Electric works, Cleveland, O. J. E. Greenawalt, '90, is employed in the railway department of the Westinghouse Electric company, Pittsburg, Pa. W. H. Powell, '90, is in the laboratory of the Westinghouse company. L. B. Marks, R. G. '90, has been appointed manager of the Washington, Pa., Carbon works.

Electrical Novelties.

In the accompanying cuts are shown devices handled by the Star Electrix company of Philadelphia. In Figs. 1 and 2 is shown the company's double break single pole switch. The contact carrying parts are of soft metal and the surfaces wear bright by use. Sparking is reduced to a



FIGS. 1 AND 2. ELECTRICAL NOVELTIES.

minimum by the double instantaneous make and break. The base is made of porcelain.

Figs. 3 and 4 show a new device for attaching incandescent lamps to gas fixtures. It is made entirely of sheet metal and can be bent at any angle. The attachment can be rigidly fastened without screws or removal of gas burners.

Sun Electric Light Company, Chicago, Purchased.

The Sun Electric Light company which has been operating at the Sperry arc plant on Third avenue, Chicago, was purchased by the Chicago Arc Light & Power company, recently.

A company to establish an electric light plant is organizing at Union City, Tenn.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
The St. Paul, Minn., Gas Light Company's Electric Light Plant. Illustrated	233, 234
Chicago Electric Club Notes.	233
Municipal Lighting in Chicago	233, 234
Electrical Department of the World's Fair	234
Glass Switch-Board for Telephone Exchanges. Illustrated	234
Loth Conduit System. Illustrated	235
Hyde Park Electric Company, Chicago	235
New Constant Current Motor. Illustrated	235, 236
The Westinghouse Electric Railway at Greensburg, Pa. Illustrated	236
Wrinkle in Pipe Welding. Illustrated	236
Storage Battery Cars for Chicago	236
Set-back for the Telegraphers	236, 237
Sir William Thomson's New Electricity Meter. Illustrated	237
Improvements at Cornell University	237
Electrical Novelties. Illustrated	237
Sun Electric Light Company, Chicago, Purchased	237
Editorial	238
The Electric Light in its Relation to the Consumer. By C. W. Naylor.	239, 240
New York Electrical Society. Abstract of a Lecture by Lieut. Bradley A. Fiske on the Civilian Electrician in Modern Warfare	240, 241
Electric Welding Applied to the Manufacture of Projectiles. By Lieut. W. M. Wood	241
Electricity in a Silver Mine	241, 242
The Central Station as an Investment. Discussion of B. E Sunny's Paper by Members of the Chicago Electric Club	242
Electricity in Mining Work	242, 243
DEPARTMENTS.	
Correspondence	243, 244, 245
The Electric Light	245
The Electric Motor	245
The Telegraph	245
The Telephone	245
Electrical Patents	246

IN another column is presented a communication from Gardner Sims, chairman of the committee on electricity and electrical appliances for the World's Fair for 1893. Mr. Sims advocates the idea of using electricity as a means of transmitting power for all machinery operated at the great exposition. Of course he does not expect that electrical companies will furnish more than their special exhibits. He recommends that the exposition authorities purchase the necessary plant for the generation of current; after the close of the fair the machinery, in Mr. Sims' opinion, could be sold for at least 75 per cent. of the cost. All railways for the transportation of passengers should be elevated and be operated by electricity, according to Mr. Sims.

SIR WILLIAM THOMSON'S new meter is described in this issue. A glance at the illustrations naturally lead one to believe that the instrument is quite bulky, and from all accounts this impression is correct. Without attempting to discuss in detail the various features of the apparatus, we will merely say that if the meter is "as large as an old-fashioned eight-day clock" and requires "winding up every twenty-four hours," as was stated by a correspondent, we are fearful of its future as a desirable instrument for anything but laboratory work. While we do not feel ourselves to be capable of criticising Prof. Thomson's effort, we can not forbear to mention that a glance at the drawings of this machine brings to mind one trait peculiar to American inventors. The Yankee electrical or mechanical genius seems to possess the valuable faculty of eliminating unnecessary parts and reducing an invention at the start to its simplest possible form. While there is not the least doubt in the world that Prof. Thomson's new meter will eventually appear as a more practical device, it is to be regretted that it had not been worked out more thoroughly before it was submitted for public criticism.

MUNICIPAL control of commercial as well as public lighting, is again advocated by Mayor Cregier in a message to the city council of Chicago, and that august body realizing the increased political power such a change would give, readily took the subject under consideration. The whole matter has resolved itself into an intricate political problem, and it is well for the taxpayers that the political features of the scheme are discernible at such an early day, thus giving them ample opportunity to study the question in a new light. "The city has no legal right to engage in commercial lighting," says the law department. It will, therefore, be necessary to secure special legislation to enable the city to go into the business. A democratic city administration pleading to a republican legislature for assistance in bracing up its organization, is truly an amusing spectacle. There is little doubt that the republican managers will realize the necessity of effectually putting a stop to this proceeding. City Electrician Barrett's position is concisely stated: "I do not favor commercial lighting by the city, but if such a course is determined upon, why, buy up the plants of the companies now operating or let them run until their franchises expire."

THE use of electrical appliances in the army and navy is increasing so rapidly that it is suggested that a special corps be organized to take charge of all electrical work for both branches of the service. The matter was discussed in a lecture delivered at a recent meeting of the New York Electrical society by Lieut. Bradley A. Fiske, whose work in the application of electricity to the naval service is well known. His ideas are presented in a report of the meeting given elsewhere in this issue. Lieut. Fiske at the outset makes the statement that the country, if war were declared, would be in no position to avail itself of the many electrical devices which experience has demonstrated are so effective in defensive and offensive warfare. The officers of the army and navy who have up to the present given their attention to electrical work would find at such a crisis their time too fully occupied to devote it to any special branch exclusively. The number of persons qualified to supervise the application of electricity to the requirements of army and navy is extremely small and, in case of necessity, a trained corps should be in readiness. In seaport towns, therefore, Lieut. Fiske thinks there should be organized companies charged with the execution of all work connected with the utilization of electrical appliances in warfare on land and sea. In view of the fact that this country is conceded to be in an extremely defenseless condition as far as the seaboard is concerned and that it must depend in the event of warfare upon the use of the most improved defensive appliances in almost all of which electricity is used as an agent, the suggestion of Lieut. Fiske is well worthy of consideration. It is no doubt true, as he says, that the organization of the corps would not be a matter of great difficulty for it is a well recognized fact that young men are to be found in an abundance ready to engage in any kind of electrical work.

In this issue is presented a paper by Lieut. W. M. Wood who deals in a special topic in the application of electricity to appliances of war. He dwells upon the great importance of electric welding in the manufacture of projectiles. By the application of this process, he says, a wrought steel projectile can be made at a less cost than a cast iron one which is practically useless except for target practice.

SOME interesting calculations as to the cost of running arc lights in Chicago are presented in C. W. Naylor's paper on "The Electric Light in its Relation to the Consumer." The majority of the readers of the WESTERN ELECTRICIAN are no doubt familiar with the spicy remarks which passed between Chicago's city electrician and M. J. Francisco at the last electric light convention on the subject of municipal lighting. Some startling figures had been given by a number of municipalities relative to the cost of running arc lamps for street lighting and in Mr. Francisco's paper a few statements were made which, if true, by no means substantiated the popular impression that Chicago's lights cost nineteen cents per night. On this account particularly Mr. Naylor's article will be appreciated. In his paper, which appears in this issue, the author takes up in detail and in a most practical manner the interesting question of the true cost of municipal arc lighting in Chicago. It may be stated that the subject of the city service is touched upon incidentally, but from the fact that Mr. Naylor is in charge of one of the largest, if not the largest, private plant in Chicago, the figures given merit the careful perusal of men on the lookout for facts. It will be of interest to many to know that Mr. Naylor calculates, on a basis of 2,000 lights, that it costs Chicago at the lowest from thirty-one to thirty-four and six-tenths cents daily for one arc light.

THE development of a thoroughly practical, reliable, and governing constant current motor, and one which will not easily get out of order, is a problem which has occupied the attention of a number of our ablest electricians ever since electricity was first sold for power purposes. A number of types of machines have been brought out and are now in operation, but as yet even the most prejudiced will admit the constant current motor, although most prominent in the field, has had to take a second place. A large number of constant current motors are in daily service and are unquestionably doing good work, but that the greater demand has been for constant potential machines must be conceded. Inventors, however, are still working, and improvements are being constantly made. In this issue a description is presented of a novel type of constant current motor. The machine is the invention of Elihu Thomson, and is worthy of special mention on account of the peculiar mode of governing employed. Prof. Thomson's method consists in shunting to a greater or less degree the magnetism of the motor fields in response to changes in speed, and thus varying the intensity of the magnetic field in which the armature revolves. In the form of motor described a short-circuiting bar surrounded with a magnetizing coil extends from pole-piece to pole-piece. By means of a simple electro-magnetic device which responds to fluctuations in the counter e. m. f. developed in the armature, the current in the coil is kept of just sufficient strength to depolarize the iron bridge bar above mentioned, and effectually oppose any inductive action between the pole-pieces proper of the motor. When the speed rises above the normal the action of the electro-magnetic controlling device is such that the magnetic shunting bar at once becomes efficient as a magnetic conductor and draws off, so to speak, the magnetism which would otherwise act upon the motor armature.

It is needless to point out that Prof. Thomson's treatment of the magnetic circuit is novel and ingenious. Shunting the strictly electrical portions of a field magnet as a means of government for both motors and dynamos, is employed in a number of types of machines, but Prof. Thomson makes a departure which is suggestive of the fact that there still exists a comparatively speaking unexplored field. It would be interesting to learn what practical results, as far as quickness of government under sudden changes of load are concerned, can be attained with this type of machine.

The Electric Light in its Relation to the Consumer.[1]

By C. W. Naylor.

The electric light is a broad subject for either study or discussion. It can be looked at from many directions. It is a theme for both the scientist and general student.

The mechanic or engineer who starts out intending to design or build electric machinery and appliances, maps out for himself a life-long course of study. To the speculative business man who makes and sells the electric light as a commercial product, it has an intense interest. The investor in central station apparatus takes a peculiarly pecuniary view of the electric light.

Still another class finds itself compelled by circumstances to investigate the subject of electric lighting. This class is composed of the consumers. The consumer is forced to consider it. His reflections lead him rapidly to conclusions. It is a powerful and easily controlled means of illumination, capable of regulation at will, it can be extinguished or relighted at pleasure, and instantaneously; it can be moved and removed from place to place. It is moreover, a safe light—safe in the insurance or fire risk sense. It is not so expensive that it can be classed among the luxuries. It must per force be admitted that the electric light is a plain everyday matter of fact illuminant, and as a practical thing has come to stay with us. As such, it is to be gauged and measured by that worldly standard—the almighty dollar.

The question is, "Does it pay?" The answer involves an intricate problem.

What does it cost to make the electric light? To anticipate somewhat, it will be found that it is proportionately cheaper to generate it on a large scale. This fact is not surprising, for it holds true in the operation of most commercial apparatus.

For very small generating plants, the costs as compared with those of medium sized or large stations are utterly disproportionate. To operate a very few lamps only, by means of machinery would be many times more expensive than any of the other ordinary means of lighting.

It will not be necessary here to claim everything for the electric light and insist that it is a necessity and that everybody must sooner or later adopt it. It will be only a matter of a few years at most when the claim will make itself good.

There is no necessity that the advocate of electric lights should lose his composure or worry over the seeming slowness of men to appreciate this great boon to the commercial world.

In a very short time—we shall live to see the day—the electric light will reign supreme where people live thickly congregated and depend for existence upon their industry. As present users enlarge their plants, as new converts augment the demand for it, production will be cheapened, and thereby its field of usefulness will be increased.

How much will it cost to put in and operate an electric light equipment?

Assume for the time being that there is no machinery in an establishment and that it becomes necessary to rent lights, the place in question being a small store or salesroom. The charge for one arc lamp to burn all day, say for ten hours will be 50 cents per day. This can be compared with the price that would be paid for gas light. Assume as a basis of comparison ten gas jets. This comparison, however, is hardly fair to the electric light, as the illumination given by the latter is vastly superior to that of the gas.

Ten gas jets at an average consumption of 5 cubic feet of gas per hour per burner, at $1.25 per thousand feet will cost for ten hours, 62½ cents The electric light as will be readily seen, is much the cheaper, is more powerful and penetrating, is cleaner, and vastly safer, so far as fire risk is concerned. It is switched on at once and off again just as quickly; it does not overheat the room; it will not ruin ceilings and walls with soot and grease, nor damage fabrics with deleterious, sulphurous and other gases. Gas cannot be obtained at a price much cheaper than that mentioned. Even at $1 per thousand, the cost figured as before will reach 50 cents per day, which is fully as expensive as the electric arc.

This is the limit of economy in gas lighting. Should it become desirable to light a large room or a number of rooms gas cannot be had cheaper. On the other hand, electric lights are rated by a graded price list. If five, or ten, or twenty electric lights are needed they are to be had for 40 cents each per day, which is 20 per cent. less than the charge for gas. In fact they can be contracted for at the low rate of 33 cents per day, almost 40 per cent. cheaper than the gas method of lighting. Gas light varies with the season and output, now weak, now strong. Sometimes it can hardly be coaxed out of the burners, at other times it flames to the ceiling. Now it is yellow and now red; it is very often blue but very seldom white. In winter so sluggish is it that it is with difficulty cajoled into leaving its natural lair under the ground.

The electric light assures to the consumer at all times the full measure of an almost perfect illumination. With all its drawbacks it is wonderfully superior to any and all other known means of artificial lighting. There are numerous objections to the use of this light, most of them, however, are trivial.

Considering it from the dollar and cents point, to which we shall endeavor to confine ourselves, there arises the apparently serious objection that the lights cost whether they are kept burning or not. Gas can be turned on or off, and a saving thereby effected.

There are large commercial houses in this city with spacious and well stocked sales and display rooms that are kept for hours at a stretch in the deepest gloom. When a salesman leads a customer prospective or bona fide through the various departments, a boy or porter precedes him turning on the gas and turning it off behind him, as he passes with his buyer.

This is not exaggerated. It is a most ridiculous transaction and cannot possibly be economical. People who are compelled to do this would save money by renting a smaller store and lighting it up as it should be lighted.

All the business done by an establishment of the kind cited above could be transacted in one-fourth of the space at present occupied.

One thousand dollars saved in rent and expended for electric lights or gas would make it possible to do a much larger business and leave what is very desirable, a good impression on the trade.

To be consistent and follow out the line of policy exhibited in their scheme of lighting the store, these firms should dispense with their engineers and elevators and hire two or three strong laborers, who by patient industry might manage to carry, piece by piece, all their freight up and down stairs, day by day.

The electric light must be used in quantities to be really appreciated. A large business, however, cannot very well get along without it Experience demonstrates the fact.

Among the firms in this city are scores that pay $25 or more for this means of lighting. Several expend upward of $40 or $50 per day, while one house expends not less than $100 hard cash each and every week day during the year for electric lights and is not yet satisfied, but cries for more. It is not used as an advertisement. It is not a luxury, but a practical everyday attachment to the machinery of the establishment.

It will pay and pay well. It does pay and is paying. Use electric lights then, even if they must per force be rented; but they are a much more profitable investment where the machines for generating the current are operated by the persons who are to use them.

The two principal items of expense going to make up the total cost of electric arc lights are fuel and labor. These two items constitute from 75 per cent. to 90 per cent. of all expense connected therewith. The cost of labor which alone may amount to 50 per cent., 60 per cent., or even 80 per cent., of the total expense is the great stumbling block in the way of operating a small plant. It is the only thing that requires special consideration when it has been decided to erect an outfit for operating fewer than twenty or thirty lights—of course circumstances have everything to do with the case and must be taken into account—for instance a firm may have an engineer and a boy or young man with but little to do. These two together could operate a plant of ten, twenty or thirty lights at a minimum cost. The cost possibly would be as low as 12 cents or 15 cents per day per lamp, provided of course the time of neither the engineer nor the boy was charged to the expense of maintaining the lights. On the other hand if an establishment has no engineer, no boilers and no, engine and provides them especially in order that it may operate a plant of ten lights' capacity, each lamp may cost it 45 cents, 50 cents, or even 60 cents per day, and that for less than ten hours' run. The cost may reach as high as 75 cents or $1 for a full day of ten hours.

These estimates have reference only to the ordinary arc lamp and do not apply at all to the incandescent lamp. The same engineer and assistant whose wages were included in the last estimate, could very easily run forty or fifty lamps at a cost not to exceed 25 cents or at most 30 cents daily per light. This last case assumes that the engineer and his assistant have nothing to do but run the lights, and that there are no elevators, no machinery, no heating to attend to. The engineer is assumed to receive $3 per day and the assistant $1.50 per day. If more is paid for help or less, the running price per lamp will vary about 4 cents or 5 cents per day one way or the other, as the case may be.

The work put upon the operator of a plant of this kind running about thirty lights and not to exceed forty lights, leaves considerable spare time on the hands of the engineer who can then with the assistance of a fireman take care of two or three elevators in addition to their duties as electricians. If so, and this is a very common case, and a fair proportion of their time be charged to elevators and heat, and the other legitimate departments of the regular engineer's work, then the cost of lighting is reduced just that much. The whole process is in harmony with the general proposition that an engineer can care for more machinery and elevators and fewer electric lights, or for a greater number of electric lights and fewer elevators and other machinery. As the proportion of each kind of work varies, so the cost per lamp for operating the electric light will oscillate between 22 or 23 cents as a minimum and 28 or 30 cents as a maximum.

It can be assumed as an axiom in electric lighting that it requires at least one-horse power's worth of fuel to operate an arc light. One horse power may mean two pounds of coal, or it may mean ten pounds. In general practice it means from four and one-half pounds to eight pounds of fuel.

It will be contended that the former figure, four and one-half pounds, or at most five pounds, is plenty large enough. Experience, however, will show that the coal bill at the end of the month, allowing for waste when starting, or banking fires, when the latter practice is followed, will tally best with a large or medium rate. We will figure then on a basis of six pounds of coal or its equivalent if a different fuel is used.

Coal costs from $1.50 to $5.50 per ton, averaging between $2.25 or $2.50 and $3.25, according to quantity and quality. Assume that it costs $3 per ton of 2,000 pounds. A difference of 25 cents one way or the other from this price will not seriously affect the general result we are seeking. With six pounds of coal per hour, the amount used in developing one-horse power or its equivalent, one arc light, will cost about nine-tenths of a cent per hour, or 8 cents to 9 cents daily for a ten hours' run.

This estimate of 8 cents per day for fuel for each lamp is the basis upon which to build when estimating for electric lights. This item is fixed and unchangeable except in very small fractions.. It is immaterial. practically speaking, whether the plant is to have thirty, forty, fifty or even 100 lamps. The coal consumption per lamp remains virtually constant.

Exclusive of labor all other expenses connected with the operation of an electric light plant can be readily compared with the cost of fuel to which it bears a nearly fixed ratio varying from one-fourth to one-half of the fuel cost, or from 2 to 4 cents per day per lamp. The average is generally midway between these extremes, and approximating therefore to 3 cents daily. It appears now that arc lights are to cost for fuel and other expenses, exclusive of labor and carbons, the sum of 11 cents per day.

To the cost again must be another added fixed charge, that for carbons. Although important, this item is unvarying and to simplify the matter. has been left untouched until this late moment. It is even more rigid in its effect upon the price of lights than coal. Carbons, or carbon pencils as they are called, do not vary in price over 10 per cent. between any two systems of lighting, nor does the amount consumed per lamp vary much more than 10 per cent. in the different systems, provided the running hours are the same and a similar general economy is practiced.

Carbons are very cheap now. Six years ago they cost $40 per 1,000; three years ago $12 per 1,000; to-day even less than $10 per 1,000. This great drop in price has effected a wonderful saving in the operation of electric lights.

Not less than one and one half and not more than three carbons per day per lamp are used. A very liberal estimate will allow for three carbons per lamp for the ten hours. If these carbons cost over a cent apiece, it is so little over that the fraction may be disregarded. Three cents a day is a very liberal allowance for this item of expense.

Add this to the 11 cents and there is obtained a grand total of 14 cents per day per lamp as a measure of the operating expense attached to the generation and distribution of the electric arc lamps It may be said that no risk will be incurred in accepting as accurate these figures of 8 cents for coal, 3 cents for incidentals and 5 cents for carbons, and using them as standards.

In addition to these fixed values is the cost of labor, a most disturbing and widely varying element of wonderful importance, and demanding careful study. When it can be said that labor varies between one-half and nine-tenths of the total expense, it will be at once perceived how important a fact it is. Sometimes it is as low as one-half or at least two-thirds of the established 14 cents and again, it is as high as five, six or seven times that amount in proportion as the daily cost per light hovers between 22 cents per day and $1 per day.

The cost we are now discussing is simply the operating expense connected with generating and distributing the light. No account is here taken of those other important elements which go to make up the total amount expended or tied up in the effort to furnish to the consumer this steady, constant, artificial means of illumination—interest on the plant, depreciation on machinery and buildings, rent, taxes, insurance, accidental expenses, collections, advertising and management, together make up an enormous total, not less in any case than 100 per cent. of the operating expenses and very often more—so it will be seen that arc lights can not very well be profitably sold for much less than 40 cents per day although they are furnished by contract for as low as 35 cents, or maybe a shade less.

In several cases lights are run for this amount and less but they cost more. If a small central station makes a practice of furnishing them for so small a sum as 30, 32 or 35 cents, it is simply throwing away money or its equivalent, the valuable time of a manager who must work for next to nothing and who could without any serious effort find much more profitable employment. It does not pay, taking trouble and worry and accident into account.

The investor in an undertaking of this character will soon discover that it does not return him dividends at all commensurate with the risk of capital involved.

These small central stations form one of the two classes of electric light furnishers which make lights at an apparently low cost. The other class embraces the public institutions, municipal corporations and the like.

In a town in New York state, of which you have all probably heard, they claim to run the lamps for 12 cents per day. The city does this at its waterworks station and does not figure in a cent for labor, rent, interest, taxes, water, management and the like, merely charging for coal and carbons The labor, it is claimed, costs nothing as the fireman and engineer are there anyway and the water departments would have to pay their wages and all other incidental expenses.

Thus these lights cost apparently an insignificant 12 cents daily. It is an absurd calculation to omit in the estimate one of the most important elements.

In Maine there is a city that runs its lights by water power and forgets to charge up the cost or rental value of that power in making the estimates, bringing the apparent cost of lights down to 16 cents daily.

Here in Chicago we have the spectacle of our municipal corporation claiming to furnish lights for 19 cents daily. The absurdity of the claim and the fallacy of the arguments in support of the claim were commented upon at the last National Electric Light convention.

Electric lights are run cheaper in proportion as they are run in large numbers.

Let us take up for study one of the large city plants and see how nearly the claim of 19 cents daily is borne out by the facts as nearly as we can get at them, and there will be no serious difficulty for the stations are run wide open and are public in their character Nothing is concealed from the inquisitive searcher for knowledge.

The station in question is fitted up with mechanical stokers under 66 inch steel boilers, with the most approved setting, and is operated under a constant unvarying load. There is probably no greater variation than 10-horse power on a total of 500-horse power from one day to another.

In the station referred to there are 18 dynamos belted direct from single acting automatic cut-off high-speed engines which take steam at 90 pounds' pressure and exhaust into an improved feed water heater.

Of the 18 dynamos one or two are running idle, being in reserve. They consume very little power, not over 5 or 6

[1]Read October 23, before Illinois Branch No. 28, National Association of Stationary Engineers.

horse power. The remainder of the dynamos are carrying a load of somewhat less than 450 lights, distributed over 30 or 40 miles of underground circuits.

Between 10 per cent. and 15 per cent. of the power is lost between the dynamo and the boiler which, added to an allowance of one horse power for each light gives a total of 520-horse power being generated and consumed.

A very cheap coal is burned if we are to judge by the appearance and amount of ashes hauled out. Eight pounds per hour per horse power, considering the style of engine used, would be a very fair measure, but to be doubly sure we will assume seven pounds per hour per horse power; 520 multiplied by 7 gives 3,640 pounds of coal per hour.

The running time varies from eight hours in summer to fourteen hours in winter, depending upon the length of the night. The averaging is about eleven hours. It requires at least one hour's extra coaling to raise the steam before starting, as full steam must be had from the send-off, all the lights being thrown on within a period of fifteen minutes. This makes a total of twelve hours and 12 times 3,640 pounds or 43,680 pounds of coal are used per day. At $2.10 per ton—a very low figure—the cost of coal is $45.86 daily. Assuming that one pound of coal evaporates seven and one half gallons of water, there will be used daily, exclusive of water for washing out, cleaning, etc. about 44,000 gallons, which at eight cents per 1,000 is worth $3.49. Gas for lighting while lamps are not running, comes to 15 or 20 cents daily. Let us call it 15 cents.

Carbons are used at the rate of two and one-half per lamp or 1,125 daily which at $8.50 per 1,000 cost $9.56.

Not less than four globes will be required daily at 50 cents each, which makes $2 per day for this item. Just here the city effects a great saving over the regular central stations and private operators of electric lights. If a globe used indoors cracks or a piece drops out, its usefulness has departed and it must be at once replaced by a new one. Each renewal means an outlay of 45 or 50 cents. Out of doors on the lofty city poles three-fourths of the life of a globe is still in it after it has become cracked or slightly broken. It may seem strange but the globe invariably lasts twice as long after a piece has fallen out as before, for the reason no doubt that it can expand and contract far more easily under great and sudden changes of temperature.

A careful inspection would show that about eighty per cent. of all globes on the street lamps in Chicago are cracked or broken; in fact many of them are more hole than glass.

Brushes for the dynamo cost $1 per day; carbon holders for the lamp cost fully 50 cents per day. Dynamo and lamp repairs, commutator segments and screws, insulating wood, varnish and tape, oil cup glasses, renewals and repairs of tools, emery paper, crocus cloth, pliers, carbon kits, etc, cost not a cent less than $2 per day.

Cotton waste and wiping rags, gaskets, sheet and piston packings cost $1 per day at a low estimate.

The amount of lubricating and cylinder oils for engines, dynamos and pumps will be six gallons daily, which at 50 cents will cost $3 per day.

The boilers and piping cost $15,000. The engines and belting cost $10,000. The dynamos and lamps cost $18,000; total $43,000. Ten per cent. of this for wear and tear and depreciation and renewals is $4,300 annually or $11.77 daily.

The building cost $20,000; five per cent. for depreciation and renewals is $1,000 annually or $2.75 daily,

The insurance on a total of $63,000 is not less certainly than $1 per day. The ground is valued at $20,000, making a total investment of $83,000; four and one-half per cent. interest on this amount is $3,735 annually or $10 23 daily.

This is a total amount so far of $94 32 daily, made up as follows:

Cost of Operation.

Coal	$45 86
Water	3 49
Gas	15
Carbon Points	9 56
Globes, Lamp	2 00
Brushes, Dynamo	1 00
Holders, Carbon	50
Incidentals	2 00
Waste and Packing	1 00
Oil	3 00
Wear and Tear on Machinery	11 77
Wear and Tear on Building	2 75
Insurance	1 00
Interest	10 23
Total	$94 32

In addition, there is the discord-breeding element of labor—costing as follows—as nearly as can be estimated without an actual reference to the pay roll.

Cost of Labor.

1 Chief Engineer	$4 00	per day.
1 1st Assistant	3 50	" "
2 Oilers at $2.25	4 50	" "
2 Boiler men at $2.25	4 50	" "
4 Firemen at $2	8 00	" "
2 Wheelers or Passers at $1.75	3 50	" "
1 Watchman	2 00	" "
1 Line man	2 50	" "
1 Dynamo man	3 00	" "
1 Dynamo man	2 50	" "
9 Wiremen at $2	18 00	" "
Total	$56 00	

In the general official headquarters are employed a manager, a chief electrician, a superintendent and a clerk, at an outlay of $30 per day for salaries. There is an additional item of $5 per day for office expenses, stationery, incidentals, etc, a total of $35 per day.

This, divided up among five stations, assuming that the city can operate that many plants with such an office force, gives $7 per day as the amount to be added to the foregoing $56 for wages daily and the $94.32 daily expense previously estimated making a grand total of $157.32 cost for each and every day Sundays included, for the maintenance of nominally 450 lights. By simple division we find the cost to be $34\frac{9}{10}$ cents daily for one light.

This is a decided difference from the claim of 19 cents made by the authorities and spread broadcast through the country. It may be thought by some the estimate is too high, It could not be shaved more than ten per cent. even if it were high and the cost brought down to 31 cents. The difference, on a basis of 2,000 lights, between 19 cents and 31 cents, would amount annually to $87,600, quite a tidy little sum.

But that is immaterial, as we are not picking a quarrel with the city people, but rather making use of their experience as a guide to us in our effort to ascertain the cost of running electric lights. We do not feel inclined to allow the reduction of 10 per cent. as figured above, but hold to the opinion that the figure should rather be increased 10 per cent., that is to 38 cents or 39 cents daily per lamp for perfect economy does not obtain in affairs political. What with incompetent and overpaid help, and there is always some of this, what with vacations, sickness, loss of time, inferior contract coal and unexpected break-downs; the total will invariably be considerably above our figures. Of the 34 cents. perhaps 25 per cent is outside of what can be justly considered as operating expenses.

By operating expenses is meant everything except rent, depreciation on buildings, taxes, insurance, interest and management.

Perhaps 26 cents or 27 cents will be a fair estimate of the actual daily running expense per lamp. This by careful business management can be somewhat reduced where the lights are used in any considerable number.

The question then arises, or may arise, how can the ordinary merchant with but a very few lights hope to produce them for less cost per lamp the city, when the latter has all the advantages inseparable from a large plant.

It must be borne in mind that there are several channels open for practicing economy, of which a public body or corporation cannot very well take advantage.

The city of Chicago follows a most liberal policy in the management of its institutions of every kind, including the electric light station. It is generous without being lavish or wasteful. It is further handicapped by long running hours, necessitating two separate shifts of men, with the accompanying heavy expense of labor. The many directions in which the private manufacturers of lights can cut down expenses have been partly brought forward in earlier portions of the paper, and partly suggest themselves. What has been done can be done again. We can repeat in our stores and shops that which we see is being done in our streets. The consumer can supply himself with arc lights for 25 cents or less, for even as little as 20 cents per day per lamp.

The lights in a large commercial house, not far distant from this location, cost approximately 21 cents per day, figuring five pounds of coal per ton per horse power with one horse power, and 5 per cent over charged to each light. The firm pays $3.75 a ton for coal. Carbons cost $10 per 1,000, considerably more than the price paid by the city, but the most rigid economy is practiced in burning them. Not a scrap is wasted. Globes cost a little more than in the case of the city. Labor costs a little less per light. A summary of the items is about as follows:

Eight cents per light for fuel.
Three cents per light for incidentals.
Two cents per light for carbons.
Eight cents per light for labor.

The total is 21 cents. An additional 5 cents per day per lamp will pay all the expenses, such as rent, interest, taxes, insurance, etc., and that can possibly be charged to the plant, will bring the total to 26 cents—a sum entirely within the means of the business man. The result obtained in the last case represents perhaps the utmost economy that can be attained where the lights are run as a distinct department of an institution, and agrees substantially with figures taken from the books of an establishment owning and running 200 arc lights Here is an expenditure of no less than $52 daily. If gas was burned $125 worth per day would not give even an approximate equivalent light.

If lights are run from a single dynamo, which is cared for by the regular engineer of the establishment, and which takes up but little or no room in his department, the expense is cut down to as low as 15 or 16 cents daily. At such figures the light is really a necessity to a shrewd live merchant. The longer such a man puts off the adoption of the light in his business, just that much longer will he be behind his electrically lighted rivals in the race for dollars.

The light has come to stay, and has taken its place with elevators and lifts as a necessary part of the machinery of an establishment that is forced to carry on its business in tall, deep, dark buildings, hemmed in on both sides by other buildings fronting on narrow streets and shut off from the light of day. It then becomes our duty as intelligent, progressive engineers to seek at once for a better acquaintance with this method of illumination.

It will be found a most simple mechanical problem, on a par with the other machinery intrusted to our care, and no more difficult to manage than the ordinary elevators and engines. It is not at all mysterious. The atmosphere in the immediate vicinity of dynamos, converters and electric circuits is commonly supposed to be full of flying and flurrying volts, watts, amperes and other hidden subtleties,

This need, however, occasion no alarm. They keep themselves in the background, and are not nearly so troublesome as hot-boxes. The thoughts of them need deter no one from undertaking a study of them.

We have no more to fear from a volt than we have from a latent heat unit. Who ever saw the engineer that was afraid of a latent unit of heat? Do not then fear the electric terms. They are but the hidden elements of the forces with which we will have to deal. Master them.

New York Electrical Society.

The New York Electrical society held the opening meeting of the season at Columbia college, on the 23d ult. The lecturer was Lieut. Bradley A. Fiske, who chose for his subject, "The Civilian Electrician in Modern War."

The lecture was in many ways a notable one, inasmuch as it showed very forcibly not only the extent to which electricity is entering into the art of war, but also the extremely awkward position in which this country might find itself in case of a sudden declaration of hostilities by a foreign power, should it not take steps to make available sufficient electrical skill to use effectively the appliances which are so rapidly superseding those which common seamen could handle.

Lieut. Fiske drew brief attention to the applications of electricity which are being made in naval and military service. No vessel pretending to modern equipment goes to sea without a complete electric light plant, and the ventilation of ships is as much dependent on electricity as are the training and firing of guns, the hoisting of shot and shell, the accurate work of the large finder and the most approved system of night signalling; moreover the electric search light is almost as much a feature of modern warship equipment as are her guns and her torpedoes. In torpedo work electricity plays an important part, and where the telephone has been introduced for the transmission of orders, the speaking tube is no more used. In point of fact, the lecturer said, the modern warship is the most intricate, tremendous and powerful machine existing, and it is only by establishing the means of instant communication and response that she can be placed absolutely within the control of her captain, and be made a perfect fighting machine.

In forts, no less than in ships, is electricity indispensable. Muscles have limitations, but it would seem that the weight of modern guns and the complexity of their attendant machinery are perpetually increasing; yet guns of the heaviest calibre are raised and lowered by the touch of a push button, and while the position finder gives the gunners continuous information of the distance and direction of the enemy no matter how thick the smoke, the commander of a fort can, from a station aloof from the smoke and noise, note the progress of the action, and by means of electricity, establish instant communication with all the different groups of guns and mortars in the fort, and control the concentration or dispersion of fire at will.

In military service, nothing is more important than the ability to move with dispatch the enormous bodies of men of which modern armies are composed, with all their ammunition, equipments, and numberless accessories, and for this purpose the military telegraph is indispensable. One great cause of the suddenness and completeness of the German victory in 1870 was the rapid mobilization of the Prussian army, which was made possible by this service.

One of the most important uses of electricity, however, is its application to the submarine mine or ground torpedo. The defence of a harbor by submarine mines consists in the execution of an elaborate scheme involving the anchoring in carefully defined positions, and the connection by armored electric cables with protected operating rooms in which batteries, measuring instruments, etc. are placed, of a large number of water-tight tanks, each holding from 100 to 1,000 lbs. of gun cotton, or other explosive. Some of these mines are very large, and must be adjusted with great care; in fact, the operation of practically planting and connecting the necessary submarine mines for New York would be a stupendous undertaking.

All these appliances, however, are practically valueless without technical skill that can be brought into instant requisition. A captain of a fine ship might lose an action simply from a lack of knowledge as to some electrical appliance, or some slight accident might break a circuit just at a critical juncture, and disaster might follow because of his ignorance of those principles of electrical engineering which would have immediately dictated a remedy.

The question naturally follows: Could all this immense amount of electrical work which the breaking out of war would entail, be done by our regular army and navy in the time that would be allowed? Lieut. Fiske said it most unquestionably could not. Both services would have their hands more than full, "and, as to fitting our merchant ships" he added, "who is to fit them out? This operation requires technical knowledge. Who has it! How many of the merchant steamship captains would be able to install and manage a battery of even Hotchkiss or Driggs-Schroeder guns or could remedy an accident to either gun or ammunition?"

The lecturer proceeded to propound a scheme for meeting this emergency. He would establish in every principal seaport town on the coast, with headquarters in New York, a corps of naval and military electricians to assist the operation of the regular army and navy. The organization would be essentially a military body, and would be subject to the direction of the governor of the state on the outbreak of the war. The corps or battalion could include at first, about 250 members, and it would be officered, uniformed and drilled in much the same way as the other corps of the National Guard. The course of instruction of its members would embrace all the known naval and military applications of electrical science, the theory and practice of gunnery, navigation, including compasses and seamanship. A certain amount of infantry drill, as a means of instilling the military idea, might be advisable, and occasional runs in a torpedo boat, and short trips out to sea for target practice, would be essential. The special duties of such a corps would be laying submarine mines, the arranging and fitting of gun carriages, the storing of ammunition, etc., as well as the installation and fitting of electric lights, motors, telegraphs, telephones and the general supervision and adjustment of all the various elec-

trical appliances which enter into the equipment of a modern man-of-war.

Lieut. Fiske was of the opinion that such a corps could be formed under existing laws, and that there would be no difficulty in enlisting members. "The attractions of the Naval Reserve and of the National Guard," he continued, "are sufficient to induce a large membership in the different regiments, and there is no reason why membership in an electrical regiment should not be equally desirable, and confer equal distinction. The qualifications for entrance as regards education and intelligence, would be higher than those for any other regiment, corps or battalion; the military and naval usefulness of the body would be acknowledged, and its position would, in all respects, be one of dignity. The whole electrical influence of New York and of the country would be at its back, with all its millions of dollars, and its men of world-wide fame, and there is no reason why it should not eventually acquire a national influence."

Electric Welding Applied to the Manufacture of Projectiles.[1]

By Lieut. W. M. Wood.

I am asked to-night to tell you something of a new process which has been originated and developed within the past year; a new and important application of an art in itself new, electric welding.

At this moment when there is so general an interest manifested throughout the country in the question of the nation's arms and defences, this new invention, which bids fair to supersede and immensely cheapen existing methods, is sure to claim its share of attention, both from experts in ordnance and the general public.

Before entering upon the subject proper, I wish to say a few words on the general state of military art and on the production of projectiles in particular. For nearly a generation we have stood aside and watched others pass us in the race; forgetting what we knew so well at the close of our late war, until now we have finally awakened to find ourselves relegated to almost the lowest place among the nations of the earth. To use a lowly simile, we might have been until very recently likened to a crab which has just shed its shell; rich and fat, but helpless—unable to assert our rights or aid our friends in time of need.

Since the earliest times man's ingenuity has been taxed, first to improve his weapons; next his defences. The race between projectiles and armor commenced with the bow and arrow or sling as against the rawhide covered buckler. It has passed by gradual evolution through an infinite number of stages; sometimes the armor, sometimes the projectile ahead; generally the latter. Indeed, at times, the projectile has been so much ahead as to cause the total abandonment of armor. This happened when the bullets and slugs from the crude blunderbuss of the middle ages made the matchless armor of the warrior of the day worse than useless. Some authorities are inclined to believe that an analogous case exists now, and that on the sea, at least, it is a folly to burden vessels with an enormous weight of armor, which can be pierced so easily by the heavy projectiles thrown by the enormous high powered guns in use. To the casual observer this may seem true, but on the other hand we must not forget that armor *does* protect against the great number of moderate-sized projectiles, and that if you can even only partially protect the vitals of your structure it is much gained. We must also remember that these latest developments of armor and projectile have never been pitted against each other in actual warfare and that there will be a vast difference between firing through a target at point blank range and at a swiftly-moving, rolling, wavering object, a mile or more away, which is at the same time firing back at you.

At the present moment it looks as though the projectile was about to gain another point over armor, and become a still more important factor. Artilleries on shore are now directing their attention largely to the use of breech-loading rifled howitzers or mortars. These guns are fired at a great elevation, rarely less than forty-five degrees and frequently at sixty degrees. The projectile has, consequently, a high curved trajectory and plunges down on and through the decks of vessels or behind parapets. The decks of men-of-war are frequently not protected at all, except over the engines, boilers and magazines, where a curved armored deck is used with a maximum thickness of from 4 in. to 6 in. Four inches is the greatest thickness of the curved protective decks of our new cruisers and is the only armor those now afloat have.

The varying ranges of these howitzer-thrown projectiles are given by increasing or decreasing the weight of the powder charge.

In some recent experiments made by Krupp in Germany very satisfactory results have been obtained by projectiles thrown from this class of gun against horizontal targets representing the armored decks of ships.

The defences of Boston and our other seaboard cities are to comprise a large number of guns of this class. They fire both armor-piercing and common shell. Redoubts and turrets on shore can be armored as heavily as you please, or guns and troops can be defended by that most excellent protection, the earthwork. Afloat, however, where every pound carried is a matter of serious consideration, the problem is a very different one and the weight of armor must necessarily be limited by the size of the vessel. A proper navy, however, will always be made of a number of vessels of various kinds, more or less dependent on each other, from the gigantic battle ship fully protected by the heaviest armor, down; including the partially protected cruisers, fast unprotected vessels, dispatch boats, converted merchantmen used as commerce destroyers or transports, torpedo boats, etc.

Troops in the field are like the unarmored cruisers, torpedo boats and converted merchantmen, practically unprotected.

[1]Read before the Society of Arts, Institute of Technology, Boston, October 23, 1890.

For use against these various defences and where there are no defences except distance and advantage of position, there are in use three general classes of projectiles (not considering the more or less experimental dynamite and other high explosive shells). They are, 1st, the *armor-piercing shell*, used solely, as its name indicates, against heavy armor; 2d, *common shell*, used against unprotected vessels and troops, for bombarding cities and earthworks, for target practice, etc.; 3d, *Shrapnel*, so named from its inventor, extensively used in field operations on shore against bodies of troops and at sea against open boats, torpedo boats or any unprotected body of men.

Leaving the ordinary bullet of the shoulder rifle out of the question, these projectiles range in weight from those of a single pound to the gigantic missiles of the 110-ton gun which weigh about one ton and are driven by almost a half a ton of powder.

Now in order to show how much is gained in the construction of projectiles by the Thomson electric welding process, I will briefly describe the present methods of manufacture.

First. The armor-piercing shell. To fulfil the government requirements these must be made of a fine quality of steel, capable of being made very hard, and still be tough. In the first operation. it is forged or rolled into a rough solid blank. After this it is placed in a lathe and turned off accurately on the outside and the powder chamber bored in the axis of the shell from the base, as in this specimen. This opening is then closed by a carefully fitted screw plug, in the center of which is a smaller threaded hole into which fits the percussion fuse which explodes the shell on impact. A groove is now turned in the outside near the base knurled or roughened. This is for the copper rotating band, and the roughening is to prevent its slipping when the copper enters the rifling of the gun. Next the shell is hardened by one of the various processes which are more or less satisfactory, and finally the copper band is forced into place by hammering or hydraulic pressure and turned off true to gauge. This completes the projectile and you will readily understand that all of this work is slow, tedious and expensive. Any one who is familiar with the operation of machining high carbon or tool steel will appreciate this. As a matter of fact, a 6 in. armor-piercing shell which only weighs 94 pounds costs in the neighborhood of $65 or $70.

Next come common shell. These at present are cast either of steel or iron, but even in this cheap form of production many difficulties are met with. In the first place, the shell usually has but one small opening to the inside powder chamber and this only allows the use of a single "print" to hold up the core which forms the interior cavity, consequently, when the molten metal flows in, it pushes this core out of place, and the resultant casting is eccentric—thin on one side, thick on the other—frequently so much so as to cause it to be discarded entirely. When the castings are received from the foundry they are first carefully calipered on the inside by a skilled operator, who uses a delicate instrument called a "star gauge," which expands within and enables him to determine the amount the casting is out of true, which he marks on the shell. It is then passed to the hands of the machinist. He is obliged to place it in his lathe eccentrically, so that the outside will be turned true with the inside; and you can imagine that even after all this care they are never perfectly concentric. Another serious difficulty met with in the cast projectiles is the liability to small blow holes or porosity, which, though they sometimes escape detection, always cause the rejection of the projectile when discovered. Through these holes the gases of the charge might be driven and thus cause a premature explosion of the shell in the gun. Steel shell of this description, of 6 in. calibre. cost about $30 each. Like the armor piercing shell, they are fitted with rotating bands and fuses, but are not hardened.

We now come to the shrapnel. It was originally invented for use in the smooth bore guns of the past and was then a hollow sphere filled with small bullets, around which was poured melted sulphur as a matrix. A small powder chamber for a bursting charge was left in the middle. It was provided with a time fuse which could be set so that the shell would explode at the desired moment in its flight, scattering its contents and fragments in the face of the enemy. So far, there seems to have been no very satisfactory shrapnel made for rifle guns. The difficulty is that the head or base has to be screwed on after the body of the shell has been filled with the bullets and matrix. This construction weakens the projectile very much at this point, and the head or base is apt to blow out without bursting the body of the shell or scattering the bullets, especially as the walls of the projectile have to be made thick enough to stand the threading.

Hoping I have now made clear the general state of the art, I will explain wherein this new process differs, and will endeavor to illustrate it by the specimens I have here.

First, instead of the solid, rough-forged ingot, we have these three component parts, which when welded together will form a 6 lb. armor-piercing shell. Each piece is now finished to exact size, except that there is a little extra length to allow for the take-up in welding. The head and base pieces are forged in dies to shape; the central portion is simply a piece cut from a length of solid drawn steel piping. It has all the additional strength due to the fibrous skin inside and out caused by the drawing process. To join these three pieces, they are clamped into a form of electric welding machine designed for the purpose, and in less than a minute are joined together and made a homogeneous mass like this.

It only now remains to grind off the two burrs which you see in this specimen, and cut in the groove for the rotating band. The front one of these burrs may be used to form an enlargement used in many forms of projectiles, called technically, a "bourillet." It supports the front portion of the shell in a bore of the gun, the remainder not touching except at the rotating band. The other burr may be removed at the same time the rotating band groove is cut. The fuse hole has already been cut and threaded in the base piece. The shell is now ready for the hardening process. I wish to call attention here to the fact that the burrs are allowed to remain on the inside and thus form strengthening ribs which help materially to support the shell against the great crushing strain it receives on impact. You will see that we have formed a strong and better shell with minimum of labor on the individual parts and a few seconds' work to join them together.

In order to illustrate the wonderful strength that may be gained by this welding process, I have here a shell which was constructed exactly as I have shown. It was fired through a 3 in. plate of iron at the naval proving grounds at Annapolis, recently. You will see that it has not changed its shape in the slightest degree, nor has it even lost the copper rotating band which was carried through the hole with it. Here is another which shows a still more remarkable result. This projectile was fired against heavy steel armor which has a resistance of about 75 per cent. more than iron which was much heavier than a projectile of this size could be expected to perforate. It, however, pentrated 5 inches, and then owing to the elasticity of the oak backing of the plate, was thrown back about 30 feet, as perfect in condition as before it was fired from the gun. The experience of the welding company has been that the metal seems to be strengthened at the point of welding and this certainly seems to justify the supposition.

After accomplishing results like this, you will see that the manufacture of the common shell becomes a very simple, matter by the welding process it is quite feasible not only to join iron to high carbon steel, but to weld wrought iron or steel to steel castings or even to cast iron. Hence, in this case, it is only necessary to substitute common iron or low carbon steel tubing and stamped or cast heads and bases and perform the welding operation. The shell which is thus cheaply put together has all the advantages of wrought and none of the disadvantages of cast metal. If made of low steel it may even be hardened to a certain extent and thus have more or less efficiency against thin armor.

In regard to the shrapnel, a single look at this section will show the problem and how it has been met. This is from a design for the United States army 3.2-inch field piece. The head and base are steel castings, which have been heated and compressed to give them density. The body is drawn steel tubing one-fourth inch thick. The projectile was built as follows: First, the head was welded on to the body. Next, the brass tube which carries the flame from the fuse to the powder chamber at the base was crimped in at the upper end. The half formed projectile was then inverted and the bullets placed within and the matrix poured about them. Next the diaphragm which forms the front end of the powder chamber was put into position at the other end of the tube crimped in. The shell is now ready for the final weld, and you will notice that the base piece is provided with a shoulder, which after the weld is made, will press closely upon the diaphragm and support it against the shock of the discharge. After the second weld is made, the shrapnel has an unbroken surface inclosing its deadly bullets, and like the other shell is ready to be fitted with rotating band and fuse.

To summarize, these shells can be produced in the method I have described so that a wrought steel projectile can now be manufactured at less cost than a cast iron one, which except for target practice is almost worthless; and as for armor-piercing shell or even moulded steel shell, there can be no comparison as to the cost of production. The same principle can also be applied to solving a still more difficult problem, and one which has hitherto baffled the skill of the inventor, viz., the welding the solid heads on large brass cartridge cases now used with the projectiles of rapid fire guns. A rapid fire gun is one having a non-recoil and pivoted mount. It is aimed and fired from the shoulder like an old fashioned swivel. They range in size up to as large as the 6-inch gun. The ammunition is fixed just the same as the bullet and cartridge of a shoulder rifle. At present, these brass cases are constructed with great difficulty and at much expense by drawing up from the solid ingot, and no one is prepared to make those of the large sizes in this country. By the Thomson process, which also welds brass and copper, this will be an easy matter, and the cost should be less than one quarter that now paid by the government for those they are obliged to import.

In conclusion, I will say that it is a well-known fact among ordnance experts that the breech mechanism and principle of the construction of the present high powered guns are entirely due to American invention, which was, however, forced out of the country by lack of appreciation and was taken up and developed in Europe. I believe the day has come at last when our military inventors will not have to seek their encouragement entirely abroad, and I think that in a very near future our government will be supplied entirely by cheap and effective projectiles of the kind I have shown you to-night.

Electricity in a Silver Mine.

Since the introduction of electric machinery of the Westinghouse manufacture into several Pennsylvania coal mines, the demand for that company's apparatus is rapidly increasing. The Westinghouse company is now engaged in manufacturing power apparatus for the operation of a silver mine owned by the Gold King Mining company of Telluride, Colo., L. A. Munn of that city being the president of the company. The mine in question is situated on the top of a mountain about two thousand feet high and as the cost of coal is a great factor in the operation of a mine under such circumstances, the advantages of electric power over steam can be easily appreciated. At the foot of this moun-

tain is a waterfall, and this power the mining company intends to utilize in conjunction with the electrical apparatus. It has been decided to place the electric plant which has a capacity of 100-horse power near this waterfall transmitting the power to the motors at the summit of the mountains, where the mining operations are being conducted.

The Central Lighting Station as an Investment.

At the last meeting of the Chicago Electric Club, Oct. 20, B. E. Sunny read a paper on "The Central Lighting Station as an Investment." It was published in the last issue of the WESTERN ELECTRICIAN. After the reading of the paper the following discussion took place:

THE CHAIRMAN, F. B. BADT: Prof. Barrett is here and may wish to say something upon the paper.

PROF. BARRETT: I am fully in accord with the paper, and I have endeavored to carry out the ideas contained in it.

MR. WILMERDING: Certainly it is true that stations always start too small, as we ourselves have discovered. Although it looks, perhaps, like starting in upon a very large scale if we plan to-day for a station that will have a capacity of three times our present requirements, still I do not believe it will be very many years, with the world's fair in view, before we will find that a 6,000-horse power plant will not carry us any further than our original plant of 2,000-horse power did a few years ago. I understand that the incandescent station here has had the same experience, and found it necessary to secure new machinery to increase its plant.

MR. DEGENHARDT: When we realize that at the time of the exposition in 1876 there was just one arc light in operation, though its operation at that time is disputed to-day, we may congratulate ourselves on having made most gratifying progress. To-day the figures furnished by Mr. Sunny showing the large number of station plants seem almost incredible, and I'm glad I am in the business.

THE CHAIRMAN: I understand that Mr. Day of England is here, and I would ask him to give us some data concerning central stations in England.

MR. DAY: I have been very much interested in Mr. Sunny's paper, and I think there is no point which he has made that can be disputed. As I understand him he emphasizes the necessity of having a central station building so planned that it will be capable of easy development on different lines, so that there shall be no necessity of reconstruction in the first place, and that the plant originally put in can be repeated again and again, as many times as may be required. That is to say, he will begin the station, as I understand him, with a definite style of architecture in the first place, capable of containing the plant immediately required; that the building can be lengthened so as to receive an additional number of dynamos and an additional number of engines, line by line. I think a station constructed after that plan will save central station companies in the future a large amount of loss, though I cannot say I know so much about the experience in this country as I do in the old world in most countries where central station plants have been in operation.

MR. CUTTER: We all think the same way about this matter, but at the same time we are glad to have papers put before the club expressing the sentiments of the electricians of the country that the electric light has come to stay. If people are going to put their money into it they might as well put it in with the idea that it has come to stay and will grow to immense proportions. If they plan their stations with that idea in view I certainly agree with Mr. Sunny that they will save money in the long run, and every paper and utterance that we can put forth to convince capitalists and convince the country that the electric light has come to stay and to grow to immense proportions, is good for our business.

MR. SPERRY: I was looking for some expression on the part of Mr. Sunny with reference to the units of power to be used in central stations. It seems to me that from a commercial standpoint the matter is one of great interest. In Providence I believe they are putting in an engine of very great horse power to run electric lights—larger than at any other point. In Boston we all know that large engines are being put in for power purposes, and it is a great question whether dynamos should not be built like those now constructed in London with large units. I suppose so far as the engineering aspect is concerned there are pros and cons; and I suppose also so far as the commercial aspects of the case are concerned there are advantages and disadvantages. But from the standpoint of potential, especially as it relates to arc lighting, there is undoubtedly a limit beyond which we cannot increase it until wires can receive a better insulation, and the insulating mediums and processes can be still further protected. I think the largest arc light machine at the present time absorbs 40 or 50-horse power, and that seems to be about the largest unit that has been proven to be a commercial success at the present time. Whether they will still further be increased or not is a question that time alone can decide. I have just returned from the East, and while there I took the opportunity to observe what was being done in the electrical world. I noticed several very large machines in process of building that seemed to point to large units, and the generation of low potentials; that is for the three wire system of 200 volts and up to 500. Those machines, I believe, were between 250 and 500-horse power. It seems, also, speaking of these large units, that in mining operations, where electricity is called upon to perform a very large amount of work, the large unit is the thing; especially where slow speeds can be employed, giving efficiency and durability, and where inexpert attendants can be relied upon to run the machines night and day, year in and year out.

The point of size of units of power in stations certainly has a bearing on the commercial side of the question, and I for one would like to hear some further discussion with reference to that part of it.

THE CHAIRMAN: I believe some of the Westinghouse representatives can tell us something about the large machines which I believe were built at Pittsburg, having a capacity for more than sixty arc lamps. I heard that they were building machines of a capacity of 125 lamps.

MR. CREAGHEAD: They are building arc machines for 125 to 250 lights.

MR. SPERRY: Are they all series machines?

MR. CREAGHEAD: Yes, they run in series at an amperage of about thirty, on which there is a transformer of twenty amperes.

MR. GREER: Prof. Badt, can you tell us anything about the incandescent machines in Berlin and Rome? I understand there is one of several thousand horse power, an incandescent machine.

THE CHAIRMAN: I have not seen them. They sent to Rome some of those big Edison steam dynamos, the first dynamos, I believe, that Edison ever built at the Edison works, but they are an abandoned type.

MR. GREER: According to my information some are the alternating type.

THE CHAIRMAN: Yes, they are the Zipernowski-Deri.

MR. GREER: I noticed also where they intend to put in, at Dresden I think it is, a large power station to light up 160 odd towns and villas within a radius of about forty miles. They seem to be pushing things in that part of the country.

THE CHAIRMAN: The latest scheme in Berlin is to have central stations, with sub-stations. They want to use storage batteries as transformers, and they are putting a large amount of money in it; if I remember rightly about a million and a half dollars.

MR. CUSHING: In connection with Mr. Sunny's paper I would like to call attention to a fact in connection with lighting stations that does not seem to have been thought of very much. I was at the exposition in Minneapolis two or three weeks ago, and there inspected an electric flat-iron, arranged with small iron wires under the base and connected with the lighting circuit. A plug was so arranged that a woman, by turning the key, could heat her iron at an expense of four cents an hour, and iron all day with a single iron, saving the trouble and annoyance of changing irons, and without a stove or any other means of heating. She could do her work a great deal better because her iron would always maintain the same heat. Then the exhibitor had a stew-pan with a socket in the end of the handle. He put in two quarts of water and boiled it in eight minutes. He went a little further and arranged the coffee-pot in the same way, so he could boil coffee or make tea in just a few moments. Then he seemed inspired by the success of his coffee-pot and arranged a vat that would hold about ten gallons of lard, I should say, and was boiling doughnuts in great quantities. In connection with central station plants all these things must sooner or later be adopted in domestic work, and where you have meters to measure the current they must add to the income of the company operating the plant. They will not add to the expense very materially. I think I can safely predict that within a short time, say four or five years, the central lighting station of small towns will be the heart and life of the place; that the people will be running their ice cream freezers, running their sewing machines pumping water up into their tanks, doing cooking, and possibly doing sweeping, by electricity. All these things are worth considering by the people going into the electric lighting business.

THE CHAIRMAN: I saw an editorial in one of the electric papers the other day calling attention to a source of loss in central stations due to the fact that in places where there ought to be one electric station there were two or three, in small towns, for instance; one operating nothing but arc lights, a second nothing but incandescent lights, and the third electric railways. Now it seems to me that if these three were united at one station the expense would be reduced considerably, and they could do with one superintendent what they are now doing at three different places with three superintendents, and so on.

MR. GREER: I was engaged on experiments in electric heating with the stew-pan, flat-iron and so on. The first experiments were in Taylor's restaurant where we were cooking griddle cakes. Mr. Carpenter, the inventor, was at that time the accountant of the restaurant. We found that we could save money by cooking griddle cakes by electricity, and after that we started to boiling coffee in the restaurant by the same means. In fact we did pretty nearly everything that was done in the restaurant by electricity at a cost of about half a cent per ampere-hour. We found it a matter of economy on account of the way we could govern it; it was as cheap as gas.

MR SUNNY: In regard to Mr. Sperry's suggestion as to the units to be used in these stations, I purposely omitted any reference to that matter for the reason that where there are so many engineers in the country I felt it would be presumption on my part to say anything about the engines and boilers, and what type ought to be used. There are so many engines and boilers made to-day that are economical and efficient in their work that it is difficult for a man to go astray. What I intended to emphasize more than anything else was the importance of starting out with the view of indefinite enlargement without having to throw away what had been done, as has been necessary in many instances with which we are familiar. In some of the stations that are being designed in the larger cities, the type of engines selected is always from 500 horse power up to 1500; a good many of them are single cylinder engines, a great many compound condensing, and some triple expansion engines. The engineers do not agree on the triple expansion engine. Some say it is not a developed type thus far, and others say it is all right. But in the central station that is laid out with the experience and light of to-day, where reasonable judgment is used, and conference is had with as many of the engineers as are accessible, it is almost impossible to make a mistake. You cannot help building a good station and getting apparatus that will be good when bought and will be standard ten years hence; and ten years do not make any appreciable difference in its condition, with occasional renewals.

PROF. BARRETT: Your remarks, Mr. Chairman, in reference to consolidation, I think are good. It brought to my mind the fact that just prior to annexation here the surrounding towns granted a great number of ordinances among which were several for electric lighting, and one or two for district service, the erection of pole and maintenance of lines and wires being part of the agreement. The city of Chicago, of course, had to recognize these grants under the laws, and about the time that one company started work they all went into line for the purpose of getting permits to set their poles. One gentleman came in for a permit, and in a few minutes another one called for a permit covering the same street, and there was a great deal of personal feeling exhibited in connection with it. I made an effort to consolidate the various lines and bring them all on one set of poles. Your point as to consolidation brought this up very forcibly. For one street, for instance, there were permits for electric lighting, a street railroad, telegraph and telephone. I told them they must consolidate. That is what they should do, in my opinion. I think that will produce the best income and profits. It is true that I have had no experience in profits and do not know anything about the commercial side of electric lighting. I am willing to, but up to date I have had no opportunity, and it is not likely that I will have for some time to come. The only profits that I can see are those that come from the displacement of gas lamps which I offset for the expense of maintaining our service. Where we can displace four or four and a half or five gas jets, we are exceedingly well satisfied with the result. Electricity gives us better light and the expense of attendance in lighting the streets is no greater than with gas. As to the construction of stations I made a great many mistakes, as well as other people. Our first station was started in the basement of an engine house, and it took a great deal of perseverance on the part of the authorities to get it in there. The next one occupied an entire engine house, eighty feet wide and ninety feet long, and we thought we had quite a station For the last one that we erected we bought a lot 140x370, which will give us ample opportunity to grow. The style of engine is uniform, but we have a variety of dynamos. As to what the outcome will be in the future, I am inclined to agree with some people that electric light apparatus lasts only a year or two. We have handled some longer than that with good results. The question of the kind of engine and the capacity and the units of power I find is rather an unsettled matter among the engineers of the country. I was in Boston something like a year and a half ago, and I found that the Brush Electric Light company there in rebuilding its station had abandoned large engines, and is putting in small ones. Go over to Providence and you will find just the reverse of that; and so it goes through the country. I believe that large engines can be more economically employed in large cities where the load is uniform in commercial stations. That is my opinion based on a limited knowledge of electric lighting. It is a question that I do not know a great deal about outside of municipal service.

MR. CUTTER: I would like to ask Mr. Sperry why he advocates slow speed dynamos. If we are going to use a large dynamo in mining operations, or anything of that sort, why is it he advocates slow speed? It is contrary to the American practice.

MR. SPERRY: I did not know that I took the ground of advocating it. I merely stated my observations with reference to it. The people that do advocate it say that the slow speed dynamo will replace the fly wheel of the engine, and owing to the slow speed, the slow actual velocity, the centrifugal force will be small, and the wear and tear and strain on all the parts will be so small that repairs and the cost of maintenance will be reduced. There is no doubt that the tendency in building large dynamos is in the direction of slower speed. The power generators of the Edison company are slower speed machines than the lighting dynamos, very materially slower; almost two-thirds slower. Some of the large machines, as I understand, although I have not seen them, of the Thomson-Houston company are of lower speed. The speed that could be best employed in small machines and large machines is a matter that could be discussed with a good deal of advantage.

Electricity in Mining Work.

The American River Syndicate, composed of English capitalists, is utilizing the water-power of Rock Creek, for operating its mine and mill in El Dorado county, California. This is the first plant of the kind in that state and its successful operation has attracted considerable attention. The power station on Rock Creek is 1,500 feet below the mine and mill which it operates.

The plant consists of an 8-foot Pelton wheel running under a head of 110 feet at 100 revolutions. It has a maximum capacity of 130-horse power. This wheel operates a 100-horse power Brush generator, speeded at 900 revolutions, the current from which is carried to the mill, two miles away, through a single insulated copper wire, No. 3 B. & S. gauge. The power from the generator is communicated to the counter-shaft of the mill by a 70-horse power Brush Motor running at 950 revolutions. The machinery operated consists of three centrifugal roller mills, a ten stamp battery and a rock breaker.

The Pelton wheel under these conditions

shows an efficiency of 86 per cent., while 85 per cent. of the power thus generated is available at the mill, though only 70 per cent. was called for in the contract with the Brush company. Sufficient power is taken from the main circuit to run sixty incandescent lamps for lighting the works. The company own the water right and the operating expenses of this plant are therefore almost nominal; only one attendant being required at the power station, and he is not an electrical expert, but one of the company's employes.

This equipment has now been in operation for five months and no interruption to the service of any moment has occurred during that time. The mills named are handling an average of 4,000 tons of ore per month, effecting a saving of 60 per cent. over the former method of working by steam power, estimating wood at $3.50 per cord, while the cost of maintenance is about as 6 to 1 in favor of electricity.

Commenting on the excellent results secured the San Francisco *Mining Review* says: "Facts like these are as potential as the power upon which they are based and go far to dispel the idea still so prevalent, that electricity is an unreliable, dangerous and uncontrollable force. While this is at present the only installation of the kind in California, several extensive plants of similar character are now running in Colorado with results equally satisfactory, and it is believed that this system, embracing as it does as great a degree of reliability as steam with much greater economy, will soon come into very general use where the conditions do not admit of a direct application of power to the machinery to be run."

CORRESPONDENCE.

New York Notes.

NEW YORK, Oct. 25.—Recent tests of the search light as applied to railways, have proved satisfactory. The new construction of search lights makes them of proper weight and pattern for use on a locomotive and a candle power of 2,300 will light the tracks for a half mile ahead of the engine, so that the smallest obstruction is visible to the engineer. A test of this light was made last Wednesday night with the Huntington search light at the yards of the Jersey Central railroad. Superintendent Wheeler of the railway's electrical department conducted the experiments, and it is said that at a distance of one-third of a mile the letters on the cars could be read with ease. Small objects could readily be distinguished at the distance of a half mile and it is the opinion of Mr. Wheeler that this form of electric light will be extensively used on locomotives, Further experiments will be continued next week.

The dedication of the soldiers' and sailors' monument at Greenwich, Conn., last Wednesday, was attended with fitting ceremonies. President E. H. Johnson of the Interior Conduit & Insulation company presented the monument to the Grand Army, and Gen. Joseph Hawley of Hartford delivered the oration. The monument was erected at a cost of $10,000. One of the chief donors to the fund was President Johnson, whose country residence is near by. The latest addition to Mr. Johnson's electrical devices for entertainment of guests at his home, is a model electric railway fitted with a couple of model trucks entirely constructed within his log cabin hall. The working of the motor on the forward truck is regulated by a switch under the control of the person in the seat of the trail truck This novel device affords great fun for the children who ride round and round, never tiring of watching the workings of the little electric motor.

Mayor Grant's letter of acceptance reviews the work of the city administration of which he has been the head, and incidentally touches upon the question of burying the electric wires. He says: "In 1885 a law was passed directing that the electric wires should be removed from the streets. On the first of January, 1889, not a foot of dangerous wire was under ground. The electric light companies insisted that it was impossible to operate their wires in the subway. By direction of the mayor the commissioner of public works cut down the poles and removed the wires. Since then 17,923 miles of wire have been put under ground. At this rate, within a short time, no electric wires will remain exposed on the streets." There are many other features of this particular work which the people would like to know more about, but the letter fails to furnish further light. In the first place it is well known that the principal objection to the subways of New York is that they are under the control of one company and the monopoly thus secured permits discrimination between rival companies, and admits of excessive charges for rentals. The local illuminating companies have asked the Board of Electrical Control to correct these abuses, but thus far they have been unable to secure relief. The people of New York have been kept in darkness long enough through the mismanagement of the affairs of this board and it is but just to say that Mayor Grant is largely responsible for the conduct of that body. He has acted as dictator of the board as mayor, and his action has been open to censure—ridiculously impatient at times, arbitrarily enforcing his views against the better judgment of electrical experts, and again deaf to all complaints from the illuminating companies when their rights were disregarded and their property endangered through the action of the subway company and the ignorance of the city employes.

On the other hand the fusion candidate for mayor in his speeches calls attention to the fact that the subways have been built by private capital and that the Tammany administration which boasts of this as one of its public improvements, has no just claim for credit.

The electric railway wires in Newark were somewhat damaged last Monday and several curious results of shocks to animals coming in contact with the wires were noticed.

W. H. T.

Cincinnati, O.

CINCINNATI, Oct. 24.—The Novelty Electrical Supply company, which was formed in this city last summer, has failed. The doors were opened for a month only when the company was forced into an assignment. It is stated that the old company cannot survive, but that the business will be bought out and continued by other parties.

Last winter the South Covington & Cincinnati Electric Railway company let contracts to the Short Electric Railway company to equip its Main street and Madison street lines with the multiple arc double trolley system. The former is two miles long and the latter not quite six in length. They are both complete in their electrical equipments. The Main street line has now been in operation two weeks and is running smoothly. The Madison street line runs to Fountain Square in Cincinnati, and on the Cincinnati side the poles and span wires are all up. There has been a hitch in the arrangement about crossing the suspension bridge, so that while the line is completed on the Covington side horses are still used. The company has erected a substantial brick power house in Covington, near the river, and has equipped it with a Murphy smokeless furnace and two 60,000-watt Brush generators, which are now running. They are installing an additional generator of the same capacity to provide for the extension of the road. The power house has been built sufficiently large to admit of extensive additions to the present generating plant. All the street car lines across the river, viz.: the Covington & Newport, Dayton & Newport, and Newport & Cincinnati lines are practically under the same management as the South Covington & Cincinnati road, and it is now the intention to equip them all with double trolley systems and to operate them from the same power house. In the Short system the gears have a wooden web which it is claimed is noiseless. Although the company is using solid steel cut pinions the cars now in operation make as little noise as other cars usually do where rawhide pinions are used, and very much less than those using both solid pinions and gears.

The Colerain avenue electric railway using the Thomson-Houston system has been operated for a length of about two and one-half miles for about a year. Extensions have now been completed at both ends and cars are running from Fountain Square to Cumminsville, a distance of six miles. The road is operated by electricity for this entire distance, and double trolleys are used. From a portion reaching from Fifth street to Court street, nearly half a mile, the cars run over the same track as the Mt. Auburn single trolley road which uses the Sprague system. The novel sight is presented of a single and double trolley equipment over a single track, the first of its kind in this country. No serious defects have occurred, although the plan has been tried for some time with both styles of cars running over the line. The wires for the double trolley are eighteen inches apart with a single trolley wire between them in the center. They are all suspended to the same span wires. In addition to the extention of the Colerain avenue road the Cincinnati Consolidated Street Railway company has wired many other streets or has the poles distributed along them for many miles for an additional double trolley line. The engineer in charge recently stated that considering the South Covington & Cincinnati route as a Cincinnati line there were in process of equipment in Cincinnati nearly 100 miles of double trolley road. The Mt. Auburn single trolley road using the Sprague system has been extended from the Zoological garden to Carthage, making the total distance from terminal to terminal about eight miles. The extension consists of about five miles of double track. The company, however, is not permitted to operate its extension as the telephone company's injunction granted last spring by Judge Wm. F. Taft prevents the use of the single trolley. An appeal has been made by the street car company and a hearing will come before the Superior court in general session this month. If Judge Taft's decision is sustained the whole system must be changed to provide for double trolleys, and the Mt. Auburn will be operated throughout by single trolley. In spite of the interference with the telephone service occasioned by this road, its operation has done much to render electric traction popular here as the present company upon taking charge changed the road from one of the worst managed railways in the city to one of the best. Each party in the present controversy seems confident of results favorable to itself at the hearing of the appeal, and the outcome is looked forward to with much interest by all concerned, the traveling public as well as the litigants.

Nelson W. Perry, electrical engineer, has removed to New York to assume a position with the Edison General Electric company. His duties will be in connection with the newly formed bureau of information and light and power department.

P.

Des Moines, Ia.

DES MOINES, Ia., Oct. 23.—The Des Moines city council has granted the Union Telephone company a twenty years' franchise. It was supposed that the franchise was granted some years ago; but an investigation of the matter by the city clerk developed the fact that the ordinance granting the franchise had never been accepted by the company, and that the lines within the city have been constructed without any franchise right whatever.

Atlantic has voted a $25,000 tax for the purpose of putting in an electric light plant, and work has already commenced. The plant will be in operation by the middle of November.

On September 30 a patent was granted C. K. Harding of Atlantic, for an electrical street car system, and a company to be known as the Harding Electrical Conduit company has been organized at Atlantic for the purpose of putting the new system into operation. The officers of the company are C. K. Harding, president; J. B. Jones, vice-president, T. G. Steirke, secretary; A. W. Dickerson, treasurer. In an interview, the inventor, C. K. Harding, gives the following details of the workings of the system: The Harding system employs the underground conduit running along the center of the track, and is entirely closed having no slot or openings through which the current is taken. The Harding conduit consists of an iron casing with a tubular lower part in which the main wire is thoroughly insulated, and carrying on its upper surface an exposed section of conductor about six feet in length, and extending about a quarter of an inch above the surface. These conductor sections are completely insulated from each other and from the wire carrying the current, and are at all times free from the electrical current except when the car is over and protecting it. The sections through which the current reaches the car are themselves brought into connection with the main insulated wire automatically by electro-magnets located in a small cavity at the end of each section. The working of the small model which has been placed on exhibition by the inventor has been quite satisfactory, and the company have great faith in its successful operation when put to a practical test.

The Des Moines Telephone company and the Electric Street Car company are just now having a little difficulty. The telephone company charge that their system has been greatly injured by the operation of the street cars. So great is this interference that it is charged that no less than 150 telephones in the city have been ordered out because of the decrease in efficiency in service since the street car system became extensive. The general superintendent of the telephone company, Mr. Beach of Chicago, has been in the city several days recently looking after an amicable settlement of the matter, and on other business in which his company is interested.

F. M. C.

Nashville, Tenn.

NASHVILLE, Oct. 25.—Frequent announcements of the incorporation of new electrical enterprises in this state bear evidence of the progress that is being made in that line. Other evidence, however, is not wanting. The constant extension of established electric plants in all departments shows that there is a steady growth in the electrical business. Telephone lines are being extended in all directions. The government established a telephone line several miles long, which was used to facilitate the work of improving the Tennessee river at Mussel Shoals in Alabama. This

line is now being extended by private companies to Florence and to Decatur, Ala. From the latter city to Athens, Ala., is only a short distance, and when these points are connected it will complete the circuit which will place this city in telephonic communication with the principal manufacturing towns of Alabama.

C. B. Holmes of Chicago, representing a number of Chicago capitalists, has paid the Memphis Street Railway company $537,000, the balance due on the purchase of the Memphis street car system, and assumed active management. The Chicago capitalists paid $1,000,000 for the roads, and assumed $1,000,000 bonded indebtedness in addition. Mr. Holmes is president of the Memphis Street Car company. The entire system is to be operated by electricity, and the work of conversion is to be begun at once.

Work on the new lines is being pushed as rapidly as possible, and also on the extensions and improvements on the old ones. The tracks around the public square, to connect the East Nashville lines with those of the city proper, are completed, and through cars will be run within three or four days.

The trouble between the United Electric and the Citizens' Rapid Transit companies about the joint use of the tracks on Cedar street was settled by a decision of the Board of Public Works that the latter should pay the former one-half the actual cost of constructing the line. This, at first, the Citizens' Rapid Transit company declined, but yesterday it paid the award, and all differences for the present, at least, between the rival companies have been arranged satisfactorily.

City Attorney Anderson has furnished the Board of Public Works an opinion on a question submitted by it to the effect that the board has the right to compel the Capital Electric company to move one of its wires, if it is necessary, to allow the railway company to put a guard wire over its trolley wire. The city electrician has prepared, and the Board of Public Works has adopted, quite an elaborate set of rules and regulations governing the stringing of wires in this city.

The demand for small electrical appliances requiring the use of batteries is increasing rapidly, and the dealers in electrical goods are enjoying an immense trade. B.

Little Rock, Ark.

LITTLE ROCK, Oct. 25.—The city of Little Rock owns its own electric light plant, and the facts embraced in the city electrician's report for the year ending Sept. 1 are of the most favorable character. The plant was operated for $1,003.71 less than for the preceding year, the first year of service. There are 112 arc street lights, which are hung at the street intersections. These lights were run 2,624 hours at an expense of $5,986. The cost of operating the plant was $16.40 per night, or for each lamp per night 14 cents; each lamp, averaging eight hours each night, per annum, $23.51.

The Arkansas *Press* is operating its printing business with electric power—presses, ruling machines and everything connected with the printing, book binding and stereotyping business. G. R. B.

Pittsburg, Pa.

PITTSBURG, Oct. 25.—The Squirrel Hill electric railroad of this city was sold at auction a few days ago and the purchase money amounted to the sum of $25,000.

This is the road which has been haunted, as it were, by misfortune ever since the company organized, but it seems now that it has gone into the right hands and its completion is said positively to be a thing of the near future. It is understood that the Pittsburg Traction company has furnished the money for the purchase, and that corporation will no doubt control it.

The Squirrel Hill line runs from the power house of the Pittsburg Traction company in Oakland along Schenley Park to the Twenty-second ward, a very beautiful portion of the city, which, however, is not much built up at present. The road will be four miles long.

The Chartiers Valley Light & Power company of Chartiers, near Pittsburg, was chartered a few days ago with a capital stock of $30,000. The directors are Samuel A. Duncan, William A. Langfitt, William M. Galbraith and Jos. A. Langfitt. The organization intends to put up a power house, furnish the residents of Mansfield, Idlewild, Crafton, Ingram and Sheridan electric lights and also build an electric road from Pittsburg to Mansfield, a distance of ten miles.

The Braddock Electric Street Railway company of Braddock, Pa., obtained permission from the town council a few days ago to construct and operate an electric street car line from Braddock to Wilkinsburg. Work is to be commenced within sixty days and the road is to be completed in a year.

The Hippely & Hopf Brewing company of Allegheny City, is the first brewing concern in this part of Pennsylvania to operate its own electric light plant. A one hundred lamp plant is being installed at the factory now. Messrs. Hippely and Hopf say that they have thrown out the gas light because electric illumination is much less dangerous as to fire than any other.

A large amount of copper wire which the Pittsburg, Allegheny and Manchester Electric Railroad company intended to use for the construction of its new line was stolen a few days ago. This is the first theft of this character which has come to the knowledge of the Allegheny police department. The thief was caught and punished.

The construction of the line of the Duquesne Traction company is now nearly completed, and the cars are promised to be running by the 1st of December. The forty cars to be used on the road are to be shipped from the Pullman company's works in a few days. The power house is so far in shape as to require only the placing of the motor generators and the engines. This road will be about twelve miles long.

Electric mining machines are gradually becoming generally used in the Pennsylvania coal fields and in some cases the miners are rising in opposition to the introduction of the machines because they allege they are losing their occupation. However, the objection of the miners is not very effective because it has been known to the coal operators for some time that the production of coal could only be followed profitably by the adoption of mining machines.

Owing to the extraordinary demand which is now made for the new street car motor of the Westinghouse Electric & Manufacturing company, the capacity of the street railway department has been greatly enlarged. The company received a shipment of tools a few days ago and they are all put in their places and in full operation. With these accessories to the capacity of the department, the company is now enabled to turn out eight motors per day.

E. H. H.

PITTSBURG, Oct. 22.—Mayor Wyman of Allegheny City, signed an ordinance recently authorizing the Committee of the Council to enter into a contract with the Westinghouse Electric & Manufacturing company for 100 mast arms and 100 arc lamps for street lighting.

About a year ago the city gave the Westinghouse company a contract for an electric light plant of 3,000 alternating incandescent and 450 arc lamps. This plant was finished early last spring and the city then put up a number of towers proposing to illuminate the streets by that system. These arrangements have been changed and the city has now ordered 100 mast arm lights. This addition will be made at once and Allegheny is expected to be one of the best lighted cities in the country by next Christmas.

A circular was issued a few days ago by the management of the Pleasant Valley Electric Street Railway company informing the patrons of that road, that in the future the cars on the Perrysville line would not be allowed to carry more than forty-five passengers at one time, either down or up grade. The company takes this measure as a precaution because the Perrysville line has a very steep grade and a car with more than forty five people in it cannot be handled with safety.

The public around the Union Station in this city was recently treated to an electrical display of pyrotechnics. In other words, a telegraph pole caught fire and was in a few seconds transformed into a monstrous torch. This pole had a box on its top, which contained several hundred Western Union telegraph wires. By some means or other, however, an electric light wire came across one of the telegraph wires and the result was that the pole caught fire. Flames shooting out of the cable box first attracted the attention of the passers-by and immediately an alarm was sent into the fire department. The fire was put out and upon examination it was found that the damage done by the fire amounted to about $200. H.

Ithaca, N. Y.

ITHACA, Oct. 25.—The senior electrical association has reorganized with H. M. Wilson as president, W. E. Lindsay, vice-president, and E. E. Williams, treasurer. At the last regular meeting of the association Instructor Geo. Shepardson gave a talk on "The Opportunities Offered a Technical Graduate." He advised graduates who are going into electric lighting or electric railroading to begin work in a station or general repair shop rather than in a large factory, but better than this, he said, is "to take up and develop some new field." He then mentioned the following fields now open for electrical work: electric metallurgy; electro plating; electricity as applied to chemistry; the attainment of "light without heat;" electricity direct from heat; the improvement of the arc lamp as to duration of carbons; electric train lighting; the decrease of weight of accumulator cells, gas battery—this may possibly be the method of obtaining electricity directly from heat; seeing at a distance; the development of the tel..., utilization of the tidal power of the ocean; the study of animal electricity and personal magnetism; electro therapeutics; utilization of atmospheric electricity; the improvement of gas lighting appliances; the employment of earth... an electric car truck in which the armature ... in the same direction, and which may rev... stops, making it possible to stop the car quickly when going down hill, also the armature to attain its speed before the car is started; method to avoid loss of power in going around curves; lightning arrester for cars; substitution of something new for present gears in connecting armature with car wheels; and last, the possible development of the "Keeley motor" principle.

At the last meeting of the American Institute of Electrical Engineers Messrs G. H. Walbridge and W. B. Tobey, both of the class of '90, presented a paper entitled, "Investigation of the Stanley Alternate Current Arc Dynamo." The experimental data upon which this paper is ba... taken at the university last spring.

Frank C. Perkins of the class of '91, has ... member of the American Institute of Elect...

Minneapolis, Minn.

MINNEAPOLIS, Oct. 25.—Yesterday morning the St. Paul Street Railway company commenced to operate its new line on West Seventh street from Ramsey street to Tuscarora avenue. A trial trip was made by Superintendent Scott on Thursday evening and on his return he gave orders to run trains on the line each way at intervals of seven minutes. The round trip is 6 15 miles and consumes forty-nine minutes. Mr. Scott says he will have the University avenue line in operation to Dale street within a few days, having matters so that he will have power to operate all ... the newly completed lines. The engine formerly used in the Selby avenue cable power house has been transferred to the Hill Street power house, where it will be used to operate two generators of 200-horse power each. T... pany has three generators of 80-horse power ea... electric power house of the St. Paul gas company; these had heretofore furnished power for the Grand avenue line. Only two of them are available at present as the large engine of the gas company is only run nights. The following arrangement has been made for operating the electric lines this winter and until the full system is completed. T... generators in the gas company power house will both the Grand avenue and West Seventh street l... the junction of Ramsey and Seventh streets to Groveland Park and Tuscarora avenue. The large generators in the temporary power house of the railway company are made to operate both lines from the crossing of Ramsey and Seventh streets to the end at Smith Park, and will operate the University avenue line as far as it is now completed. Mr. Scott believes there will be enough power for the satisfactory operation of these lines, and some to spare. From Mr. Scott it is learned that the Allis company at Milwaukee will not have the remaining two 1,200-horse power engines completed within ninety days which will necessarily delay the completion of work now progressing. There are now eight 200-horse power generators on the ground at St. Paul.

Articles of incorporation have been filed at St. Paul for the Duluth Construction company, a new corporation with a capital stock of $750,000, the principal purpose of is to build and operate an electric railway line and es... an electric light plant at St. Louis, Minn., a young, out very promising suburb of Duluth. Branch offices are to be established at both Duluth and West Superior, and both cities may be ultimately connected by the line they propose to build. The incorporators are wealthy and energetic men, among them being H. B. Walmsley, Geor... H. Delting and Wm. H. Smith.

Since the return of Mr. Lowry from Buffalo he has injected wonderful animation into the work of electrical railway building in Minneapolis. The addition to the main power house on Third avenue north is fast nearing completion, and within a week or two will be ready for its portion of the machinery. Closed motor cars have been put upon the First avenue line, which is now in successful operation. The Lyndale line and the Chicago avenue line will be completed simultaneously probably within a week, and this will leave but two prominent lines in West Minneapolis depending on horses for operation. At the car shops of the company the work of equipping cars with motors is making very rapid progress, so that all of the lines will be fully equipped as soon as they are completed. By far the most important announcement that has been made is that the inter-urban line will be put in operation on the 15th of November. It will be equipped with forty motor cars each with a capacity for speed of twenty-five miles an hour, drawing a trail car. The poles are all set with the exception of a few on Washington avenue bridge over the Missis-

and they will be strung within a few days. The new line will unquestionably be the most popular route between the cities for summer travel and cut largely into the business of the Manitoba and Milwaukee short [illegible] is practically an air line and much shorter than [illegible]. This will make up the difference in time, [illegible] great with the powerful motors that will be employed on the inter-urban line. There are many shrewd business men in both Minneapolis and St. Paul who believe that electric inter-communication will remove the difficulties in the way of the municipal union of the two cities more effectively than any other agency which could be employed. It will certainly have the effect of multiplying suburban residences in the midway district, thus concentrating the population in the most favorable situation to forward this end. It is one of Mr. Lowry's objects to get several electric lines in operation between the cities within a few years, passing through all of the suburban [illegible]d giving them quick and convenient access to both

[illegible] who has been for many years in the employ [illegible] Sabin & Co., and their successors in business [illegible], Minn., has been appointed chief engineer at the Third avenue power house of the Minneapolis Street Railway company. Mr. Logee has patented a number of useful inventions and is an engineer of long experience. He is exceptionally well qualified for the position he assumes.

Eighty telephones were rendered useless for a time in St. Paul the other day. An electric light wire came in contact with the telephone lines on Minnesota avenue with that result.

In the damage suit of little Herman Bruden against the [illegible]s Street Railway company, the jury rendered [illegible]dict for the company. The boy was injured while stealing a ride on the Fourth avenue electric train.

The West Duluth electric light plant will be in operation [illegible] the 1st of November. N. O. F.

Pittsburg, Kan.

PITTSBURG, KAN., Oct. 22.—The Pittsburg Gas Light & Coke company of this city have lately installed a Westinghouse alternating arc dynamo of forty lamps' capacity. The dynamo reached here Oct. 12, and on the 13th forty-two lamps were burning with perfect satisfaction.

The Westinghouse company is also installing a complete [illegible]lway system consisting of ten miles of track, two [illegible]he 60-horse power generator. The dynamo was put in by Pittsburg Gas Light & Coke company, which has a five years' contract for furnishing power to the road The dynamo and motors are simple in construction and massive in appearance. This road will be in operation some time during the month of October. F.

Cleveland, O.

CLEVELAND, Oct. 20 —The electric railway presidents met recently to consider pending street railway legislation, but instead of doing so they took an inspection trip on the new Westinghouse motor purchased by the Broadway & Newburgh company and the Rae motor, purchased by the East Cleveland company. Both motors made 125 feet in five seconds, which is equivalent to eighteen miles an hour. The East Cleveland company has just purchased twenty-one new motors, most of them for the Central ave[illegible] line to be opened about November 1.

[illegible]Eden Park & Mt. Adams electric road, Cincinnati, now in course of construction, will be open for business by January 1.

The eleventh annual meeting of the Cleveland Tele[illegible]ne company was held Tuesday. The following gentlemen were elected members of the board of directors: Chas. E. Adams, Lowell; John E. Hudson, Boston; A. B. Hough, Cleveland; Chas. J. Glidden, Lowell; W. J. McKinnie, Cleveland; J. P. McKinstry, Cleveland; E. P. Williams, Cleveland; Thomas Sherwin, Boston; Geo. W. Short, Cleveland; Levi Sprague, Lowell and E. P. Wright, Cleveland. The old officers were re-elected: President, Levi Sprague; treasurer, Chas. J. Glidden; general manager, J. P. McKinstry, Cleveland. Superintendent McKinstry stated that there are now 650 miles of underground wire in this city. The long distance circuit between New York and Milwaukee, now in course of construction, was favorably reported on. The constructing force is now at work between Erie and Cleveland.

Cincinnatians want to give their city a metropolitan air and are trying to bury the electric wires.

Two new concerns have entered the electrical field here. They are the Schneider & Frenkamp company and T. H. Lovell & Co. R.

The question of issuing bonds to enable the city to install an electric light plant was voted upon by the taxpayers of Water Valley, Miss., recently and decided in the affirmative.

THE ELECTRIC LIGHT.

The National Electric Manufacturing company of Eau Claire, Wis., has the contract for erecting the electric light plant for the Rockbridge company at Glasgow, Va.

The Hyde Park Electric Light and Power company has begun operations with 167 arc lamps in use. The Sperry system is used. Charles E. Gregory is manager of the new company. He hopes to increase the capacity of the plant at an early day.

Owing to the demand for incandescent lights the Chicago Edison company has been compelled to refuse further contracts for motor service until Jan. 1, when it hopes to have another addition to its generating plant. The increase in incandescent lighting in Chicago last year was marvelous.

The lighting plant that the Thomson-Houston Electric company will furnish for the United States cruiser Newark will consist of three sets of dynamos and engines, each dynamo being directly connected and secured to the same bed plate as the engine driving it. The dynamos will be compound wound, and will be run at a speed of 400 revolutions per minute. They will have a capacity of 200 amperes at 80 volts pressure, and the specifications call for an efficiency of not less than 80 per cent. at full load. The insulation resistance of the entire system, including the circuits of the dynamos, must not be less than 100,000 ohms. The incandescent lamps are to be of 10, 16, 32 and 50-candle power, the total number of lamps being 425. The ship is also to be furnished with four Mangin projectors of the latest type, each supplied with two combination lamps.

The Edison company at Rochester, N. Y., has just completed an interesting piece of work. The power plant is just south of the Erie canal and as the business district of the city is chiefly on the other side of that waterway the wires have been carried across the canal on poles. Last week, however, the company made a change and the wires are now supported on an iron bridge, specially constructed by the Rochester Bridge & Iron company for the Edison company. The bridge had already been put together and it was taken across the canal by means of staging erected on a canal boat, roller and lever power being applied to force the structure along. The bridge is intended solely for the support of the electric wires and will not be open to the public in any way, all the interior being filled with the wires, which will be strung in three tiers. The bridge has capacity for 168 wires and a few light ones may be strung on the top. The weight of the bridge is 35 tons and its height will be 21 feet above the canal. Owing to the great amount of business which the company does the pole supports were considered insufficient both in strength and capacity.

Among the contracts for alternate current electric lighting apparatus which the Westinghouse Electric and Manufacturing company obtained last week is one from the Elmira Illuminating company of Elmira, N. Y. This company was organized only a little over a year ago and has an apparatus for 750 lights installed. The demand for the modern system of illumination, however, increased to such an extent that the Elmira company was obliged to arrange for several additional alternating current machines. Three times an increase had to be made until to-day the central station has generating machinery for 3750 alternating current incandescent lamps, the last contract being for 1,500 lights. The Westinghouse company is also manufacturing apparatus for several other alternating current central station plants, which are already operating the Westinghouse system. The capacity of the Oswego, N. Y., Electric Light company is now inefficient to meet the demands and a 750 light machine is being added to the plant. Lincoln, where the Lincoln Electric Light & Power company has now been operating the Westinghouse alternating current system in a central station plant of 1,950 lights' capacity will also have more light shortly, the company having just concluded a contract with the Westinghouse compahy for apparatus to generate 1,600 16-candle power incandescent lamps. Electric lights have been introduced in Tampa, Fla., since 1887, and since then the Florida Electric company of that city has energetically gone to work to prove to its patrons the many advantages accruing from the use of electric illumination. The Westinghouse alternate current system of incandescent lighting is employed. A few days ago the company contracted for additional apparatus which will enable the Tampa central plant to supply the city 1,900 16 candle power incandescent lamps. Apart from these increases in the generating capacity which the Westinghouse Electric & Manufacturing company has contracted to furnish, the alternate current system is also being introduced in new central stations at Durango, Cal., a plant of 750 lights' capacity and at Orange, N. J., the Westinghouse company is going to install a plant with 750 lights' capacity.

THE ELECTRIC MOTOR.

The Tacoma & Steilacoom Railway company of Tacoma, Wash, expects to complete its electric line, sixteen miles in length, by Feb. 1. Fifteen cars equipped with Thomson-Houston motors will be operated. The company states that its power and station will be the most complete for its size on the Pacific coast.

The Galveston, Tex. City Railway company has contracted with the Detroit Electrical Works for a full electrical equipment of Rae motors and generators. The first installment of twenty motor cars and four generators with full station equipment will be in operation on or before Jan. 1, 1891. The Detroit Electrical Works have forwarded to Portland, Ore., the first shipment of their standard 30-horse power motors and trucks as the first installment of a large order.

The Short Electric Railway company has received an order from the Rochester Street Railway company for twenty-four 25-horse power motors to be placed on the snow sweepers now being constructed by the Lewis & Fowler Manufacturing company of Brooklyn, N. Y. These sweepers, six in number, will be heavier than any yet made by this company, and the motors are large and powerful. Two of them will be needed to operate the truck and one to run each broom, making four motors to each sweeper.

In the last issue of the WESTERN ELECTRICIAN in an item referring to the exhibits at the convention of the American Street Railway association, it was stated that the Sheffield Velocipede company had been building *motors* for the Detroit Electrical Works. The statement was erroneous. The paragraph would have been correct had the word "trucks" instead of "motors" appeared in the sentence. It is thought no one could have been misled by the mistake, as the context showed that "trucks" instead of "motors" were referred to. It is known by all interested in electrical matters that the Detroit Electrical Works have always built their own motors.

The electric street railway at Rochester, N. Y, is now operating several street cars by electricity. About a week ago the first car was operated within the city limits. The trial trip was made Saturday evening, and although no formal announcement had been made, the route was lined with citizens eager to see the first car. Officers of the company, city officials and prominent citizens to the number of thirty enjoyed the first trip. There was not a hitch in the proceedings. The trial was highly successful. A local paper says: "The new car presented a most attractive appearance. It was brilliantly lighted by two clusters of electric lights, three bulbs in a cluster and two electric lights at each end, while bright oil lamps were placed behind colored bull's eyes at either end near the roof. The new cars are finished both inside and out in the most attractive manner. No expense seems to have been spared in their appointment. In many respects they are as luxurious as the interior of a modern steam coach. Each car is provided with a cosy little stove. Small colored glass windows extend around the car at the top. The cars are operated by a lever similar to that of a locomotive and are furnished with reverse levers at each end. By means of this system a car can be controlled with great ease by the operator. The new cars have a body length of eighteen feet with six large windows on each side and vestibules at each end inclosed with glass." The company is prosecuting its work on the other lines and hopes to have the principal routes transferred into electric lines within a short time.

THE TELEGRAPH.

Arrangements are making for a meeting of representatives of the Eastern Telegraph company and the Canadian government to discuss the proposed construction of an additional cable to Australia.

The Pacific Postal Telegraph company is now building a double line between Olympia and Port Townsend. The Pacific Postal company has leased the lines of the Puget Sound Telegraph company, and with the new line now building, and the cable across the Straits of Vancouver, will give three outlets by wire, so there is no danger of important messages being side-tracked in future on account of the wires being down.

A press dispatch from Boston announces the crippling of the telegraph service in that city by a fire in the Western Union cupola Sunday evening. An electric light wire, the dispatch says, was blown down by the wind somewhere in the city and crossed a telegraph wire. The electric current at once steered for the cupola on the Western Union building, from which 250 wires radiate. The New York, Western and Southern wires were burned out, and a fire was kindled which required the services of the fire department. The fire was quickly subdued, but the water which poured down the shaft connected all the wires and rendered them useless for service. "The wires on top of the building were repaired in a few hours, but the water behind the switchboards can't be removed before morning, and the service will, therefore, be crippled during the night." It is evident that no positive information was received concerning the origin of the fire, yet the breaking of an electric light wire 'somewhere" in the city is the cause assigned. Those who have any knowledge of the relative merits of the line construction of telegraph and electric light companies will assume that it would be far more likely for a telegraph wire to "blow down" than an electric light wire.

THE TELEPHONE.

Material for a telephone line along the Congo railway has been shipped from Antwerp. The wires are of phosphor-bronze, and the apparatus is on the Dejongh system, made at Brussels, with magneto bells of the model adopted, after a competition, by the administration of Belgian Posts for its private lines.

The Bell Telephone company sent a communication to the executive board of Rochester, N. Y., last week stating that it was doing all it could to hurry the connection of the underground wires with its subscribers without interference with the telephone service. It will be impossible, the board states, to complete these connections by Nov. 1, 1890.

Personal Mention.

J. G Brill of Philadelphia was in Chicago last week.

W. G. Halm of the Perkins Lamp company was in Chicago last week.

Nelson W. Perry of Cincinnati, has accepted a position with the Edison General Electric company in New York City.

F. B. Badt, who has been connected with the Edison General Electric company at the Chicago office, has accepted the position of manager of the power and mining department at

the Chicago office of the Thomson Houston Electric company.

George Lathrop Wright, president of the River & Rail Electric Light company, New York, was in Chicago last week.

City Electrician Barrett, Chicago, has been confined to his house by illness, but he is rapidly recovering and hopes to be out soon.

D. C. Jackson of New York has been appointed to the position of district engineer of the central district of the Edison General company, Rialto building, Chicago.

Clift Wise, who has been connected with the Minneapolis Street Railway company, has accepted the position of chief engineer of the Interior Conduit & Insulating company, New York.

James A. Lounsbury of the National Engineering Bureau of Chicago, has been appointed consulting electrician for the Thwing Electric Manufacturing company, and is looking up a site for the factory.

Business Mention.

The Canvas Jacket patent woven insulated wire is enjoying a rapidly growing popularity among users of high grade wires. The Murray overhead trolley switch is another article handled by the Illinois Electric Material company of Chicago, which is meeting with approval by railroad men.

Alexander, Barney & Chapin of New York are introducing a new incandescent lamp for which many advantages are claimed. The firm also sells Edison lamps, and is carrying a large line of electric railway supplies. The firm keeps a full assortment of standard electrical books. The new concern is already doing a large business.

James S. Doren superintendent engineer of the Inmain Steamship Line writes to the Magnolia Anti-Friction Metal company. "We have had your metal in use for about three years in various service, some of which is the hardest I have ever seen anti-friction metal put to, and am free to say that it has given entire satisfaction. It is the best metal for its purpose that I now have knowledge of."

The Great Western Electric Supply company of Chicago reports continued activity in all departments. The orders for railbonds, pole ratchets and curve insulators are in keeping with the spread of the electric railways, and the new designs of fixtures are beautifying hundreds of homes. The company is supplying the coming generation with learners' telegraph instruments and with experimental apparatus.

St. John Day, who has been connected with the Kester Electric company of Terre Haute, Ind., for several months, has decided to open an office in Chicago as an expert in electrical engineering. Until within a few months Mr. Day's home has been in England, where he has a well established reputation as an engineer. He has been associated with Sir William Thomson and many of the most prominent English electrical engineers.

The Thomson-Houston Electric company proposes to develop vigorously the power and mining branch of its business. Transmission of power, metallurgy, electrolysis and the application of electricity to mining work generally, will be made a much more prominent department of its business. Francis B. Badt, R. E., of Chicago, will have charge of the department with headquarters at the company's office, 148 Michigan avenue, Chicago.

The Central Electric company, Chicago, is to be congratulated upon the acquisition of George W. Vernor, who has taken charge of the bookkeeping department of its house. Mr Vernor has been secretary of the Southern Electrical Supply company at St. Louis for the past year, and is well-known to the electrical trade. Charles E. Brown of the same company has just returned from an extended trip of over eight weeks. Mr. Brown reports business good. He secured several orders for improved Candee wire. The Central Electric company's new fixture and electrolier department is now complete and adds materially to the showy appearance of its already handsome store. The Central Electric company is showing a piece of plain Okonite wire that was placed in the Lumber Exchange building at Minneapolis five years ago, and has been used continuously ever since. The wire was stapled to the fireproofing and plastered over, and is now apparently in as good condition as ever. The Central Electric company, which has the agency for this wire, has fully two million feet of Okonite in its storerooms.

The Page Belting company of Concord, N. H., reports business brisk in all classes of goods, both staple and special, which it manufactures. Among the large orders recently filled are the following: A 48-in. heavy double belt, 127 feet long, sent to the Thomson-Houston Electric company, Memphis, Tenn.; a 32-inch belt, 114½ feet long, sent to the Mallers Manufacturing company, Sheboygan, Wis.; a 24-inch belt, 135 feet long, sent to the Star Thread company, Athens, Ga.; a complete outfit for the Chicago, St. Paul, Minneapolis & Omaha Railroad company; a number of 15-inch light dynamo double belts for the Edison company, Chicago. Several electric belts were sold to W. A. Brown, Lynn, Mass; special Acme link belts have been sent to a large number of customers, among them the following: The Pennsylvania Railroad company; White Manufacturing company, Rockville, Conn; Marshall Light & Power company, Marshall, Texas; H. D. Smith & Co., Fayetteville, Tenn.; Davis & Thomas, Catasauqua, Pa. The company reports that several of these belts were put on to dynamos where the draft was at the top fold instead of the under-fold of the belt, and in some cases where dynamos were placed tandem. The company has link belts in use with light dynamo double belts running over the link belts, a novel construction. Their works in Concord, N. H., are taxed to their utmost capacity and their branches at Boston, New York, Chicago and San Francisco are full of business.

The New York Insulated Wire company has received an order for wire to be used in the Executive Mansion, Washington. The company writes: "As we have furnished the wire for the Statue of Liberty, Washington Monument and State, War and Navy Departments, we are beginning to feel as if we were entitled to the name of the National Wire Manufacturers."

J. A. Hood of 247 North Wells street, Chicago, who has recently placed on the market a new wood mat or floor for street cars, is busily engaged in filling a contract made through the Pullman company for the placing of his improvement in 100 closed motor cars now being built for the Duquesne Traction company of Pittsburg. Forty of these cars have aleady been delivered and the remainder is well under way, the contract calling for their delivery before Jan. 1. The Pullman officials are much pleased with this invention.

The Yale & Towne Manufacturing company has made a number of important changes and appointments in the executive staff. Schuyler Merritt, since 1878 secretary, and since 1884 the general manager, resigns the latter position, but retains that of secretary. He will have charge of the company's legal and patent affairs, and bank lock department W. F. Donovan, since 1880 the manager of the company's Chicago house and manager of its Western business, is appointed to the position of general manager, with headquarters in Stamford Conn., and New York. Geo. S. Redfield, recently manager of the tubular axle department of the National Tube Works company of Boston and McKeesport, Pa., has been appointed to the position of manager of department A, locks and hardware, in the Stamford office. B. H. Warren, recently superintendent of the works of the Hancock Inspirator company, Boston, has been appointed manager of departments C and D in the Stamford office. Henry H. Suplee, recently editor of the technical journal *Mechanics*, and also consulting engineer in Philadelphia, has been appointed to the position of editing manager in the Stamford office. He will have entire charge of the presentation of the products of the company before the public, including all editorial work and advertising. W. H. Bryan, recently secretary of the Heisler Electric Light company, St. Louis, Mo., is appointed to the position of manager of the Chicago house. Frank H. Taylor, formerly president of the Belmont Iron company, Philadelphia, has been appointed manager of the Philadelphia house, vice John T. Boyd, resigned.

The Belding Motor & Manufacturing company, Chicago, exhibited its standard railway motor at Buffalo during the recent convention. A 15-horse power machine was attached to a very handsome vestibule 28-foot car built by Gilbert of Troy. Many novel features are introduced in the system. Rope transmission is used in place of the usual metal gearing. The company claims this feature to be a most valuable one from the fact that a practically noiseless action is obtained and friction is reduced to a minimum. The well-known type of armature used by this company in its stationary motor, is employed in the railway motor. It may be mentioned in this connection that this armature is built with no crossing coils. Each coil is entirely separated from its neighbor and there is no bunching of the wires at the ends. The armature is of comparatively large diameter in order to obtain the advantages of a slow speed machine. The Belding company's car was put in active service on the streets in Buffalo after the convention and was run in place of one of the regular cars on the line. The car had a 7-foot wheel base, and although provided with but one motor, it took, it is stated, the numerous short curves without trouble, and with a very small expenditure of current. The Belding Motor & Manufacturing company has recently purchased ten acres of land and a large factory building in Chicago, and is equipping the factory with all necessary machinery for a large output. N. S. Possons, who has been the general superintendent of the Brush factory at Cleveland for twelve years past, has been engaged to take a similar position with this company. Harold P. Brown has also connected himself with the company.

Electrical Patents.

Issued Oct. 21, 1890.

438,598. Electrical Water Alarm. Francis M. Ashton, Lima, Ohio.

438,602. Alternating Current Generator and Motor. Charles S. Bradley, Yonkers, N. Y.

The invention consists in the combination of a multipolar machine having on its axis the inducing member of an auxiliary magnetic system in addition to its own armature, cross connected in a reverse manner, so that the shifting polarity, which takes place in its own armature in a direction contrary to its rotation, is caused to take place in the rotating inducing member of the auxiliary magnetic system in a direction the same as its rotation, thus doubling the speed of polar propagation, and in causing the auxiliary inducing member to produce alternating currents in the stationary secondary circuit.

438,603. Electric Motor. Charles S. Bradley, Yonkers, N. Y.

438,619. Arc and Incandescent Lighting System. John E. Giles, Hazleton, Pa.

438,620. Electric Crossing Gate. Harleigh Gillette, Highland Park, Ill.

438,631. Telephone Transmitter. Archibald J. MacDonald, North Tiverton, R. I.

The invention consists of a diaphragm having its body made of hard carbon and its front face made of ferrotype metal.

438,632. Telephone. Archibald J. MacDonald, North Tiverton, R. I.

438,653. Electric Guest Call. Alexander Striemer, Sleepy Eye, Minn.

438,656. Electric Motor. Elihu Thomson, Lynn, Mass.

The invention comprises a short-circuiting magnetic bar and its coil, a current controller therefor and a governing magnet in a derived circuit around the armature.

438,657. Process of Electric Welding. Elihu Thomson, Swampscott, Mass.

The invention consists in the improved process of electrically welding three or more pieces together by placing said pieces in abutment with one another in the desired relation, passing current through the joints until they assume the desired welding temperature, and welding the joints

438,658. Electric Welding of Pipes. Elihu Thomson, Swampscott, Mass.

438,668. Brush Holder for Dynamo Electric Machines. Charles F. Winkler, Troy, N. Y.

438,698. Insulating Composition. Anthony E. Menuez, St. Paul, Minn.

438,721. Thermal Cut-out. George H. Whittingham, Baltimore, Md.

The invention consists in the combination, with the rotary head and its clamps, of the wedge shaped deflector engaging the movable sections of the clamps, and the guide located in rear of the deflector.

438,723. Electric Blank Heating and Feeding Apparatus for Forging Machines. George D. Burton, Boston, Mass.

438,767. Electro Pneumatic Clock. Victor Popp, Paris, France.

438,773. Electric Light Pole. Patrick J. Dinn, Boston.

438,779. Extension Device for Incandescent Lamps. Samuel O. Newton and Melville A. Newton, North Pitcher, N. Y.

438,780. Electro Magnet. Frederick M. Schmidt, Brooklyn, N. Y.

438,784. Telephone. John C. H. Stut, San Francisco, Cal.

438,788. Lightning Arrester. Anthony C. White, Boston, Mass.

438,814. Device for Automatically Insulating Broken Wire. Max Kerstein, Boston, Mass.

438,818. Telephone. James W. McDonough, New York, N. Y.

438,827 Secondary Battery. Emile N. Reynier, Paris, France.

The last claim follows:

"12. The combination, for facing an electrode, of a sheet of active matter having its edges reduced in thickness, and a marginal frame or border of insulating and incorrodible material applied to the so-reduced edges."

438,828 Telephone. Wilton L. Richards, Malden, Mass.

Claim one reads as follows:

"In a magneto telephone, the inducing magnet, helix and diaphragm, in combination with a magnetic screen interposed between the body of the said magnet and the diaphragm."

438,837. Electric Drill. Gordon Buchanan, Chicago, Ill.

438,847 Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

438,870. Magneto Electric Transmitter. Archibald E. Todd, Providence, R. I.

438,882. Portable Reflecting Galvanometer. Charles P. Frey, East Greenbush, N. Y.

438,891. Electrical Speculum. Samuel H. Linn, Rochester, N. Y.

438,894. Trolley Switch for Electric Railways. Henry W. Marcy, Utica, N. Y.

438,897. Magnetic Separator for Paper Pulp. Francis H. Richards, Hartford, Conn.

438,934. Insulator. Fidel Miro, Cienfuegos, Cuba.

438,982 Telephone Exchange Apparatus. Franklin G. Beach, Chicago, Ill.

439,011. Arc Lamp. John Kent, London, England.

439,015. Electric Station Indicator. George H. Kirwan, Wilkesbarre, Pa.

439,017. Apparatus for the Rhythmic Generation of Electric Currents. Charles Langdon Davies, London, England.

The claim reads as follows:

"An instrument for generating rhythmic electric currents, consisting of a temporary magnet, a contact stop, a single circuit closer, and a vibrator co-operating with the circuit closer, whereby the periods of transmission and of cessation of impulses are equalized."

439,023. Device for Raising and Lowering Electric or Other Lights. David B. Matson, Watkins, N. Y.

439,042. Electrical Transmission of Power. William Stanley, Jr., Great Barrington, Mass.

439,047. Electric Lamp Socket with Regulating Attachment. William F. Wollin and Elmer H. Werline, York, Pa.

439,055. Electrically Controlled Lock for Fire Arms. Albert von Derschau, Emden, Germany.

439,069. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

439,070. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

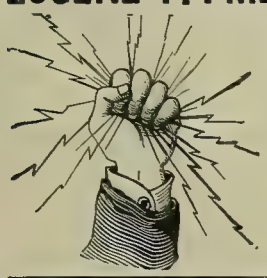
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

Cheaper than Overhead Wires,

MORE THAN TEN TIMES AS DURABLE.

Guaranteed to stand a pressure of 100,000 volts when used for Electric Light Mains. Write for Estimates to the

Brooks Underground Telegraph Co., 207 Walnut Place, Room 5, Philadelphia.

THE TURNER BRASS WORKS
4 LASALLE AVE
MAKE ANYTHING IN BRASS. CHICAGO.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

FRANK T. BROWN, Late

PRINCIPAL EXAMINER ELECTRICITY,

U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 8½x10 Armington & Simms Automatic Engine.

One 20-Light Fuller-Wood Arc Light Dynamo and Lamps.

A. L. IDE & SONS,

SPRINGFIELD, ILL.

BUSINESS CHANCE.

WANTED.

To place, at a bargain for buyer, within 30 days, a Steam Engine and Boiler plant. No real estate.

Address,

"CODAC,"

Care of WESTERN ELECTRICIAN.

DO YOU USE

THE LAW BATTERY?

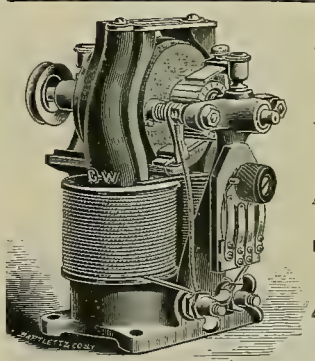
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

LAMP SOCKETS FOR SALE CHEAP. We have about 100 new, both Key and Keyless Sawyer-Man Lamp Sockets. Will sell lot very cheap. Address "SOCKET," WESTERN ELECTRICIAN, Cleveland Office, 1-5 Superior Street.



THE **CROCKER-WHEELER**

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base - Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Prest.

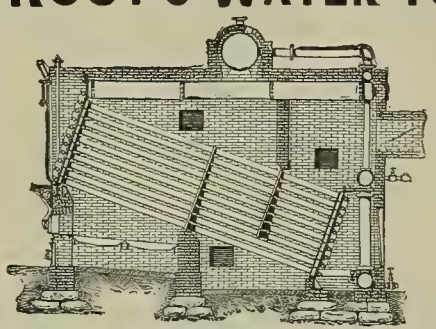
NO LOSS OF CANDLE POWER.

FOR PARTICULARS WRITE

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— **INTERNATIONAL OKONITE COMPANY, Limited, - - 13 Park Row, NEW YORK.**

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

STANDARD ELECTRIC TEST INSTRUMENTS

AMMETERS AND VOLTMETERS

For Direct and Alternating Currents.

QUEEN'S NEW PORTABLE COMBINATION TESTING SETS

With Galvanometers.

☞ We pay special attention to recalibrating Ammeters and Voltmeters.

Send for Catalogue **1--66** of Electric Test Instruments.

QUEEN & CO., PHILADELPHIA.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1 00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

FOR SALE.

One 15-light	50	volt Dynamo
One 25-light	50	volt Dynamo
One 50-light	50	volt Dynamo
One 75-light	110	volt Dynamo
One 100-light	110	volt Dynamo
One 150-light	110	volt Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

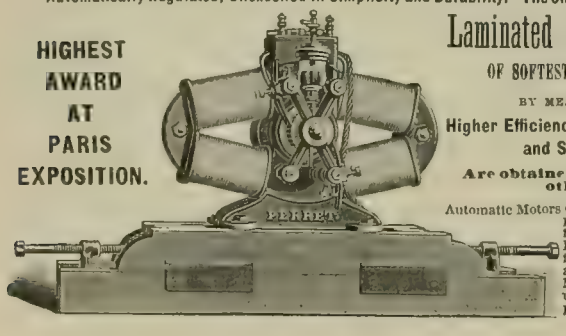
79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets

OF SOFTEST CHARCOAL IRON,

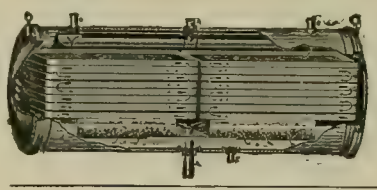
BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting, Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

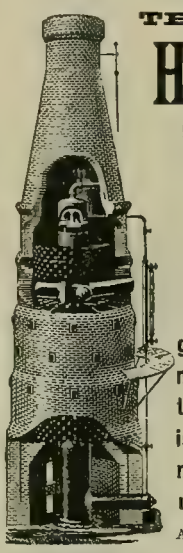
Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.

THE

Hazelton Tripod Boiler.



Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental

MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

BALL AUTOMATIC CUT OFF ENGINE

MADE ONLY BY THE BALL ENGINE CO ERIE PA.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

---

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

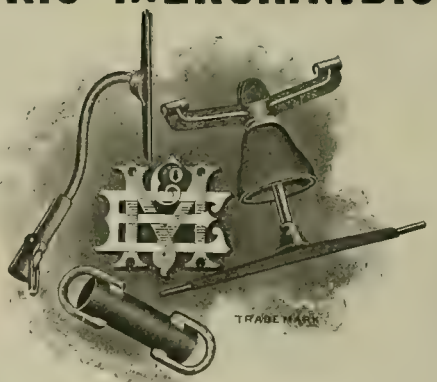
OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS, ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

Electric Light and Street Railway Goods a Specialty.

SEND FOR CATALOGUE AND SPECIAL PRICES.

ELECTRIC MERCHANDISE CO.

Standard Devices for all Systems.



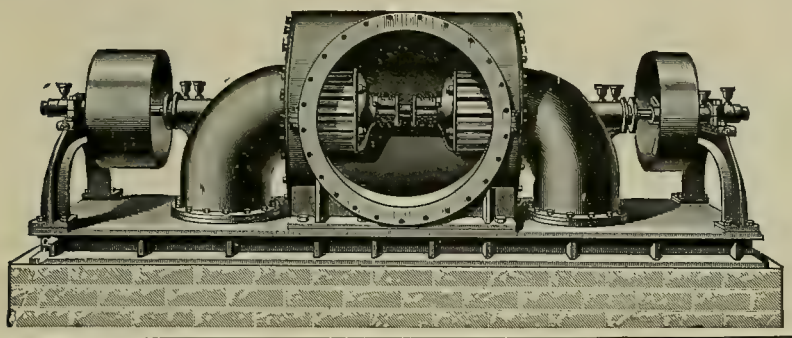
11 Adams St., Chicago.

CATALOGUES FURNISHED.

W. R. MASON, General Manager.

ELECTRIC RAILWAY SUPPLIES.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

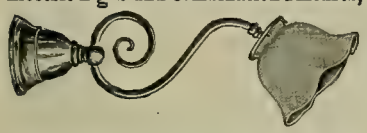
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

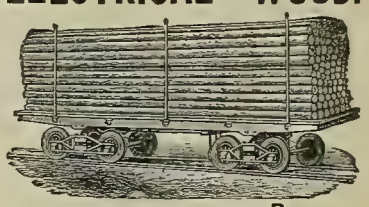
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.

Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

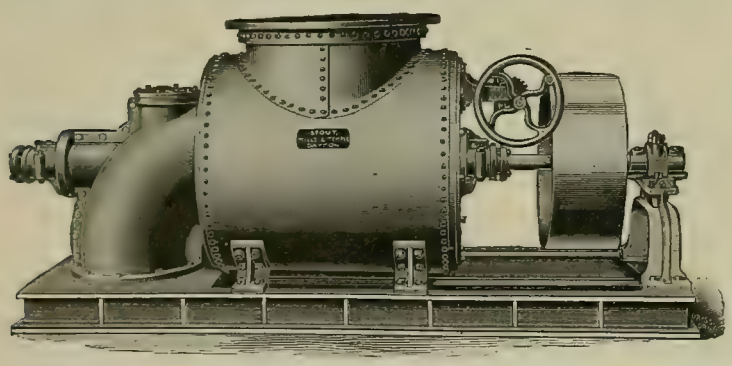
GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

Electrical Testing Apparatus manufactured to order, repaired or calibrated.

WESTERN ELECTRIC COMPANY, - - NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

ADVANTAGES OF THE EVANS SYSTEM OF DRIVING DYNAMOS.

ECONOMY IN ROOM.

No loss of room by reason of long lines of belting. All the space is made available. More than double the number of dynamos can be put in the same space than by ordinary belting. In the erection of new stations, or the increase of old, an immense saving is realized.

EFFICIENCY.

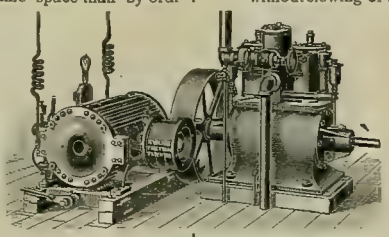
There is no slip. Consequently there is less loss of power in transmission, and a steady light is obtained. There is also less pressure on the bearings than by ordinary belting for the same amount of power.

SAVING IN BELTS.

Belts cost less than one-tenth of ordinary belts, and last over twice as long. The saving in belts alone nearly pays the royalty.

SIMPLICITY AND COMPACTNESS.

The dynamo pulley is placed in immediate contact with the driving pulley. No expensive clutches or complicated belt holders are necessary. The Evans Friction is a perfect clutch in itself.



PERFECT CONTROL.

Each and every dynamo can be stopped or started independently of every other without slowing or stopping the engine or other motive power.

FOR POWER GENERATORS.

Where the load is intermittent and subject to sudden changes, as in street railway work, the Evans Friction adapts itself promptly and effectively to the work without the "flop" or unsteady motion of ordinary belting.

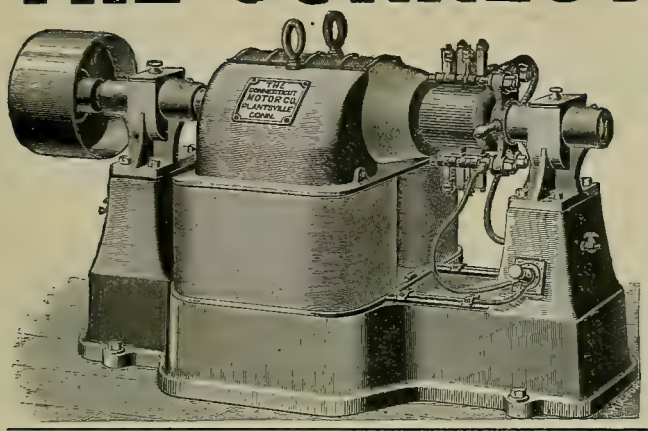
CLEANLINESS.

The Evans System does away with long flying belts which carry a large amount of dust, and not only is the room cleaner but the bearings are freer from grit.

For SIMPLICITY, COMPACTNESS, ECONOMY, EFFICIENCY and CLEANLINESS, the EVANS SYSTEM surpasses anything yet devised for driving dynamos.

{ *This Ad. will be changed Sept. 15.* } Send for Catalogue "D" to ***The EVANS FRICTION CONE CO., 85 Water St., Boston.***

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 N. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

John A. Roebling's Sons Co.,

MANUFACTURERS OF

BARE AND INSULATED WIRES

FOR ALL PURPOSES.

ALSO WESTERN AGENTS FOR

SAFETY INSULATED WIRE AND CABLE COMPANY'S

SEAMLESS RUBBER WIRE.

Of the many attempts during the last ten years to make a reliable RUBBER INSULATED WIRE none has been so successful as that of the SAFETY INSULATED WIRE. Investigate the merits of this WIRE and you will become convinced of its great insulating qualities.

We Carry the largest Stock of the above Wires in the west at our

WAREHOUSE, 171--173 LAKE STREET, CHICAGO, ILL.

Works, Trenton, N. J. GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.
FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

BALTIMORE, M.D.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

OKONITE TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

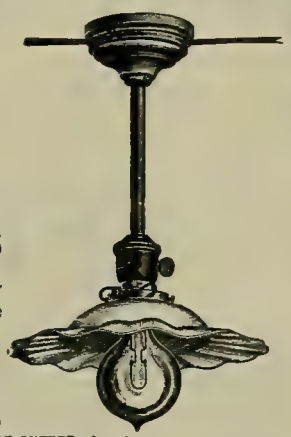
Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE. 190 Fifth Ave., GEORGE CUTTER, Agent.

BARNES' NEW SENSITIVE DRILL

Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

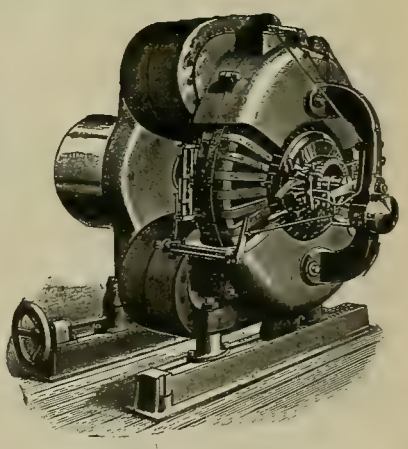
Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators. Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

EXCELSIOR ELECTRIC CO.

(HOCHHAUSEN SYSTEM.)
MANUFACTURERS OF

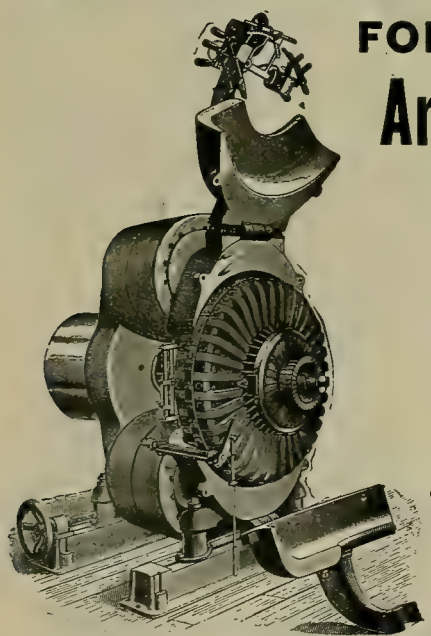
Arc and Incandescent Apparatus



FOR LIGHTING,

Arc AND Incandescent Motors,

Electro-Plating and Electro-Deposition Machines.



Distinctive Features

LIGHTEST WEIGHT, LARGEST OUTPUT, LEAST POWER REQUIRED,
HIGHEST EFFICIENCY AND LEAST FLOOR SPACE.

MOST PERFECT AUTOMATIC REGULATION.

The New Arc Lighting System of this Company is the MOST SIMPLE, PERFECT and ECONOMICAL on the market.

For estimates and other information, address:

WESTERN OFFICE:
No. 425, THE ROOKERY, CHICAGO, ILL.

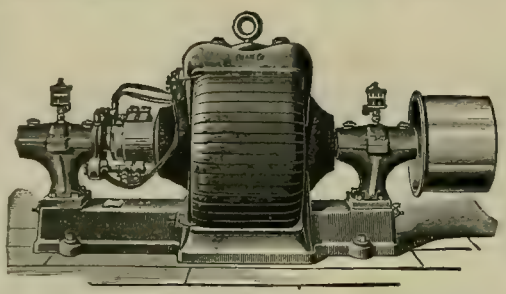
NEW YORK OFFICE:
115 BROADWAY, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

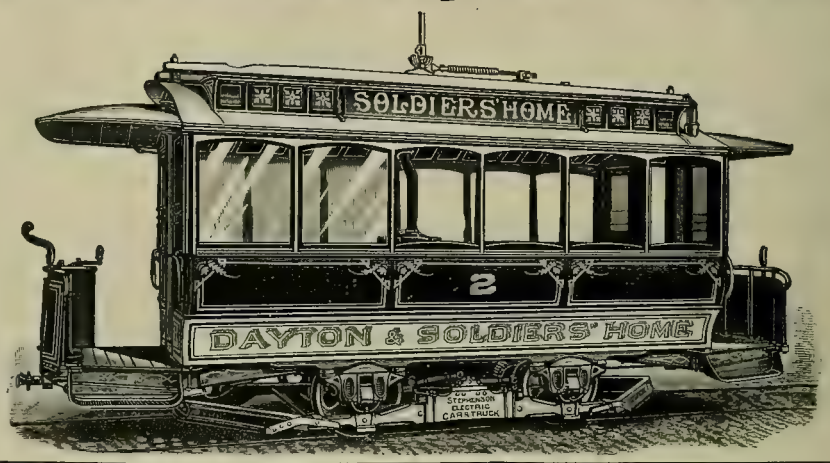
NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.



EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP ... and 1914 Olive ...

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

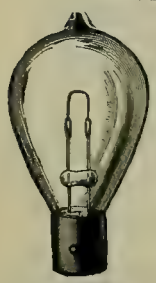
In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

E-D-I S-O-N

Miniature Incandescent

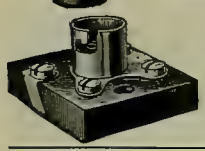
ELECTRIC LAMPS.



1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions



How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

ELEMENTS OF ELECTRIC LIGHTING.

BY PHILIP ATKINSON, Ph. D.

260 Pages, Cloth Binding, Illustrated, Price $1.50.

This book is an elaboration and revision of the popular series of articles which ran through the Western Electrician under the same title. It treats of: Principles of the Dynamo; Alternate Current Dynamos; Direct Current Dynamos; Electric Terms and Units; Electric Measurements The Arc Lamp; The Incandescent Lamp; The Storage Battery; Electric Distribution.
Sent, postage prepaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, Chicago

GEORGE P. BARTON,

LAW OFFICE,

225 Dearborn Street CHICAGO, ILL

PATENT AND TRADE MARK CASES.

DICTIONARY

—OF—

ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

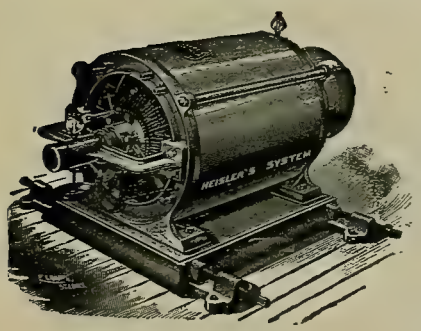
4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. **CORRESPONDENCE SOLICITED.**

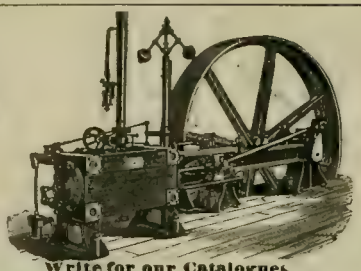
HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



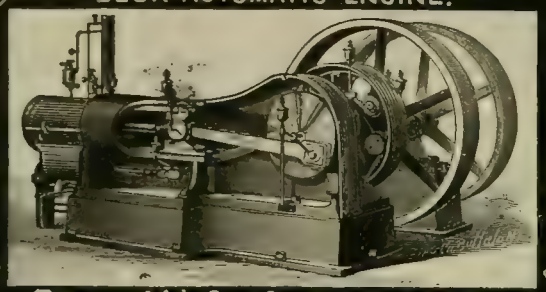
Write for our Catalogues

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.
ECONOMY UNEXCELLED
REGULATIONS PERFECT
HOT BEARINGS UNKNOWN
PRICES MODERATE



TAYLOR MFG CO. CHAMBERSBURG, PA.
COMPLETE STEAM PLANTS A SPECIALTY

PRIMARY BATTERIES
For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,
MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

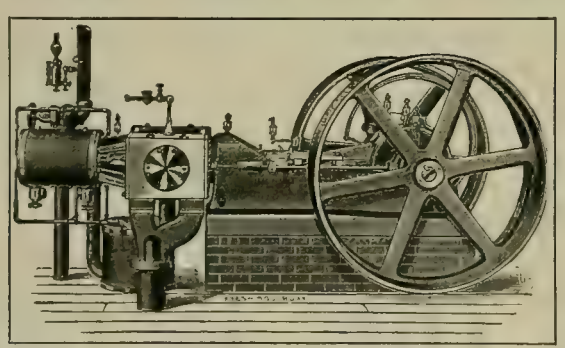
COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.
Guaranteed as represented.
These Batteries are in practical use, and giving perfect satisfaction.

Cleverly
1018 CHESTNUT ST.
PHILA.

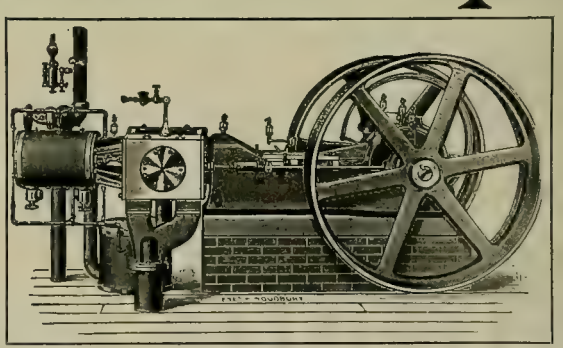
Electric Specialties
—WE MAKE—
Electric Supplies Under Contract.

ARMATURES REPAIRED and REWOUND
COMMUTATORS TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

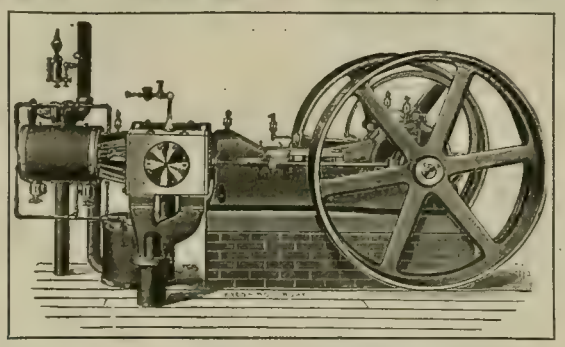
None so Good, None to Equal.



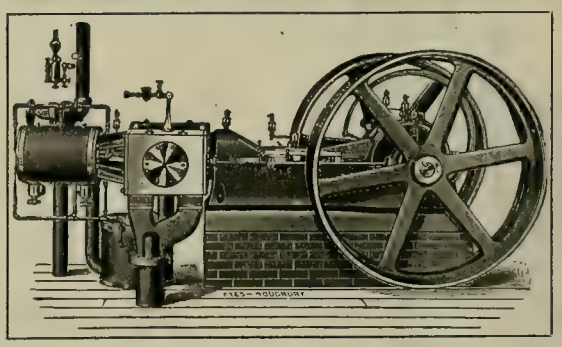
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



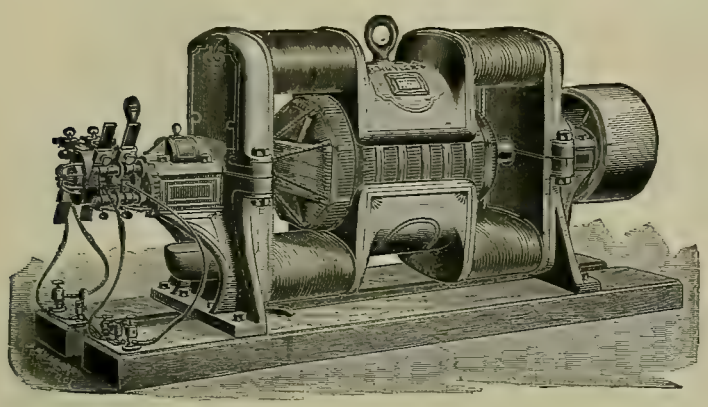
WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature. proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. **Compound and Valveless.**

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

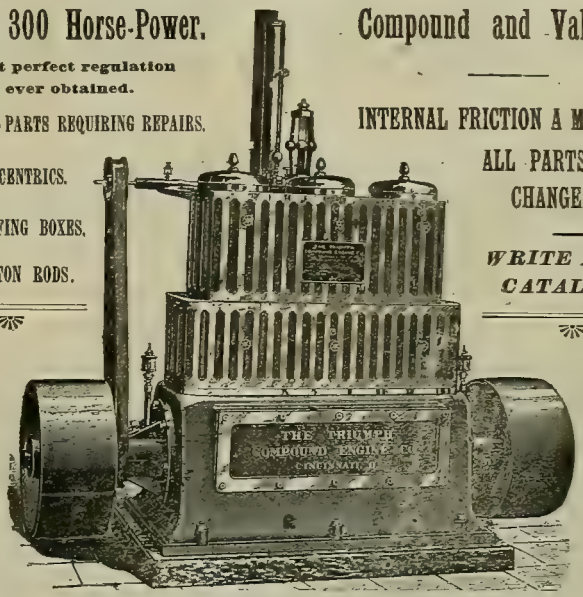
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

Trade Mark Registered.

For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

The LECLANCHE BATTERY CO., NEW YORK.

THE

THOMSON-HOUSTON ELECTRIC CO.'S

RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

Companies desiring Centre Pole Construction should see the Indianapolis Plant, illustrated below. Also Washington, D. C., Rochester and Brooklyn, N. Y.

Citizens' Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

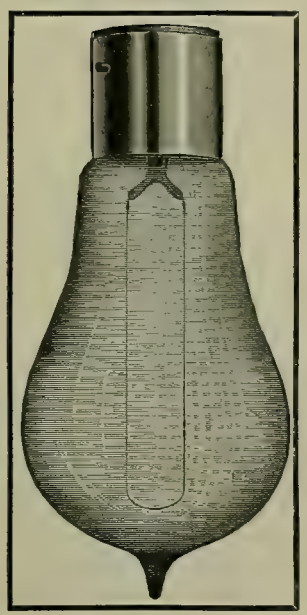
PRINCIPAL OFFICES:

BOSTON,
620 Atlantic Ave.

CHICAGO,
148 Michigan Ave.

ST. PAUL,
408 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

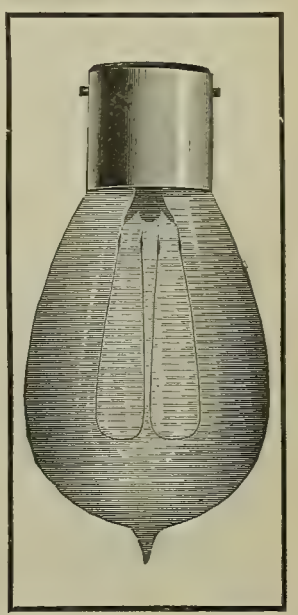
—THE—

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

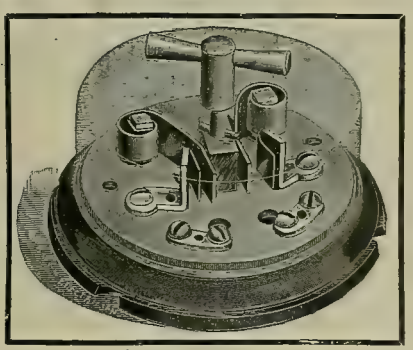
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

—WE CALL SPECIAL ATTENTION TO—

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

—FOR—

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

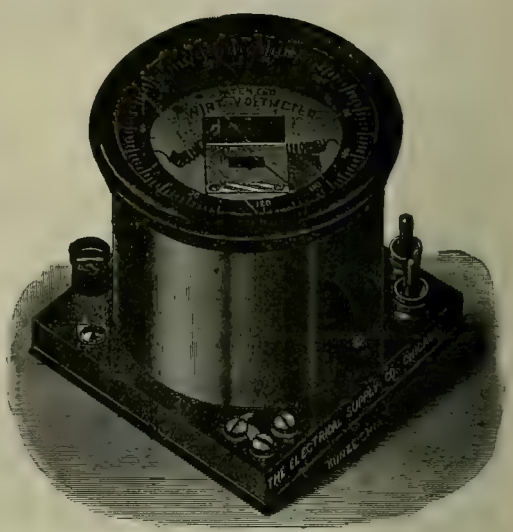
NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.

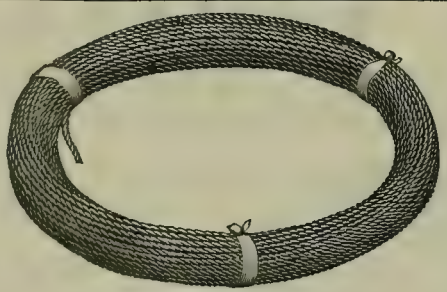
171 RANDOLPH ST.

CHICAGO.

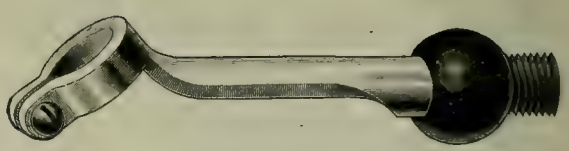


THE ELECTRICAL SUPPLY CO
SUNBEAM
INCANDESCENT LAMP
CHICAGO ILLINOIS U.S.A.

Try Them.

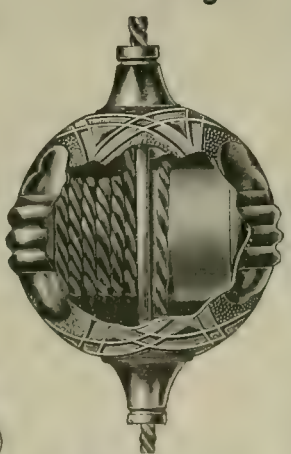


Lamp Cord.



Universal Gas Attachment.

The Bradner Adjustable Hanger.



With Cover Removed.

In Operation.

HABIRSHAW.

The best rubber covered wire.

SHIELD BRAND.

The best weatherproof and only moistureproof line wire.

THE AJAX.

The BEST and only reliable dry battery.

FUSE WIR.

Guaranteed and accurately determined.

Habirshaw Duplex Fixture Wire.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES.
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.

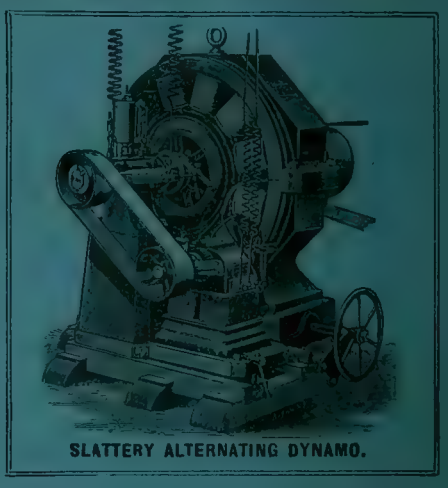
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

The Consolidated Electric Storage Co.,

MANUFACTURERS OF

THE JULIEN
ELECTRIC STORAGE BATTERY.

Exclusive licensees for the whole of the United States of the Storage Battery Patents of Charles F. Brush [lately owned by the Brush Electric Company], and sustained by the Circuit Court of the United States.

Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

BATTERIES FOR LIGHT AND POWER,

Sold at Prices so Low as to Defy Competition.

For Agencies and Licenses apply at the Company's Office at

120 BROADWAY, NEW YORK CITY.

All other inquiries, more especially those in relation to Purchase of Batteries, should be addressed to the Philadelphia Office of the Company.

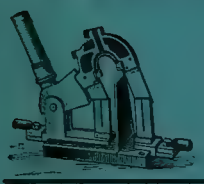
926 Drexel Building, PHILADELPHIA, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, NOVEMBER 8, 1890. No. 19

"AJAX SWITCHES"

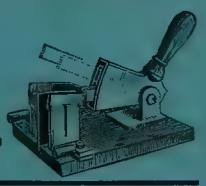


In all Sizes, for any Potential,
Single, Double and Treble Pole

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,
74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas.
{ PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin'

ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4⅞-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

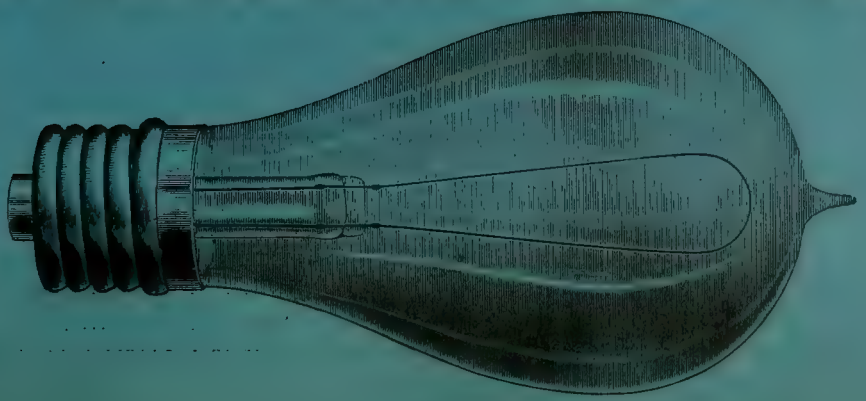
Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York,
{ 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

Edison



Lamps.

FOR PRICES . . . . . SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave, CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment.

Electric Motors.

A REMARKABLE GROWTH.

[From the *Electrical World*, New York, March 20th, 1889.]

Electric Lighting by Gas Companies.*

In *Progressive Age* for October 1, 1888, was published a list of gas companies operating electric lighting plants; in the present number we repeat the list, with the most complete additions and corrections it has been possible to obtain, down to the hour of going to press. The former list was far from being complete, notwithstanding every effort was made to have it so, and there are undoubtedly numerous omissions from the present one, though it is beyond question more nearly perfect than the other.

From the list published last October it appeared there were at that time 153 gas companies operating a total of 12,834 arc lights, of 13 different systems. The list now published shows a total of 266 companies, operating a total of 21,313 arc lights and 55,890 incandescents. The number of different systems represented is 21. The systems and number of lights of each in use by the companies represented in the list are as below. But it is pertinent to state here that some companies in the list have failed to furnish us either system or number of lights, others operating two, three or four different systems only the aggregate number of lights. Taking the figures as they stand they make this showing:

System.	Arc.	Inc.	Total.
Thomson-Houston	11,084	8,826	19,910
Brush	3,964	.....	3,964
Westinghouse	.....	27,710	27,710
Edison	.....	10,256	10,256
American	1,813	2,875	4,688
United States	250	4,425	4,675
Schuyler	734	.....	734
Ball	613	.....	613
Western Electric	566	250	816
Indianapolis Jenney	794	.....	794
Fort Wayne Jenney	185	750	935
Jenney (Ind. or Ft. Wayne not specified)	324	.....	324
Van Depoele	285	.....	285
Waterhouse	222	.....	222
Heisler	.....	500	500
Remington	159	300	459
Sperry	130	.....	130
Excelsior	90	.....	90
Hochhausen	60	.....	60
Weston	30	.....	30
Fuller	10	.....	10
Total	21,313	55,890	77,203

Grand total of Arc and Incandescent lights, 77,203.

This exhibit is an evidence of the rapidly growing conviction on the part of gas companies that the proposition, which it is well understood *Progressive Age* was first to advance, that gas and electric light supply should be entered into by gas companies, is unquestionably correct, and it is safe to predict that a republication of the list six months hence will see it again doubled.

Progressive Age, March 15, 1889.

[From the *Electrical World*, New York, June 14th, 1890.]

Electric Lighting by Gas Companies.

From Brown's Gas Directory, noticed by us last week, we gather some interesting statistics of the increasing use of electricity by gas companies throughout the country. We have previously referred to these figures, and now take pleasure in presenting them in full. In the following table will be found the number of arc and incandescent lights now run by gas companies, with the system adopted:

System	Arc.	Inc.
Thomson-Houston	16,927	[illegible]
Brush	6,090	4,259
Westinghouse	321	49,467
Edison	...	[illegible]
American	1,537	[illegible]
United States	632	6,141
Schuyler	1,766	.....
Ball	962	6
Western Electric	788	.....
Fort Wayne	1,756	8,005
Van Depoele	450	.....
Waterhouse	287	.....
Heisler	.....	[illegible]
Remington	129	.....
Sperry	160	.....
Excelsior	205	80
Hochhausen	70	.....
Weston	138	.....
Fuller	10	.....
Reliance	30	.....
National	.....	1,000
Bernstein	.....	215
Total	31,558	132,771

The very great growth of this branch of the electrical industry during the past year is shown in the following figures:

	1889	1890.
Number of gas companies operating electric lights	266	304
Number of different electric light systems used	21	23
Number of arc lights operated	21,313	31,558
Number of incandescent lights operated	55,890	132,771

It is no wonder that *Progressive Age* is moved to remark that "The model illuminating plant of the future will be an establishment that supplies gas and electricity for illumination; gas for fuel and power; electricity for power, whose management industriously pushes sales of stoves and other gas-consuming appliances." The gas-works of the future, brother, will furnish non-illuminating gas for electric light engines.

The following table, which has been compiled from the data obtained from the clippings reproduced above, requires no explanation or comment, and **THE SYSTEM** which is being used more generally by Gas Companies than **ALL OTHER SYSTEMS COMBINED** can have no better commendation than this fact, when it is considered that Gas Companies, in buying electric lights, look

FIRST. For a system that **CAN NOT BE APPROACHED** in point of perfection, so that they can always offer better lights than their competitors.

SECOND. For the **MOST ECONOMICAL** system, which not only insures them maximum profits from the business obtained, but makes it possible for them to supply lights at a profit, at prices that would ruin their competitors.

THIRD. For a system that is **ABSOLUTELY RELIABLE.**

It will be borne in mind that these figures include only the sales to Gas Companies, and do not touch upon those made to Electric Lighting companies, Water-works companies and private parties, aggregating 70,000 Arc and 278,000 Incandescent lights.

	Arc Lights.		Incandescent Lights.			Arc.		Incandescent.	
	March 20, 1889.	June 14, 1890.	March 20, 1889.	June 14, 1890		T. H. System.	All other Systems	T. H. System.	All other Systems.
Total number of lights in use by Gas Companies	21,313	31,558	55,890	132,771	Lights in use as per clipping, June 14, 1890.	16,927	14,631	45,055	87,716
THOMSON-HOUSTON lights by Gas Companies	11,084	16,927	8,826	45,055	Lights in use as per clipping, March 20, 1889	11,084	10,229	8,826	47,064
Number lights of all other systems by Gas Companies	10,229	14,631	47,064	87,716	Increase	5,843	4,402	36,229	40,652
Proportion of Thomson-Houston to whole number of lights	52%	53 6-10%	15 7-10%	33 9-10%	Percentage of increase	52 7-10%	43%	410%	86 8-10%

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co.....xxviii
Abendroth & Root Mfg. Co.. —
Alexander, Barney & Chapin. xii
Allis, E. P. & Co.....xxii
American Electrical Works. . xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co..... vii
Baggot, E..... xvi
Bain, Foree..... xvi
Ball Engine Co..... —
Barnes, W. F. & Jno..... xxi
Barton, Geo. P..... —
Baxter Electric Motor Co.....xxviii
Bernstein Electric Co..... —
Bleckert & Nelson..... xvii
Brown, Frank T..... xv
Brooks Underground Tel. Co. xv
Brush Electric Co.....xxvii
Bunnell & Co., J. H..... —
Butler Hard Rubber Co..... xx
C. B. & Q. R. R..... xvi
C. & C. Electric Motor Co... ix
C. & N. W. R. R. Co..... xvi
Central Electric Co..... xi
Chicago Electric Club..... xxii
Cleverly Electrical Works... xxii
C. M. & St. P. R. R. Co..... xvi
Colburn & Co., I. W..... xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... —
Consolidated Electric Storage Co..... —
Continental Dynamo Co..... iv
Cowles Electric Smelting and Aluminum Co..... xv
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... —
Day's Kerite Insulation Co.... i
Dayton Globe Iron Works Co. xviii
Eastern Electric Cable Co. xv
Eddy, Henry C..... xv
Edison Mfg. Co..... ix
Edison General Electric Co.,— Lighting Dept..... —
Edison General Electric Co.,— Lamp Dept.....i, viii
Electric Construction & Sup. Co iv
Electric Merchandise Co..... xvi
Electrician Publishing Comp'y .....xvi, xix, xxi
Electrical Supply Co.....xxvi
Elektron Mfg. Co..... xvi
Empire City Electric Co.....xviii
Empire China Works..... xvi
English, Morse & Co..... xvii
Eureka Tempered Copper Co.. xvii
Evans Friction Cone Co..... xix
Excelsior Electric Co..... —
Fibrone Mfg. Co..... xv
Fletcher & Fletcher Electric Co xv
Forest City Electric Works.... xx
Fort Wayne Electric Co..... xxviii
Gibson Gas Fixture Works... xviii
Globe Carbon Co..... xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S..... xiv
Harmount, G. A..... vii
Hawkeye Electric Mfg. Co.... —
Hazelton Tripod Boiler Co... xvi
Heisler Electric Light Co..... —
Hill Clutch Works..... xx
Holmes, Booth & Haydens.....xvii
Holmes & Co., C. H..... xvii
Holtzer-Cabot Electric Co..... i
Humphrey, H. H..... xiv
Ide, A. L. & Son... xv
Illinois Electric Material Co.... xiv
India Rubber & Gutta Percha Insulating Co..... i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L.. ..... —
Jewell Belting Co..... xv
Jones Bros. Electric Co..... xxii
Knapp Electrical Works..... xxv
Laminar Fibre Goods Co..... xvii
Law Telephone Co..... xv
Leclanche Battery Co.....xxiii
Magnolia Anti-Friction Metal Co i
Mason, James H..... xxi
Monitor Electric Co..... vii
Munsell & Co., Eug..... xv
Munson Belting Co., Chas..... xiv
National Carbon Co..... iv
National Conduit Mfg. Co... —
National Electric Mfg. Co..... x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T... ... xxii
N. Y. Belting & Packing Co.... —
Okonite Co..... xv
Ostrander & Co., W. R. xviii
Page Belting Co..... —
Paiste, H. T..... xiv
Peckham Street-Car Wheel & Axle Co..... vii
Partrick & Carter xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co..... —
Pond Engineering Co..... xxi
Powell Co., Wm..... —
Pumpelly Storage Battery Co. xxi
Queen & Co..... xv
Roeblings' Sons Co., Jno. A... xix
Sawyer-Man Electric Co..... xiii
Schieren & Co., Chas. A..... xiv
Schoverling, A..... xxi
Schuyler Electric Co.....xxiii
Shultz Belting Co..... xx
Southern Electrical Supply Co. xx
Sperry Electric Co..... xviii
Standard Electrical Works... xvi
Standard Paint Co..... xiv
Standard Underground Cable Co. i
Standard Carbon Co..... xx
Stanley & Hall..... xiv
Star Electrix Co..... vii
Stephenson & Co., Jno ix
Stiff, E. D. & Co.... xiv
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xxi
Sunbeam Incandescent Lamp Co —
Taussig, S..... xvi
Taylor Mfg. Co..... xxii
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxiv
Triumph Compound Engine Co xxiii
Tripp Mfg. Co..... —
Turner Brass Works..... xv
Union Hardware Co..... xiv
United Electric Traction Co....xxiii
United States Electric Lighting Co..... xiii
Van Nuis C. S..... i
Wanted..... .. xv
Western Electric Co xviii
Western Electrician..... —
Western Power Construction Co. xxii
Westinghouse Electric Co..... —
Weston Electrical Instrument Co..... xiv
White, R. T..... iv
Wollensak, J. F..... xvi
Woodbridge & Turner..... xvii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Aluminum.
Cowles Electric Smelting & Refining Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanché Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.

Belting—continued.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brooks Underground Telegraph Co.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
River & Rail Electric Light Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
White, R. T.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Eddy Electric Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Gibson Gas Fixture Works.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.

Lamps, Incandescent—Con'd
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Eddy Electric Manufacturing Co.
Elektron Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
The River & Rail Electric Light Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank T.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Eddy Electric Mfg. Co.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Tripp Mfg. Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

DAISY CHAIR

For T Girder or Rail, having a T Form of Base.

R. T. WHITE,

PATENTED MATERIAL FOR

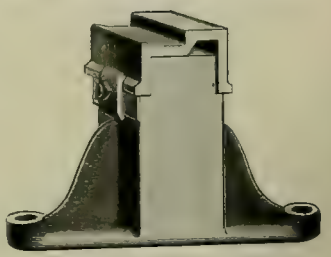
STREET RAILWAY ROAD-BEDS

Also **Cable, Electric and Elevated Railways.**

12 PEARL STREET, Rooms 6 and 7, BOSTON, MASS.

NEW YORK OFFICE, 52 Wall Street, Room 41.

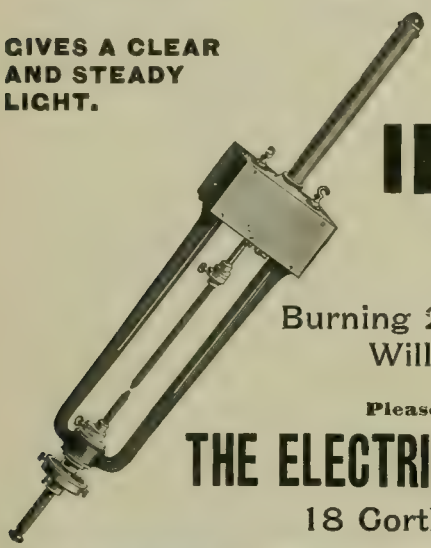
Patented January 28, 1890—No. 420,135. *CORRESPONDENCE SOLICITED.*



EUREKA CHAIR

For Channel Iron Form of Rail.

GIVES A CLEAR AND STEADY LIGHT.



THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use Only 8 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

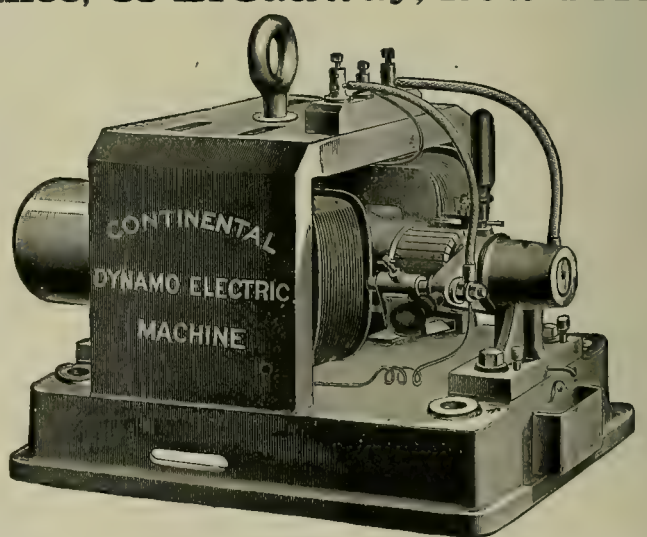
87 and 89 South Fifth Avenue, - - NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2 Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190-192 Fifth Avenue, CHICAGO.

DESIGNERS
—OF—
Electric Railway Specialties.

MAKERS
—OF—
Choice Electric Supplies.

DEALERS
—IN—
Standard Electrical Goods.

POLES

Of Extra Strength in all Sizes and Styles.

PLAIN WOOD POLES:
GET OUR PRICES.

OCTAGONAL WOOD POLES.
NEAT AND LOW PRICED.

POLES

ANGLE IRON POLES

Superior to pipe poles at about half the cost.

Our 28-foot pole will stand a strain of 3,000 pounds without deflection.

LATTICED CORNER POLES.

Extra strong and stiff. Will stand all strains met in practice without appreciable deflection.

BRACKETS

Of angle iron. Stronger and neater than those made of piping. Maintain their shape perfectly.

Try us on

BRACKETS AND POLES.

IF YOU WANT MATERIALS

That have the greatest strength,
That give the highest practical insulation,
That pay best in the end,

TRY US FOR YOUR SUPPLIES.

TREBLE CURVE INSULATOR.

Gives the Greatest Strength and the Highest Insulation. Try it and you will use no other.

RESISTS ABRASION AND GIVES THE HIGHEST LINE INSULATION.

SIMPLEX WIRE.

THE WIRE THAT PAYS BEST IN THE LONG RUN.

Try it for mains and you will always use it.

For lines in mines or among trees it is unequaled.

SEND FOR A SAMPLE.

ALL-COPPER RAILBONDS.

SEND FOR A SAMPLE.

Have practically no resistance. Are quickly and cheaply applied. Will not oxidize.

WATCH FOR NEW ADDITIONS TO OUR

Electric Railway Specialties.

We insist on having only the very best, and that at figures which will command your orders.

ALL OF OUR

SPECIALTIES

WEAR WELL.

Prove it for yourself by trying them.

Our place at 190-192 FIFTH AVENUE is the

HEADQUARTERS

For Electric Railway Supplies

In any quantity,
For any system,
And to meet any circumstance.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

405 Sibley Street, ST. PAUL. PORTLAND, ORE., Branch, 266 1st St.

ELECTRICAL SUPPLIES.

Having recently reorganized our supply department and greatly enlarged our quarters, we are prepared to fill all orders promptly, from our stock, to which we would call attention as the largest and most complete line of **ELECTRIC SUPPLIES,** in the Northwest. We invite correspondence and will cheerfully quote prices or give any information in our power.

WRITE TO US FOR PRICES ON CARBONS.

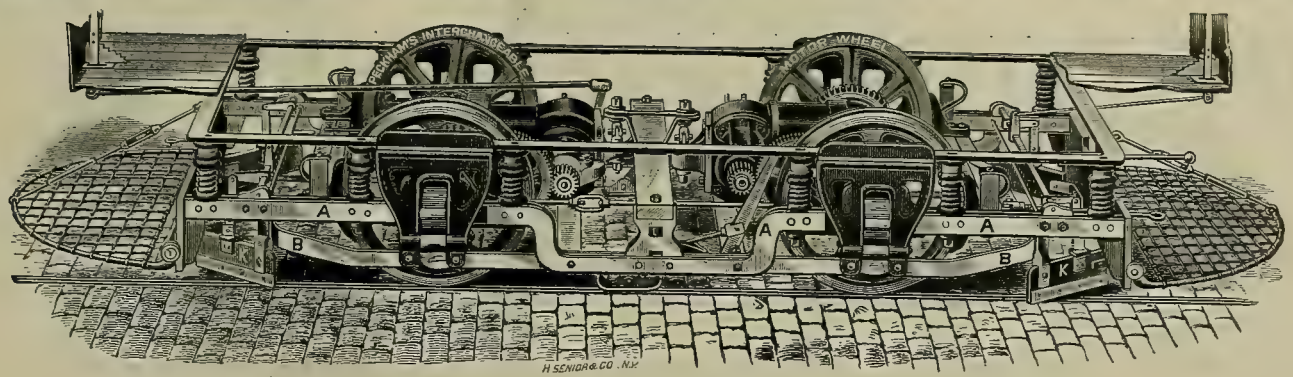
Let us quote you bottom figures on

Wire and Incandescent Lamps.

A large line of Porcelain Articles constantly on hand.

Send for CATALOGUE and DISCOUNT SHEET.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

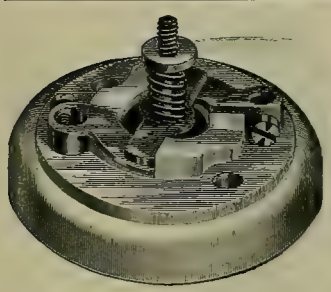
WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

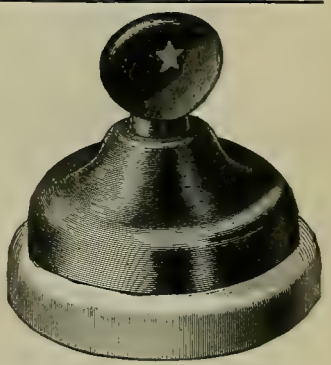
For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

NOTICE!



We desire to call the attention of Central Station Managers and Superintendents, Contractors and Dealers, to our Electrical Specialties which embody the most recent improvements in their respective lines, and are entirely new and "taking" with the electrical fraternity.



Now ready: Five and ten ampere S. P. Switches, plain and insulated gas attachments. Will soon have complete line of D. P. Switches, cut outs, sockets, etc., etc. Dealers can not afford to miss this opportunity. Samples, prices and discounts promptly furnished.

THE STAR ELECTRIX COMPANY, 1320 WALLACE STREET, PHILADELPHIA, PA.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM
AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

EDISON LAMPS

16 C. P. - - 44 CENTS EACH.

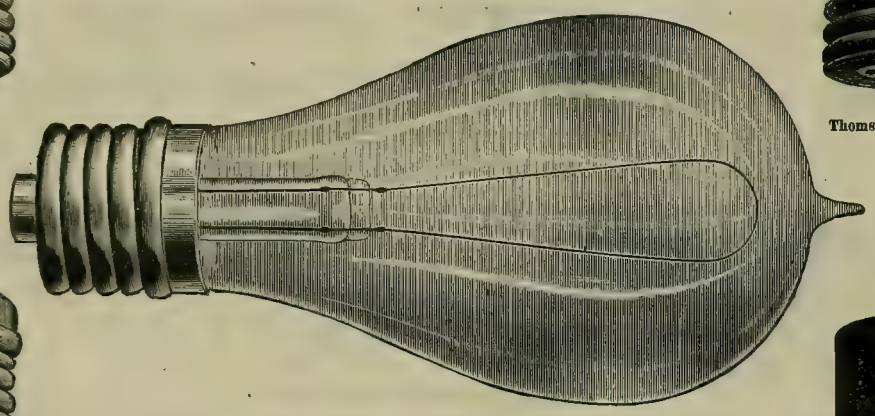
PRICE REDUCED ONE-THIRD!!!

16 C. P. Lamps. 12 to the H. P. 600 Hours Average Life.

No. 1, Edison Base.

No. 2, Thomson-Houston Base.

The Edison Incandescent Lamp.



No. 3, Westinghouse Base.

No. 4, United States Base.

Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge.

From Nov. 1st, 1890, Subject to Change Without Notice.

16 C. P. Lamps, List Price, 80 Cents Each.	Net Price.	Discounts for Larger Lots Quoted on Application.
Discount in Lots of 25 to 150,.....45%	44 cents each.	
" " 150 to 500,.....47½%	42 " "	
" " 500.....50%	40 " "	

Allowance for Old Bases, $1.35 per 100, f. o. b., Newark, N. J.

Write for Circulars and Price List to Nearest District Office or any Electrical Supply House.

EDISON GENERAL ELECTRIC COMPANY.

MAIN DISTRICT OFFICES.

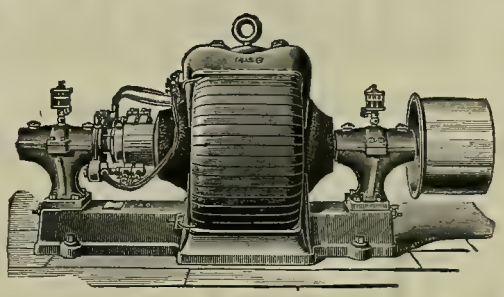
Eastern District, 16 & 18 Broad Street, New York.
Central District, Rialto Building, Chicago, Ill.
Southern District, Cotton Ex. Bldg., New Orleans, La.
Mountain District, 730 Seventeenth St., Denver Col.
Pacific Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Northwestern District, Fleischner Bldg., Portland, Ore.
New England District, 38 Pearl Street, Boston, Mass.
Canadian District, Bank of Commerce Bldg., Toronto, Can.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.

EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP

and 1914 Olive

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

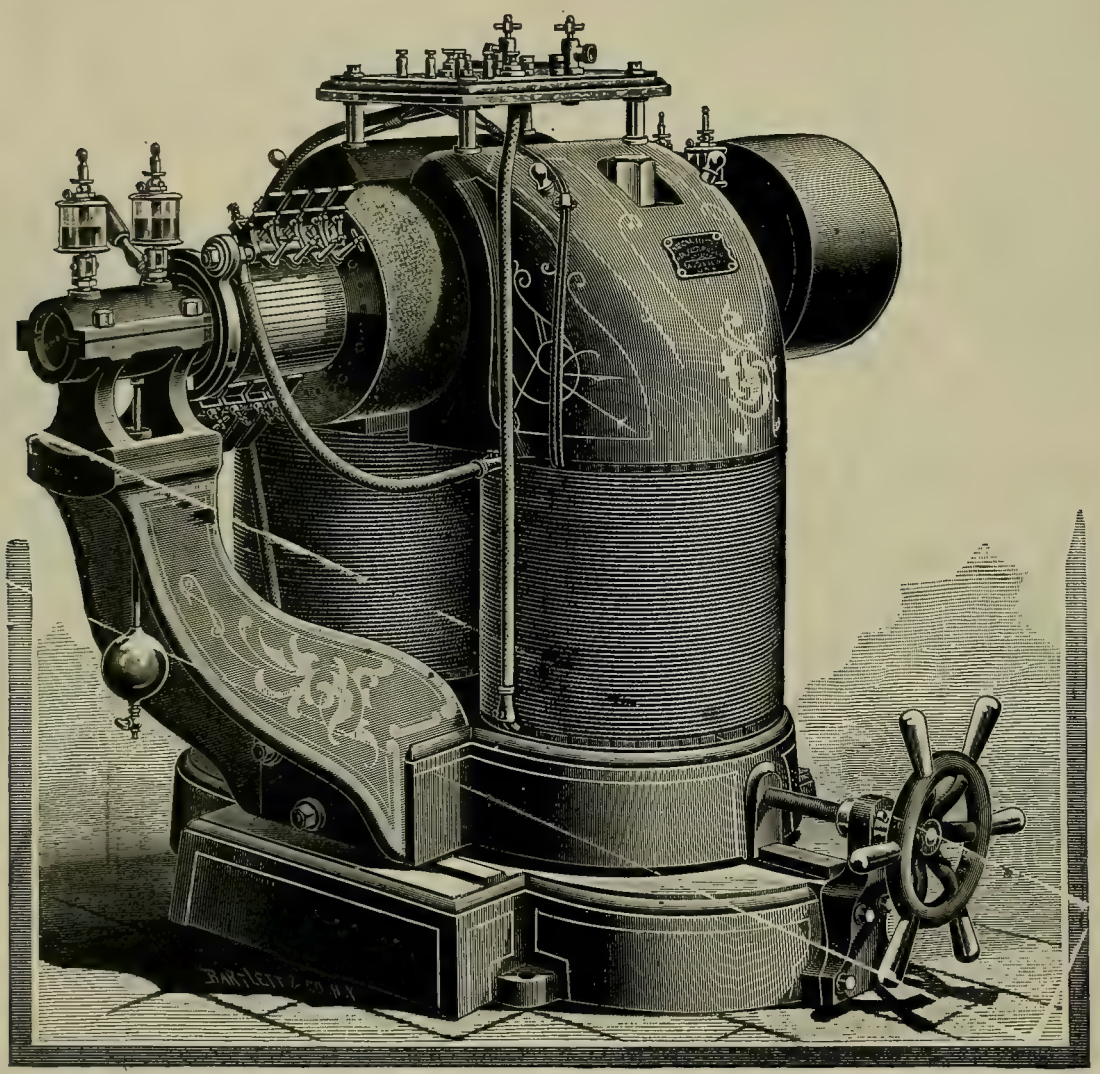
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMO ,CAPACITY 500 16 C. P. LAMPS.

COMPLETE

Central Station Equipments

—FOR—

LIGHT OR POWER

DISTRIBUTION.

OUR APPARATUS

IS OF THE

Highest Efficiency,

MECHANICALLY AND ELECTRICALLY.

We guarantee its operation and

PROTECT OUR CUSTOMERS.

COMPLETE

Direct Current System

—FOR—

ISOLATED LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building, St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BLDG.,
20 Cortlandt St.,

TRADE A.B.C. MARK

NEW YORK.

A NEW LAMP.

THE A. B. C.,

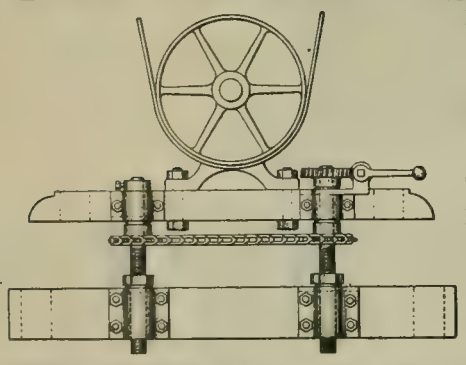
An Incandescent Electric Lamp made to fit any socket. Any Candle Power manufactured under new and improved processes.

EDISON LAMPS AT EDISON PRICES.

ELECTRIC RAILWAY SUPPLIES,
THOMSON-HOUSTON and EDISON.

GENERAL ELECTRICAL SUPPLIES.
BOOKS on ELECTRICAL SUBJECTS.

VERTICALLY-ADJUSTABLE DYNAMO SUPPORT.

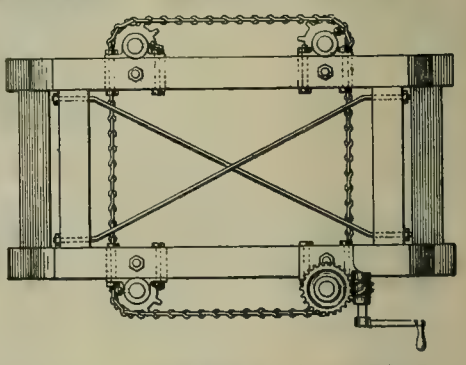


Patented August 12, 1890. For full description see article in WESTERN ELECTRICIAN of September 20, 1890, or Patent Specifications 434,011.

The Best and Cheapest Adjustable Support

In Stations where Dynamos must be placed either above or below the power. In use exclusively in the Chicago City Lighting Stations. Will license users to manufacture the apparatus on royalty, or will sell the patent outright.

CORRESPONDENCE INVITED.

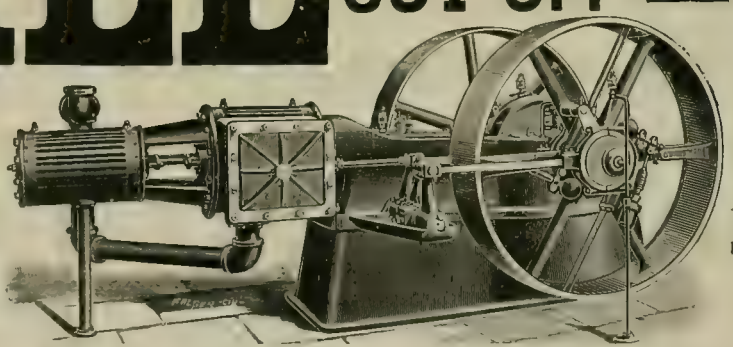


Manufactured and for Sale by

THOMAS WRIGLEY, 85 Fifth Avenue, CHICAGO.

BALL AUTOMATIC CUT OFF ENGINE

Standard.
Cross Compound.
Triple Expansion.
Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER.
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Building, CHICAGO, ILL

WILLIAM T. BONNER,
618 New York Life Insurance Building,
OMAHA, NEB.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

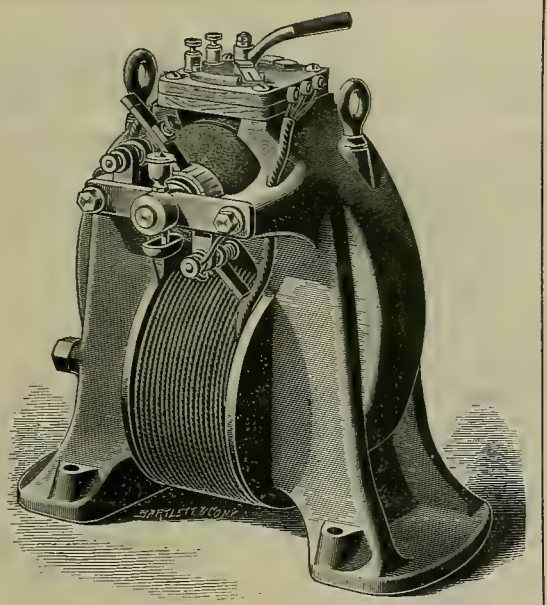
The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos. — Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

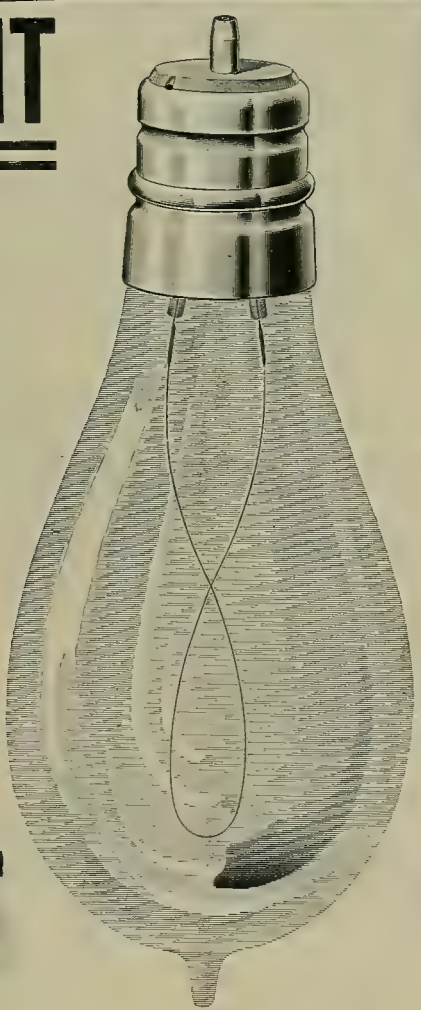
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.

INCANDESCENT LAMPS.



To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS

THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, NEW YORK.

620 Atlantic Avenue, BOSTON, MASS.

217 La Salle Street, CHICAGO, ILL.

INCANDESCENT and ARC LIGHTING and MOTORS.
Isolated Lighting a Specialty.
H. H. HUMPHREY,
1034 New York Life Building.
Contracting and Consulting Electrical Engineer. OMAHA, NEB.

EXPERIMENTAL, MODEL AND ELECTRICAL Work, Intricate and Special Machinery and anything that can be done in a first class experimental machine shop is solicited.
E. D. STIFF,
67 and 69 South Canal Street, Chicago.
Light Manufacturing under Contract.

THE E. S. GREELEY & CO.,
GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.
ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.
Illustrated Circular of Lamps and Lamp Novelties upon Application.
MINIATURE INCANDESCENT LAMPS.

DUST-PROOF BELLS.
None Genuine Without the Washer.
STANLEY & HALL,
(Formerly HAZAZER & STANLEY,)
32 and 34 Frankfort St.,
NEW YORK.

PATENT PERFORATED ELECTRIC LEATHER BELTING
Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.
CHAS. A. SCHIEREN & CO.,
PATENTEES AND SOLE MANUFACTURERS,
Also New York, Boston, Philadelphia.
46 SOUTH CANAL ST., CHICAGO. ILL.

THE WESTON STANDARD
Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.
Send for Illustrated Catalogue.
ADDRESS
WESTON ELECTRICAL INSTRUMENT CO.,
114 & 116 William Street, Newark, N. J.

THE THING for Electric Railways. **"CANVAS JACKET"** FEEDER WIRES.
INDESTRUCTIBLE PATENT WOVEN INSULATION.
POLES. POLES.
ELECTRIC LIGHT **SUPPLIES** ELECTRIC RAILWAY.

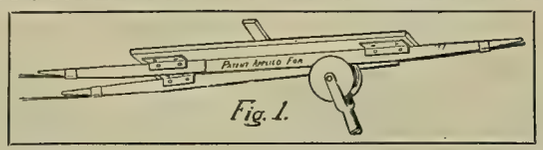



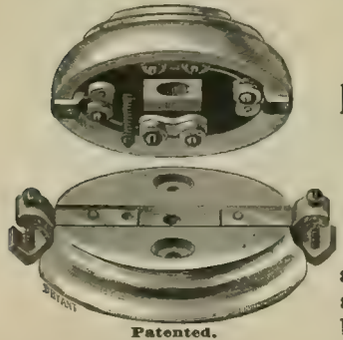
Fig. 1.
MURRAY OVERHEAD **TROLLEY SWITCH.**
CUSTOMERS REPORT:
"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."
Send for descriptive circulars, **THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.**

THE TUBES OF THE **INTERIOR CONDUIT & INSULATION CO.**
ARE ESPECIALLY APPLICABLE TO
ELECTRIC RAILWAY REQUIREMENTS.
A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.
INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.
UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.
For Catalogue, Price List and General Information, Address
INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.
Edw. H. Johnson, President.

THE
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.
Charles Munson Belting Co
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

TRADE MARK.
PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.
28,30,32,34 & 36. S. CANAL ST.
Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.

Patented.
DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.
A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.
H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.
Kept in Stock and for Sale by all Prominent Supply Houses.

GET THE BEST!
P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY
The Standard Paint Co.,
NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

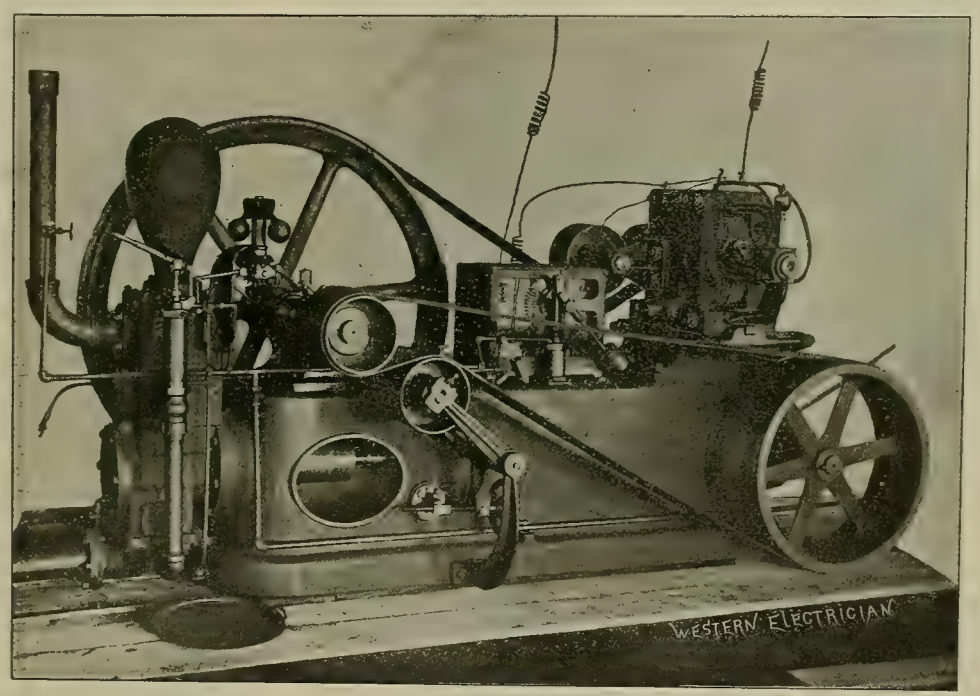
Vol. VII. CHICAGO, NOVEMBER 8, 1890. No. 19

Hale Electric Pump for Elevator Service.

Elevator pumping plants operated by electric motors, as generally arranged, take up considerable room and, unfortunately, may be said to give more or less trouble. The problem has been to produce such method of regulation that motor and pump may be kept in operation only when water is required in the tank.

The Hale Elevator company, Chicago, has recently put on the market a combination of an electric motor and pump which, it is claimed, entirely overcomes the difficulties hitherto experienced with both the water and electrical regulating devices.

The new combination pump is shown in the cut. It is compact and simple in design. The motor is placed on the pump-bed and the entire outfit rests on a single foundation but little larger than that laid for the ordinary style of pump. By means of ingenious regulating devices the motor is controlled so that it runs only when the pump is required to do work. At other times it is at rest.



HALE ELECTRIC PUMP FOR ELEVATOR SERVICE.

The operation is as follows: The pump used is what is known as a differential pump, and is connected as shown by belts with the motor. The belts obtain sufficient adhesion by means of tightener pulleys. The motor when starting is without load, the governor shown at the left has opened a "by-pass valve," and has thus relieved the pump of the load, there being a check valve in the pump delivery. As the pump increases its speed, the governor begins to operate a three-way cock which admits water into the cylinder above the by-pass valve and closes it. This action allows the pump to take its load gradually. If when starting there is no water to close the by-pass valve it can be operated by hand by means of the lever shown above the cylinder.

In the pressure tank system, when the pressure has reached the maximum the piston in the cylinder shown at the right moves. This piston operates to throw the motor in or out of the circuit.

The regulator is adjusted to act at the given pressure, and is controlled by a weight. As the pump reduces its speed, in consequence of the power taken from the motor, the balls of the governor shown at the left drop and open the three-way cock, so as to take the pressure from the cylinder of the by-pass valve, and discharge the water from it. A spring in this cylinder gradually opens the by-pass valve and relieves the pump from load. It is now in condition for the motor to be started again without load, when the pressure in the tank falls below the desired point.

For a gravity system with the open overhead tank the regulating device referred to above is operated by means of a float in the upper tank. This float is connected by cords or chains to a lever which operates a three-way cock, which in turn admits or discharges the water from the cylinder. The piston of this cylinder, as already explained, throws the motor in or out of the circuit according to the height of the water in the upper tank.

The Hale company is about to install in Henry Young's building, Joliet, Ill., a pump of this style, using the Thomson-Houston constant current motor.

Future Improvements in Electric Railway Equipment.

Development in electric traction is a subject about which much is written and many are the wild speculations as to the wonders which are yet to be accomplished. There is one fact, however, that in many cases is overlooked. Dreamers are prone to forget that electricity is merely an agent by means of which power transmission is facilitated, and that the profit comes in the greater convenience of application. "Everything will soon be run by electricity," says the enthusiastic newspaper reader as he peruses the account of some new wildcat scheme, but he fails to take into consideration that the steam engine is after all the prime mover. More economical production of current would undoubtedly lead to a great increase over the amount of electric power machinery now in service. Until, however, the great problem of the economical and practical production of electricity directly from coal, is solved, we must look for development and improvements more in the line of details.

The question as to what changes are to be expected was recently put to Theo. P. Bailey, manager of the railway department in the Chicago office of the Thomson-Houston company. Mr. Bailey took a similar position to that already expressed in this article. "I look for no radical changes in the overhead system of electric railway in the near future," said Mr. Bailey. "The trolley wire has come to stay for some time, I think, but the street railway companies will spend more money on their overhead work. The public now understands that the electric railway is no longer an experiment, and from the fact that the street railway is a permanent institution there will be a demand for the best overhead work.

"You know," he continued, "rough wooden poles are good enough in a country town where the people are anxious for rapid transit. But when the system has entirely ceased to be a novelty and the realization comes that the wooden poles might just as well have been iron—as far as the people are concerned — then we'll have less talk about the unsightly overhead work. I mean by this, fancy and substantial construction will be in demand.

"What do I expect in the way of a conduit system? Well, my company is experimenting with a conduit system but as yet we have seen nothing to alter our opinion that the overhead arrangement of the conductor is the only thoroughly practical plan. I have nothing to say against the conduit system. If one is successfully developed it will undoubtedly have a place, especially in crowded thoroughfares. I have already stated, though, that an overhead wire by the expenditure of a little money, can be strung in a manner to be almost an ornament. Look at some of the work just finished for companies which believe in handsome construction and I think you'll agree with me. To sum it all up the electric road is not an 'infant,' it is a developed thing and the near future will only see correction of small defects."

"You notice, I say the near future," remarked Mr. Bailey, "because you know, I am like the rest of them, a little bit of an enthusiast, and I have gotten into the habit of not committing myself with predictions as to the future of anything electrical."

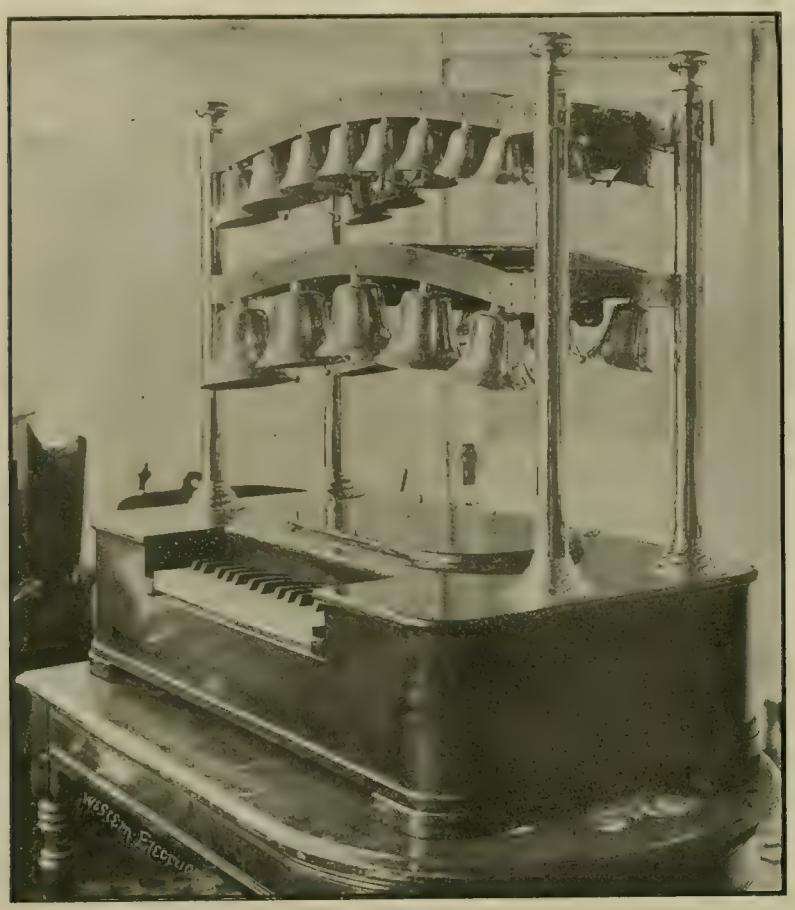
"Will the motors be kept under the cars and will one or two motors be used on a car?" was next asked. "Yes, I think the motors will stay under the car floor. This location has some objections, of course, on account of the machines having to run in the mud and slush. The motors are well protected and encased, though, and although we have had some trouble from this source, the advantages outweigh the disadvantages."

In answer to the inquiry as to what size of motor was recommended as best adapted for street railway uses, Mr. Bailey replied that in cities or towns with a population of 15,000 to 25,000

inhabitants and where the grades are slight, it was his practice to use ordinarily a 15-horse power motor. In places of larger population and where it is desired to haul one or two trail cars, often upon heavy grades, say, to the extent of 10 to 12 per cent., the horse power of the motors was increased and two motors would be used. Whether they should be 15-horse power each, or 20-horse power each, would be determined entirely by the maximum load which was to be handled with the equipment.

"Do I believe that experience will lead to the employment in the street of electric locomotive and trail cars? Well, you see if we were to locate the machinery above the floor instead of beneath it, we would have a locomotive according to the popular idea, but there would be fewer passengers on board, and consequently less weight on the wheels. The locomotive would have to be made artificially heavy—in other words, we would lose the advantage of the increased adhesion of the wheels."

In concluding the interview Mr. Bailey stated that in station equipment the tendency of the present was in the direction of large power units. The 80-horse power generator has been largely introduced up to date but more extensive street car systems are now being fitted up, and larger machines will constitute to the units. A number of stations are now equipped with 100-horse power generators. The West End road at Boston operates machines of this size.



ELECTRIC CHIMES.

Rope Gearing for Electric Locomotives.

The accompanying cuts illustrate an electric locomotive truck which contains a number of ingenious features. Power is transmitted from the motor shaft to the wheels by means of a combination of cogwheels and rope gearing. The manner in which the designer has overcome numerous difficulties, will be appreciated.

Referring to Figs. 1 and 2 the general arrangement of parts will be readily understood. A glance at Fig. 1 will show that the gearing is carried on two frames, one set on the other. The lower and more substantial frame *A* rests on the four main boxes of the wheel axles. Another and secondary frame *A'* connecting the sides of and supported by the main frame, carries the main shaft *b*. On this central shaft is a grooved rope pulley *D*, and a wooden-toothed gear *C*, into which the armature pinion works. Each wheel axle is also provided with a grooved rope pulley. Tightener pulleys *K* and *K'* are upheld on swinging yokes by springs as represented.

The designer of this truck, F. W. Dean of Cambridge, Mass., claims for his arrangement the following advantages: Greater accessibility of parts and less exposure to dust and grit, due to placing the motor above the truck frame instead of beneath it; a considerable reduction in the noise made by the gearing.

It may be mentioned that Mr. Dean has also designed a truck in which the driving rope pulley is mounted directly upon the motor shaft thus dispensing with the gear and pinion.

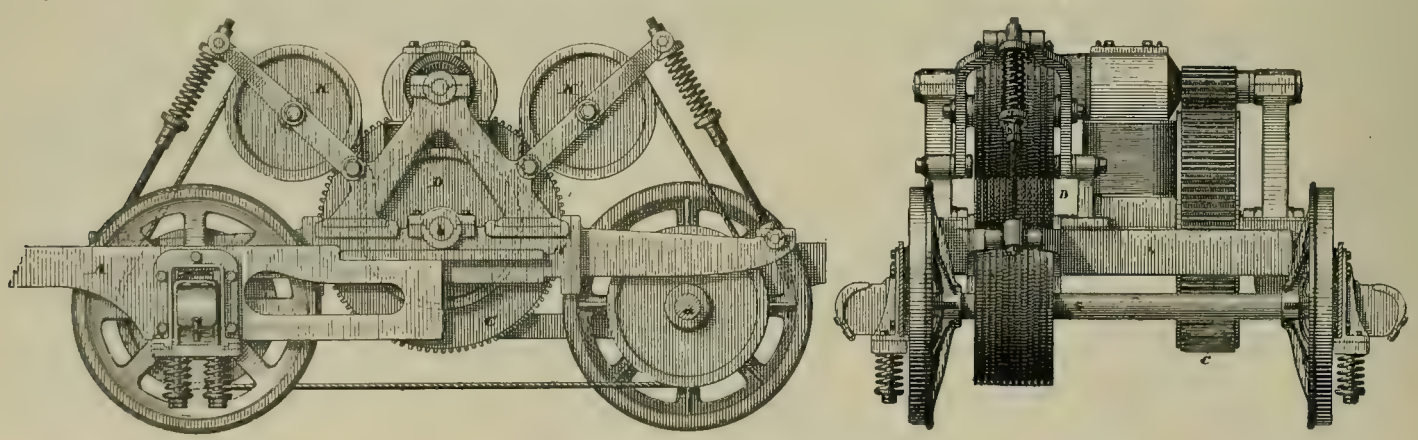


FIG. 1. ROPE GEARING FOR ELECTRIC LOCOMOTIVES. FIG. 2.

Electric Chimes.

Dr. Alva Owens of Chicago recently constructed the somewhat unique musical instrument shown in the illustration. The apparatus, which might be described as a set of chimes to be rung by electricity, was designed for advertising purposes. The instrument, it is intended, will be carried through the streets on an electric tricycle and will be played on the trip after the manner of an ordinary piano. The details and operation of the device are so simple as to require but little explanation: Attached to each of the thirty bells hung on the rack above the keyboard is an electro-magnet. The keys make the circuit from a battery in the base to the electro-magnets at the bells.

Cable or Electric Cars for South Chicago.

There is considerable rivalry between the Calumet Electric Railway company and the Chicago City Railway company. Both corporations are looking for franchises to construct street railroads on several important streets on the South Side. The South Chicago Street Railway company, which has heretofore held undisturbed sway over the surface lines on the South Side, also wants to extend its system so as to cover the territory on which its rivals have designs.

The South Side Cable company desires to extend its system on Sixty-third street, from the Illinois Central Railroad to Stony Island avenue; Stony Island avenue, from Sixty-third street to South Chicago avenue; Sixty-seventh street, from Cottage Grove avenue to Stony Island avenue; South Chicago avenue, from the terminus of its present line at Seventy-third street to South Chicago; Seventy-fifth street, from Auburn Park to the Illinois Central railroad at Windsor Park; Seventy-ninth street, from Stony Island avenue east to Commercial avenue and south on the latter street to Ninety-second street, and on Yates avenue from South Chicago avenue to Jackson Park.

The Calumet Electric Street Railway company has an ordinance pending before the council for a right of way along South Chicago avenue between Ninety-fifth street and Stony Island avenue, and on Stony Island avenue from Eighty-seventh street to Sixty-seventh street. Notwithstanding their efforts to obtain a right of way on Commercial and Yates avenues, the directors of the South Chicago Street Railway company have not abandoned the idea of a road to Jackson Park east of the Illinois Central, striking Coles avenue at Seventy-ninth street and continuing north to the park.

The activity manifested in this line shows that street railway facilities for the South Side will be greatly improved before the World's Fair is opened.

Electro-Magnetic Clutch.

A number of ingenious mechanical and electrical features are embodied in the clutch illustrated in the accompanying cuts. A peculiar and valuable feature is that the friction is not obtained directly between the magnet and its armature as is the case in a number of electric clutches and brakes. The device is constructed in the form of a double cylinder similar to a Camacho magnet. Magnetizing coils of insulated wire are wound in an annular space between the two cylinders. The armature or piece to be attracted consists of a disk adapted to be attracted axially by the magnet.

An inspection of the cuts will enable the reader to understand the details of the clutch. Fig. 1 shows the device in section. It may be located within the rim of a pulley as shown.

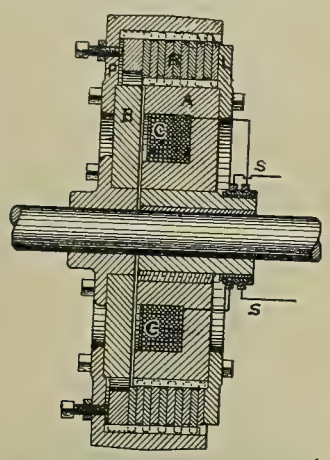


FIG. 1. ELECTRO-MAGNETIC CLUTCH.

The armature disk *B* is a short distance from the magnet, and the friction is obtained by a number of friction rings *R* shown in section in the illustration. Extending from the part *B*, which is the loosely mounted part, is a brass ring *P*, which has splines running across its inner face at given intervals. About its inner circumference and from the portion *A*, which is secured to and revolving with the shaft, is a similar brass ring *L*, also provided with splines, which are placed oppositely to those on the ring *P*. One-half of the friction rings slide upon the splines of the ring *P*, and the other half slide upon the splines of the ring *L*. When the coil *C* is energized these rings are forced firmly together, and the friction is in this manner largely augmented because of the great number of

FIG. 2. ELECTRO-MAGNETIC CLUTCH.

bearing surfaces. This construction has also the advantage that when the current is broken permanent magnetism or residual magnetism will not hold the parts *A* and *B* in firm contact, as might otherwise be the case. Adjusting screws are provided so that the wear of the rings may be compensated for. Current is supplied through *S* and *S*.

Fig. 2 shows the shape of the friction rings, the manner on which they work on the splines, and the location of the magnetizing coil. The clutch is the invention of C. H. Veeder of Lynn, Mass.

The National Detachable Safety Fuse Box, Ammeter and Voltmeter.

Of the many devices which have been adopted for automatically opening circuits when the current becomes too great, the fuse is doubtless not only the simplest but the most reliable, under average conditions. Unfortunately, whenever the fuse has accomplished its mission the circuit is kept open until the strip can be re-

FIG. 1. DETACHABLE SAFETY FUSE BOX.

placed. Any device, therefore, by means of which the replacement is made easy and through which it may be accomplished quickly and safely, will certainly be appreciated by users of electric currents.

On page 330 of the last volume of the WESTERN ELECTRICIAN, there is described a safety fuse-box recently put upon the market by the National Electric Manufacturing company of Eau Claire, Wis. The accompanying cut, Fig. 1, shows a similar arrangement adapted to a transformer.

Referring to the cut, the simplicity of the arrangement will be appreciated. The lid of the transformer fuse-box is hinged and carries on its insulated base a number of lugs which are

FIG. 2. AMMETER.

provided with contact pieces fitting into corresponding grooved projections in the transformer base. It will be seen at a glance, that pulling down the fuse box cover opens the transformer circuits and entirely disconnects the fuse clamps from the live wire. A burned-out fuse can be replaced therefore without any injury from shocks from leaky circuits, and without any danger of burning hands or tools.

Those who have tried to replace a burnt fuse on a thousand-volt circuit during rainy or sleety weather, will recognize at once the practical utility of this simple device.

This detachable fuse-box cover may also be used after the manner of a switch, for the purpose of temporarily disconnecting a transformer from the circuit.

Figs. 2 and 3 show a voltmeter and a meter recently placed on the market by the same company. They are intended to be used for either direct or alternating currents. These instruments contain no permanent magnets.

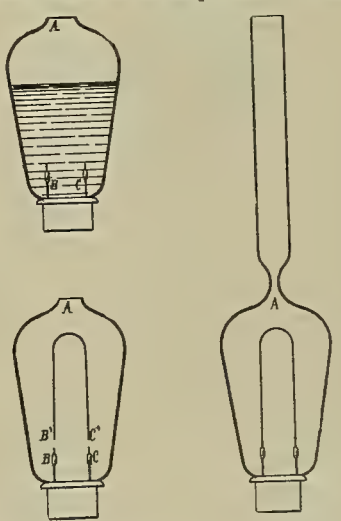
Welding Broken Filaments in Incandescent Lamps.

To reunite a broken filament in an incandescent lamp is at best not an easy process, but a

FIG. 3. VOLTMETER.

French inventor, Casimir Pauthonier of Paris, has devised a method which he claims is both simple and labor saving. His plan is to introduce into the lamp bulb containing the broken filament, a liquid or gaseous hydro-carbon and then bring together the sundered ends of the filament. When in this position a current is next caused to flow across the joint so as to weld the ends by a deposit of carbon.

The cuts illustrate Mr. Pauthonier's process. In Fig. 1 a lamp open at the top is shown. The filament which is broken, has been completely withdrawn and there has been only left on the platinum electrodes about the two millimeters of the old carbon to act as primers to the sold-



FIGS. 1, 2, 3. WELDING BROKEN FILAMENTS IN INCANDESCENT LAMPS.

ering at *B* and *C*. This cut also shows the level of hydrocarburet, which may be varied, but which ought to be such that the electrodes may be entirely uncovered. Fig. 2 shows a new carbon introduced into the globe, by the aperture *A*, and the ends of which *B'* and *C'* are presented to the primers *B* and *C*. The filament is held in this position by a thread of copper attached to a gallows, the arm of which may be raised or lowered, as required. The extremities are brought to the primers *B* and *C* by means of a small plier, the head of which is connected by a supple thread to one of the poles of any

electric source. The soldering of joint *B* and *B'* is first effected by bringing the filament ends into contact, and by starting the current. Under its influence the hydrocarburet decomposes in part and a deposit of solid carbon forms in *B* and *B'*, which holds the end of the new carbon steady on the primer of the old carbon arranged to receive it. The current is then turned off. The process by which *C* and *C'* are united is similar to that employed in connecting *B* and *B'*. Fig. 3 shows the lamp when made ready for exhaustion.

New Brush Arc Lamp.

In the accompanying illustrations is shown the new Brush-Adams arc lamp in which the manufacturers state, springs that can in any way influence the arc have been abolished and thus the chief cause of uneven and changing adjustments is eliminated. No glycerine, oil or mercury is used. The frame of the lamp is entirely and durably insulated from the wires. Unless

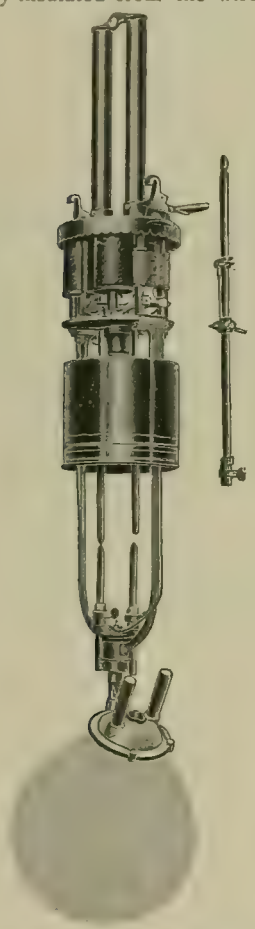


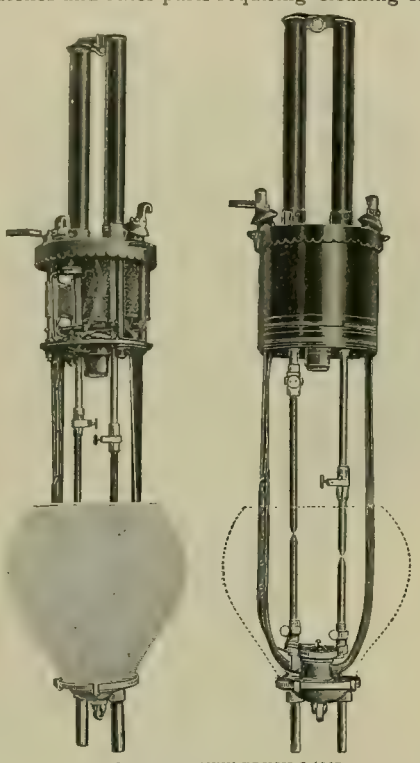
FIG. 1. NEW BRUSH ARC LAMP.

a hanger board is desired no hood need be used as the lamp is weatherproof. Hanger boards, globes, etc. are all alike for both single and double lamps.

The method of securing the globe upon the lamp, Figs. 1, 2 and 3, it is stated, will effectually prevent the blowing off of globes and the breakage resulting from heating or the dropping of melted copper from the carbons. No thumb screws, which so often crack the globes, or drop out and loosen them, are used, and it is claimed that the flaming arcs which sometimes occur when the lamps are about to cut out, cannot possibly cause breakage of globes. A feature that will be appreciated, especially in "hot trimming" is that the globe can be removed and placed out of the way with ease and rapidity.

The Brush-Adams lamp is adjusted to a standard current and voltage, and no means of changing this adjustment is provided. The amperage is stamped upon the lamp and with this current the manufacturers claim that it will burn with perfect steadiness and reliability on any circuit. Lighting companies and the public suffer much from readjustments made by careless and incompetent employes. The adjustments of the Brush lamp need never be changed, or if alterations for a different current are required the change must be made with special but inexpensive tools provided by the manufacturers.

Cleanliness of arc lamps, which is necessary for perfect working, is often neglected in dusty or smoky locations on account of the difficulty involved in taking apart of the old forms of lamp. The Brush-Adams lamp is so constructed, Fig. 3, that while the lamp is in its ordinary burning position in the street or elsewhere, the rods, clutches and other parts requiring cleaning can



FIGS. 2 AND 3. NEW BRUSH LAMP.

be slipped out quickly and be replaced without any soldering or other work.

Another feature is the arrangement of carbon rods and clutches. The latter are claimed to be as durable as any other part of the lamp. A true round surface usually necessary is not necessary with the rods, as the bearing surface of the self-cleaning clutches will feed a rod pitted, scarred or worn. The cut-out is positive and sure, with no liability to burn out. A device is provided for preventing the "lapping" of carbons, and for insuring the lighting of the lamps whether trimmed with the carbons in part or in contact.

The jacket, though tight, can be easily removed. The exterior finish of the standard lamp is black japan with bronze trimmings. The user can therefore bronze or ornament this surface for special purposes if necessary.

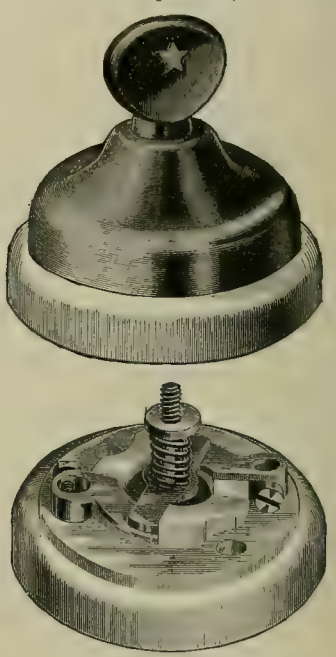
The hanger-boards, alike for single or double indoor or outdoor lamps, are provided with a switch very strongly made, arranged to close one circuit before the other is opened, to prevent arcing, and to cut the lamp entirely out of circuit when switched off. The lamp is manufactured by the Brush Electric company of Cleveland.

Electrically Heated Dental Tool.

The little tool illustrated in the cuts was designed for working gutta percha or other similar materials or fillings, into cavities in teeth. In the methods employed before electricity found its way into the dental office, a simple hand-tool heated first in a flame and then brought into contact with the filling, was usually employed. This plan, however, was at the best unsatisfactory, and the electrically heated tool here represented was designed with the view of overcoming the well-known disadvantages of the old method.

Referring to the illustrations, the parts may be described as follows: The handle or casing is of any suitable insulating material. This holder is provided at the lower extremity with a removable button, and at the opposite extremity or working end, with a tapering cap, having in it a recess adapted to receive a dental tool. The recess or cavity may be made in such form as to permit of an artificial crown being mounted on it as shown, for instance, in Fig. 2, for securing the crown into a natural tooth or root in the mouth.

The heater proper consists of a small incandescent lamp mounted in one end of the holder, and connected as indicated. The cap is made of aluminum, and is provided with one or more apertures in order that the operator may readily ascertain whether the lamp is being maintained in the proper state of incandesence. The cap, whether of tapering form, as shown in Figs. 1 and 3, or of a form adapted to receive an artificial crown, as shown in Fig. 2, must be made of a material that will readily conduct heat from the lamp. It will be observed that as the instrument is arranged, in case of breakage of the lamp the cap may be readily removed, and also the button at the opposite end of the holder, to permit of the withdrawal of the lamp with its two conductors. In practice, it is stated, tool

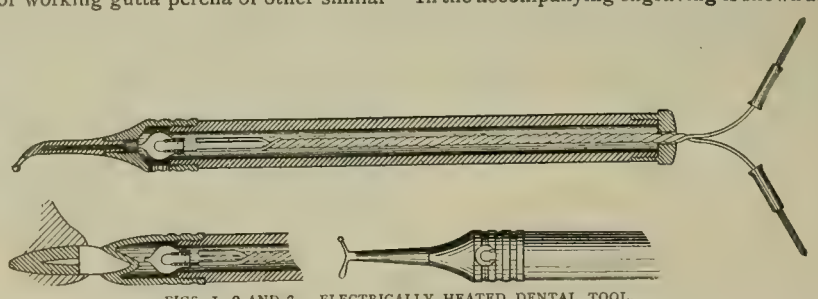


SINGLE POLE SWITCH.

points of aluminum give the most satisfactory results, and a lamp of from 2 to 5-candle power is sufficient for ordinary work. This device was designed by L. A. Faught, of Philadelphia, Pa.

Single Pole Switch.

In the last number of the WESTERN ELECTRICIAN was illustrated a switch manufactured by the Star Electrix company of Philadelphia. In the accompanying engraving is shown another form of switch made by the same company. This switch is designed to meet all the requirements asked of a single pole switch. It is a simple arrangement. All the contacts are of soft metal, and the surfaces wear bright. The make and break action is positive and instantaneous. It is very convenient to wire up, and is made with a porcelain base.



FIGS. 1, 2 AND 3. ELECTRICALLY HEATED DENTAL TOOL.

Underground Electrical Work.[1]

By F. E. Degenhardt,

To Charles Augustin Coulomb no doubt belonged the honor of discovering that most essential necessity of modern electrical work, insulation. He it was during the latter part of the last century, who developed the fact that the momentary dissipation of electricity was proportional to the degree of electrification at the time, and that when the charge was moderate its dissipation was not altered in bodies of different kinds or shapes.

The temperature and pressure of the atmosphere did not produce any sensible change, but he concluded that the dissipation was nearly proportional to the cube of the quantity of moisture in the air.

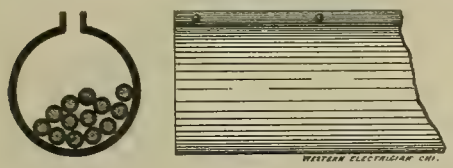


FIG. 1. UNDERGROUND ELECTRICAL WORK.

In examining the dissipation which takes place along in perfectly insulating substances, he found that a thread of gum-lac was the most perfect of all insulators, as it insulated ten times as well as a dry silk thread, and that a silk thread covered with fine sealing-wax insulated as powerfully as gum-lac when it had four times its length.

He found that the dissipation of electricity along insulators was chiefly owing to adhering moisture, but in some measure also to a slight conducting power.

History, as far as the writer knows, is silent as to the first attempts at insulating wires commercially, for electrical purposes, but as these remarks apply entirely to underground construction, we will refer only to the earlier efforts in that line, accepting at once the conclusion that wires had perforce been insulated before that time. In 1829 Prof. Henry used insulated wire for experimental work.

It was during the year 1832 that Prof. Morse first conceived the idea of underground transmission of electricity, and among his earliest plans we have a suggestion of the conduits of to-day, and as these drawings are of historical importance, I have produced two views, as shown in Figs.

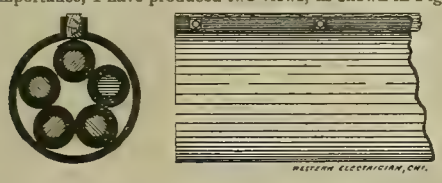


FIG. 2. UNDERGROUND ELECTRICAL WORK.

1 and 2, which will clearly illustrate the general similarity of ideas, covering a lapse of fifty-eight years.

Prof. Morse adopted the underground plan without experiment, not knowing the disastrous failures that had followed like attempts in England, and, strange as it may seem, the very work in this line in this country to-day carries with it the ear-marks of fifty years ago, and Morse's first cable was a bunch of five wires, lead encased.

Prof. Morse's first cable was laid from Baltimore to the Relay House, seven miles distant, and the failure of this cable all but sealed the fate of underground electrical work.

While referring to these earlier experiments I cannot refrain from a mention of the first attempts of overhead construction, simply that by comparison, we may show that at the present day underground as well as overhead work has been perfected only after much cost and study.

The first overhead insulation adopted on the line built by Prof. Morse shows how rudimental were the conceptions of men at that period. The insulation consisted simply of two plates of glass, between which the wire, wrapped well with cloth and saturated with gum shellac, was placed, and

FIG. 3. UNDERGROUND ELECTRICAL WORK.

over which a wooden cover to protect from rain and press the glass upon the wire and keep it in place, was nailed. Fig. 3 will illustrate the method of insulation. This was before the door-knob era.

It is not necessary to further cite the history of experimental underground electrical conduction or construction. It is enough that the problems involved came thick and fast, and the modern applications of electricity seemed for a time to have stamped success of the underground branch of the business as an impossibility. As each day proved the utility of the new agent, the fact also became apparent that we would soon be walled in by a network of wires. At this period popular clamor arose and necessity once more became a fond mother, and her child, invention, brought forth in turn a multitudinous offspring, among which were some that had merit and others which had none

It is safe to say that underground work slumbered for a period of twenty years from the date of Prof. Morse's first experiments, when in the city of Chicago an objectionable pole line had been placed through a prominent residence portion of the city. The citizens of that particular section banded themselves together and selected a committee, who waited upon Prof. Barrett, chief of the city telegraph department of the city of Chicago, and stated their grievances.

The professor told them that the line might be buried underground, but that the city did not furnish the means for so placing it. After momentary deliberation the gentleman composing the committee volunteered to defray the expenses. The poles were removed, and thus the first underground work was started in the city of Chicago.

Eight hundred and forty feet of two-inch wrought iron pipe was laid about three feet below the surface, the exterior of the pipe being first treated with a liberal amount of tar and linseed oil. In this pipe two insulated wires were placed. These wires are in service to-day and are giving as good service as on the day when they were placed underground.

From this date on the underground question was agitated in the city of Chicago, and in the year 1883 the common

FIG. 4. UNDERGROUND ELECTRICAL WORK.

council passed an ordinance requiring all electric conductors to be placed underground.

In accordance with this ordinance the several companies doing business in the city, after exhausting all means to evade it, adopted various systems for placing their wires underground, and to-day the wires so placed underground embrace all branches of the service, viz.: Telegraph, telephone, police, fire alarm, electric lighting and power.

In 1883 a franchise was granted to the Sectional Electric Underground company to build underground conduits for commercial purposes. This company built about seven miles of conduit in the business district of the city, and rented space in the same for $1,000 per mile per duct per year, the city being allowed the use of one duct free of charge.

The cables laid underground in the city of Chicago are placed in conduits of various kinds, viz.: Iron pipe laid

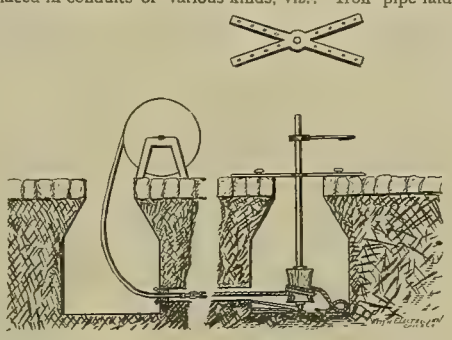


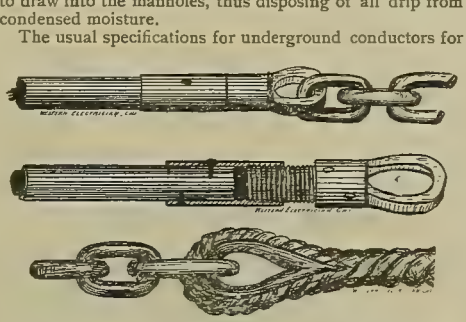
FIG. 5. UNDERGROUND ELECTRICAL WORK.

in the earth without other protection; iron pipe laid in concrete; iron pipe cement-lined, laid in concrete and multitubular blocks of bituminous concrete about four feet long.

Manholes in many cases are built circular in form, and in other cases rectangular-shaped, the latter averaging forty-six inches in length by forty inches in width, and are from four and one-half to nine feet deep with double iron covers, one of which is set below the grade and made water-tight by packing, the other set on a level with the street.

The iron pipe used for conduit is thoroughly reamed at the ends, thus removing the burr. Conduit is laid with a pitch or difference of grade from six inches to one foot so as to draw into the manholes, thus disposing of all drip from condensed moisture.

The usual specifications for underground conductors for



FIGS. 6, 7, 8. UNDERGROUND ELECTRICAL WORK.

the purpose of arc lighting may perhaps not be out of place, and I give them herewith.

The insulation resistance should not be less than 500 megohms per mile, and the insulation should not materially deteriorate for the space of two years after being in service on an electric light circuit, having a voltage of from 2,500 to 3,000 volts, and a current of from 9 to 12 amperes, or a voltage of from 900 to 1,200 volts, and a current of from 18 to 20 amperes.

The early method of preparing the trench for underground work was to plow a furrow and place the conduit and the insulated wires in the trench thus made. To-day the tools and accessories are quite a feature of underground work, for after the conduits have been made, and the ducts placed in most perfect alignment, so that no obstruction may be offered to the introduction to the cables, a competent corps of men take charge of the drawing in of the cables into the ducts, and I have prepared some sketches of the most essential tools, and the mode of application there are shown in Figs. 4 to 10.

Moisture is to-day, as it has always been, the worst enemy of perfect underground construction, and therefore in selecting men for the difficult work of making joints it is well to secure those who are possessed of that sovereign virtue, sobriety, and instill into their minds the fact that it is not how many joints they can make, but how good they can do them.

This class of men should be well paid and fostered, and I believe should be under the supervision of some one higher in authority than a mere boss line man.

Like Prof. Morse, I am afraid that many tried the problem of underground work without experiment, and depleted pocketbooks are silent reminders of the fact.

But underground electrical construction is here to-day,

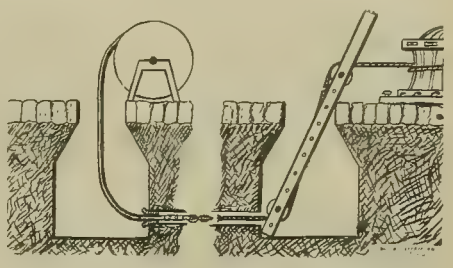


FIG. 9. UNDERGROUND ELECTRICAL WORK.

and here to stay, and the success that now attends it is as signal as were its failures fifty years or more ago.

Electrical currents of infinitesimal potential are no more easily conducted than are those electrical giants of four or five thousand volts.

To-day the user of the cables for electric lighting simply tells the manufacturer of the potential that he wishes to carry over his lines underground, and lo, the cable is forthcoming, and with it a guarantee.

The telephone manager tells you that he must have a cable with an electrostatic capacity that must not exceed a given number of microfarads, and that it must contain so many conductors; that its insulation must be so high and no higher; that all the conditions must be complied with within a given space; that the wires must be twisted in pairs so that they can be formed into a metallic circuit if desirable, and your manufacturer goes at once to work and evolves a cable that meets these most exacting requirements. Thus, through the whole list, for transmission of power, telegraph, arc or incandescent lighting, it matters not, you

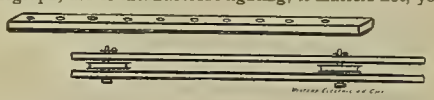


FIG. 10. UNDERGROUND ELECTRICAL WORK.

simply make known your wants; aye, even whisper them, and twenty bright and active workers stand ready to take your orders and deliver the results you desire.

Pardon my return to statistical information, but in the progressive city of Chicago alone there is at present in successful daily operation the following enormous amount of underground electrical cables and wires, the telegraph companies alone using no less than 650 miles of wire:

The Chicago Arc Light & Power company operates 140 miles of arc light cable and 30 miles of ducts; the city of Chicago 174 miles of arc light cables, 1,264,430 feet of conductors made into cables from 5 to 25 wires each, and 65 miles of single wires.

The city has 20,441 feet of conduit, or about 100,000 feet of ducts in addition to iron pipe, and of the latter it has 478,087 feet used for conduit.

The Chicago Telephone company has in operation at this date 6,080 miles of wire in the form of cables, or 32,102,400 feet of conductors.

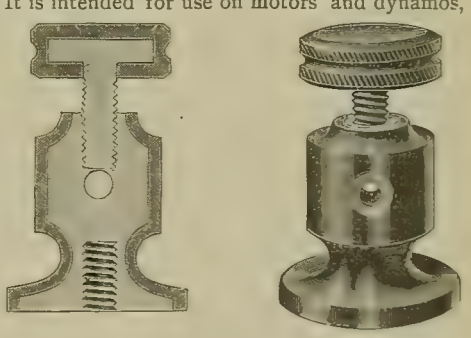
Its conduit system consists of 67,175 feet of main conduit, in which are 192,786 feet of duct. These conduits have a carrying capacity when entirely utilized, of 1,000,000 feet of cable, of 200 conductors.

In addition to the above it has lateral conduits which measure 7,451 feet, and duct capacity in these laterals of 8,004 feet, and a cable capacity of a like amount.

The Chicago Edison company has ninety miles of conductors.

Safety Binding Post.

In the two cuts is illustrated a form of binding post designed by J. D. Clagham of Chicago. It is intended for use on motors and dynamos,



SAFETY BINDING POST.

and is so constructed that a sure contact can be effected. The cuts illustrate the features of the binding post. The metal post is covered with rubber. The device is introduced by M. C. Chase of Chicago.

[1] Read before the Chicago Electric Club, November 3, 1890.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Hale Electric Pump for Elevator Service. Illustrated 247
Future Improvements in Electric Railway Equipment 247, 248
Rope Gearing for Electric Locomotives. Illustrated 248
Electric Chimes. Illustrated 248
Cable or Electric Cars for South Chicago 248
Electro Magnetic Clutch. Illustrated 249
National Detachable Safety Fuse Box, Ammeter and Voltmeter. Illustrated 249
Welding Broken Filaments in Incandescent Lamps. Illustrated 249, 250
New Brush Arc Lamp. Illustrated 250
Electrically Heated Dental Tools. Illustrated 250
Single Pole Switch. Illustrated 250
Underground Electrical Work. By F. E. Degenhardt. Illustrated (Chicago Electric Club) 251
Safety Binding Post. Illustrated 251
Editorial 252
The Root New Water Tube Steam Boiler. Illustrated 253
Municipal Lighting at Baltimore 253
Collapse of the Brotherhood of Telegraph Operators 253
Investigation of the Stanley Alternate Current Arc Dynamo. By W. B. Tobey and G. H. Walbridge. Illustrated. (American Institute of Electrical Engineers) 254, 255
Electric Power at Kearney, Neb 255
Patent Litigation on Fire Alarm Apparatus 255
A New Method of Analyzing the Magnetic Reactions of Armatures Applied to the Stanley Arc Light Alternating Current Machine. By Thorburn Reid. Illustrated. (American Institute of Electrical Engineers) 256, 257, 258

DEPARTMENTS.

Correspondence 258, 259
The Electric Light 259
The Electric Motor 259, 260
Electrical Patents 260

ACCORDING to the latest reports there is now no probability of a general strike among telegraph operators. They have come to the conclusion that the organization was not strong enough to warrant them in making a fight for higher pay.

Two papers read at the last meeting of the American Institute of Electrical Engineers are presented in this issue. Both relate to the Stanley alternate current dynamo. The papers are both mathematical in character and the investigations in each case have been most carefully and elaborately pursued.

MINNEAPOLIS papers assert with great vigor that they were shabbily treated by the census department. The registration lists show, they assert, that their population is much greater than that estimated by the United States census. They are comforting themselves by the thought that Minneapolis is to have the greatest electric railway system in the world. Sixty miles of track are already traversed by electric motors, and when the system is complete a person may travel over 200 miles of electric railway in Minneapolis alone. That statement is authorized by the street railway company. The peculiar manner of burying the feeder wires was mentioned in the WESTERN ELECTRICIAN of Oct. 18. This method, the engineers of the company state, promises to prove extremely efficient. The recent heavy rains in Minneapolis have not interfered in the slightest with the working of the wires, a fact which has interested the engineers in no small degree.

UNDERGROUND New York is becoming so crowded that the the city authorities are puzzling over the problem of securing additional room for subterranean systems. The discussion in reference to the advisability of constructing a tunnel for the accommodation of the multitudinous wires and pipes has been started afresh. The extraordinary amount of underground work done within the last few months by the electrical companies has had the effect of drawing attention to the matter. According to Mayor Grant's message there have been buried since Jan. 1, 1889, 17,903 miles of electric conductors. A New York paper quotes "one of the highest officials of the city" as saying that it would be advantageous for the municipality to construct a tunnel. The expense of such construction, he estimates at a million and a half dollars per mile. At least twenty-five miles of tunnel would be necessary. Doubtless a system of tunnels would free New York from many of the ills from which it has suffered, but the expense is prohibitive.

ENTHUSIASTS who expect to see in the near future radical changes made in electric railway equipment, will find that men actively engaged in this particular field take a more conservative view of prospective developments. In another column is presented an interview on the subject with Theo. P. Bailey. Mr. Bailey, as is well known, has grown up, so to speak, with the electric railway, and his views are interesting in that they bear evidence of experience and a knowledge of the present situation. In his conversation Mr. Bailey makes no startling predictions. He looks for no fundamental innovations in equipment for some time, but predicts that details will be much improved. "The trolley has come to stay for some time," he thinks, but we are to have more tasty overhead work. Substantial and artistic overhead construction will be more in demand when the general public awakens to a thorough realization that the electric system is no experiment, but is a permanent institution. "The motors will stay under the car floor," says Mr. Bailey. The one or two-motor equipment will continue to be employed according to the conditions of operation. The tendency at present in power station equipment is in the direction of larger power units.

ENGINEERS are at present busily engaged in bringing out a number of different styles of car trucks adapted for service in connection with the electric motor. Now that the novelty of riding on an electrically propelled vehicle has to a great extent worn off, complaints of certain minor defects in the new system are beginning to be heard. One grumbler will tell you that the car bodies, which in certain cases were of necessity slightly raised to make room for the motor equipment, are too high, and consequently it is not so easy to enter an electric car as it would be to board the old horse car, which is nearer the ground. This is one of numerous trivial criticisms which one may hear and laugh at. There is, however, one feature of the present equipment which must be conceded to be a most serious objection. The riding public is beginning to appreciate that the electric car is by no means a noiseless mechanism. The hum of the gearing is an annoyance to many, and the unenthusiastic public are already beginning to "wonder why that noise cannot be overcome." All this means that noisy gearing will have to go sooner or later, and even at the present time we find the greatest efforts are being made to produce something better. Progress is to be expected, and realizing that much energy is being expended to bring about a satisfactory solution of the vexing problem, the WESTERN ELECTRICIAN endeavors to keep its readers thoroughly posted on all meritorious work in this particular field. For instance, in another column is presented a style of electric motor truck on which is arranged an ingenious combination of cog-wheel and rope gearing. This truck is of recent design, and while certain features of its construction may be criticized its arrangement is such as would indicate that the inventor thoroughly understands the value of space, substantial parts and noiselessness of operation.

IN developing the electric welding process the one great object seems to have been to build machines which would weld satisfactorily bars of large diameters. In other words, it was once considered a feat to weld a one-quarter inch rod, and now an account of the welding of one inch bars causes no comment. The fact that the electric process may be used advantageously to unite pieces of extremely small diameter was of course realized, but we hear little of any application of this kind in the arts. A French inventor, Casimir Pauthonier, claims, however, to have devised a method of repairing incandescent lamp filaments, in which the sundered ends may be welded together by the aid of an electric current. His processs as explained elsewhere in this issue is quite simple, yet ingenious. The ends of the carbon filament are brought together within the lamp bulb in a liquid or gaseous hydrocarbon. While thus immersed a current is passed across the joint and the ends are welded together by a deposit of carbon.

PROF. LANGLEY has recently contributed to an English periodical an extremely interesting paper on the cheapest form of illumination. His article refers to the light produced by the glow-worm. He has proved by experiment what has been generally assumed but has never been demonstrated, that the production of the light of the insect is attended by less heat than in any other case. The tests indicated that the insect light was accompanied by less than one-four-hundredth of the heat given by an equal amount of gas light. Some idea of the smallness of the quantities measured in the experiments is conveyed by the statement that the heat given off from the glowworm per second, was less than one-millionth part of a gramme degree, and the portion of this falling on the bolometer in one second was not enough to raise an ordinary mercurial thermometer one-millionth part of a degree centigrade. In concluding, Prof. Langley says if the light of the fire-fly could be manufactured on a large scale it would be far cheaper than any other known form of light; and this, he adds, does not appear impossible, since vital processes do not seem an essential feature in its production.

AT the last meeting of the Chicago Electric club F. E. Degenhardt read a paper on "Underground Electrical Work," which is presented elsewhere in this issue. After referring generally to the subject of insulation the author of the paper spoke briefly of the failure of Prof. Morse's underground work, after which, he said, nothing was done practically until the residents of a Chicago avenue objected strenuously to the erection of a pole line on their street. At their request and at their expense the wires were taken from the poles and put under ground, where they remain to-day in excellent working condition. Mr. Degenhardt speaks of the great amount of underground work done since that time, and refers to the excellence of cables now manufactured for use under ground. As an illustration of what has been done in this field of electrical work, Mr. Degenhardt presents figures showing the extent to which electric wires have been buried in Chicago.

Mr. Degenhardt's paper excited the keenest interest at the club meeting. The discussion which was unusually spirited will be published in the next issue of the WESTERN ELECTRICIAN. Theo. P. Bailey's paper on "Electric Railways" which it had been announced would be read, was not presented. It will be read at the next meeting of the club.

The Root New Water-Tube Steam Boiler.

The engravings give an excellent idea of the construction of the new Root improved water-tube steam boiler. Briefly described, it consists of a nest of inclined water-tubes connected at the front and rear ends with a series of horizontal overhead drums. The water level is carried at the middle of the drums and the fire is applied under the front and raised ends of the tubes.

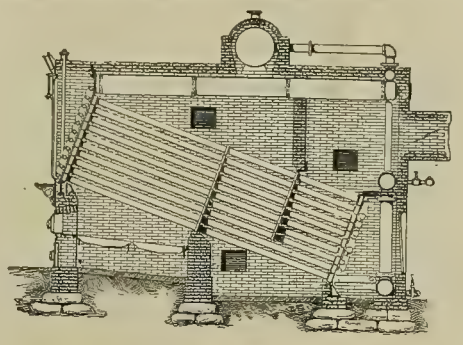
The action of the fire is to cause an upward and forward flow in the tubes. The water thus forced from the tubes into the front end of the horizontal drum is constantly replaced by a downward flow from the rear end of the drum to the rear end of the tubes. There is, therefore, a steady continuous circulation of the water throughout the boiler, and the steam is disengaged into the upper portion of the horizontal drums. The tubes are expanded in pairs at both ends into bored holes in cast iron headers, and when in place they are in identical conditions, as far as exposure to flame, temperature of contents, etc.,are concerned. The expansion and contraction of both, consequently, must be uniform. One horizontal drum with its underlying row of headers and the tubes therein, forms a separate "section" of the boilers. It will be noted that the rows of headers at the front and back of each section, with the bends connecting them, form a single header through which the ends of the tubes in that section are connected to the ends of the overhead drums. In this manner the connections are made between the tubes and the drum to provide for the circulation of the water. For the purpose of equalizing the pressure and water level, as well as to supply feed water and take away the steam, the several sections are all connected to a common cross steam pipe and a common mud drum, located at the rear or rigid end of the boiler.

From the common steam pipe two outlets connect with an overhead cross steam drum, of ample capacity, to which are attached the main stop and safety valves. The drum is provided with a drip pipe leading below the water line so that condensation may drain back into the boiler.

The path of the downward circulation in large boilers is from each overhead drum through its connected downtake, into the common feed drum; from this, through the standpipes to the mud drum; thence the water is distributed to the lowest headers of all the sections. The object of this arrangement of feed drum and standpipes is to heat the entering feed water by mingling with the descending currents from the overhead drums.

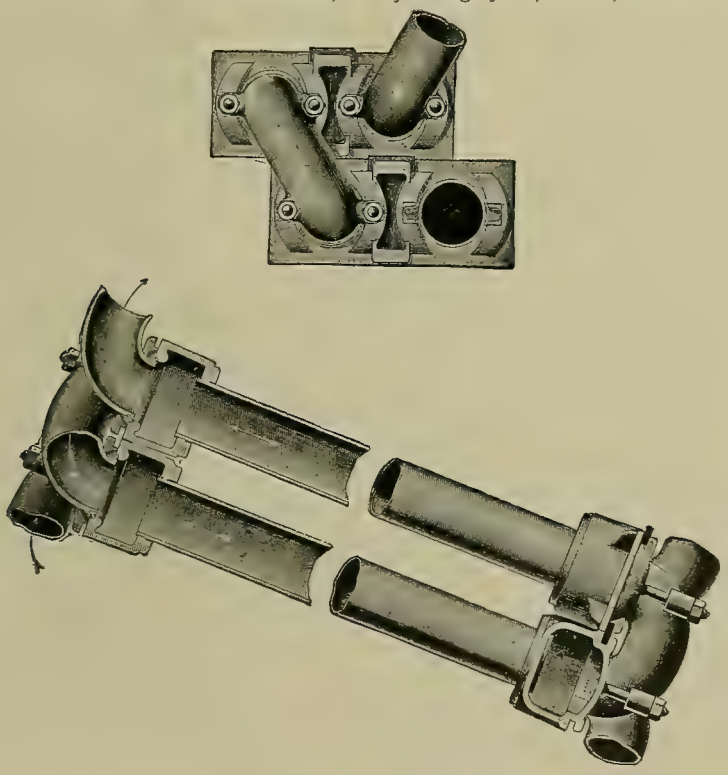
The boiler is inclosed in brick work, the headers which are milled on their sides, forming the front and rear walls of the combustion chamber. A brick wall at the rear incloses the mud drum and the rear end of the boiler, so as to prevent undue radiation, and a chamber is thereby formed between this wall and the rear headers to which access may be had at all times, even with steam up.

The subdivision of the water into small masses, the largest only fourteen inches in diameter, is an element of safety in the boiler. The tubes are strong, and under heavy pressure do not tend to actually explode. Little more than a rupture can happen it is claimed. Should a tube explode, it is stated, the accident would be local and slight so that no damage would follow. A reduction of pressure on the boiler and the gradual blowing-out of the contents would ensue.



ROOT WATER TUBE STEAM BOILER.

In the Root boiler the manufacturers claim that every single part is free to expand and contract independently and fire strains are absolutely eliminated. This has been accomplished by the Root metallic joint which is made, metal to metal, without any intervening substance and without "grinding." It may be described as a yielding joint, which, while it is absolutely tight at all pressures, yet allows the connecting parts to move slightly. The boiler, which is made by the Abendroth & Root Manufacturing company of New York, is in use in a large number of electric light stations.



ROOT IMPROVED WATER TUBE STEAM BOILER.

Municipal Lighting at Baltimore, Md.

Municipal lighting has found another advocate, it is reported, in the mayor of Baltimore, Md. He will shortly recommend the city to establish an electric light plant, it is said, but it is not known whether he will advocate commercial lighting in connection with the public service. At present the city lighting is done by a local commercial company. It is reported the mayor will address a special message to the city council on the subject of electric lighting.

Collapse of the Brotherhood of Telegraph Operators.

The last week was eventful in telegraph circles as it witnessed the collapse of another movement on the part of the operators to secure an organization that could command the attention of the big companies. Since the great strike which proved so disastrous to the operators, numerous attempts have been made to form a union that would embrace all branches of the business, but in every case failure was precipitated by some hasty action on the part of the men. They have never since had a thorough organization. The prominent figures in all of these movements are men who have lost their positions with the companies presumably through their connection with the labor movement. They are looked upon as sufferers in the cause by their associates, and have naturally gained considerable influence over them. It has not been hard for the telegraph companies to follow closely the movements of these men and keep thoroughly acquainted with the plans of their employes. This has, of course, given them an advantage over the men, and they have been able to protect themselves against the projected strikes.

It seems, however, in the last movement that the men themselves were not united as the leaders of the brotherhood represented. It will be remembered that the gentlemen who conceived the idea of organizing for the protection of the operators declared that the railroad men needed as much protection as others, and that the Order of Railway Telegraphers, which opposes strikes, was declining, that the railroad companies were breaking up the organization and that the members were deserting the order and flocking to the new association, which believed in strikes. The *Railway Telegrapher*, the official organ of the Order of Railway Telegraphers, charges the leaders of the brotherhood with making false statements and sailing under false colors. Speaking of the new organization, it says: "Of the leaders of this movement we have nothing to say, as nearly all members of the O. R. T. know their history and their former connection with our order, but of their practices in endeavoring to tear down and destroy all the good that has resulted from this noble organization, we do protest against it most emphatically. The falsity of their assertions prove the unrighteous and selfish ends for which they are laboring. They say: 'Of late this order has been rapidly decreasing in strength, and in its place has sprung up the Brotherhood.' The facts in the case are the grand secretary's books will show more members in good standing to-day than at any previous date in the history of the organization." The members of the order believe the day of strikes has passed, and they have no sympathy with the advocates of such methods. It is claimed the order is stronger to-day than ever before, and it is further asserted: "There is not a member in good standing to-day but who knows that the O. R. T. has done the telegraphic fraternity more substantial good than all the telegraph organizations combined which have ever existed before it."

It is not, therefore, surprising that the movement failed, inasmuch as it did not command the sympathy of the men in whose interests it was ostensibly organized. The ill-advised action of the men at several points in stirring up contention precipitated the downfall of the organization. Relying upon the reports that the brotherhood was thoroughly organized and had plenty of money in the treasury, they became bold in their demands, and finding that the companies would not consider them as an organization, they undertook to enforce their demands. The result was the exposure of their own weakness. The Brotherhood is practically a wreck and the Order of Telegraphers, which does not believe in strikes, is reported in a prosperous condition. It is hardly possible the Brotherhood will again be heard from, and it is equally impossible for it to assume a threatening attitude.

Investigation of the Stanley Alternate Current Arc Dynamo.[1]

By W. B. Tobey and G. H. Walbridge.

Before entering directly upon the subject to be presented this evening, i. e., the investigation of the Stanley alternate current arc dynamo, it may be well to give a brief description of that new and extremely novel type of machine. Descriptions of it have been given in some of the electrical papers during the past spring, but some here may not recall its general mechanical construction. The dynamo is manufactured and sold by the Westinghouse

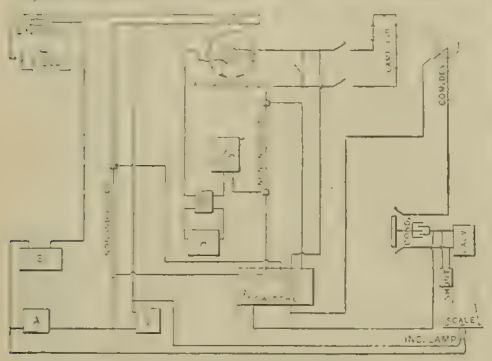


Fig. 1.—DIAGRAM OF CONNECTIONS.
A, A, A. Ammeters; V. Voltmeter.

Electric company under patents granted to Wm. Stanley, Jr., the inventor. Mr. Albert Schmid, superintendent of the Westinghouse Electric company shops, deserves much credit for perfecting the machine in detail, and to him is largely due its success commercially. In general appearance it closely resembles the Westinghouse alternate current constant potential dynamo, which has become so familiar to all. In fact, the frame, pole pieces, field windings, etc., for any given size machine are identical, whether for constant current or constant potential. The distinguishing feature between them lies wholly in the form and winding of the armatures. Figs. 12 and 13, showing

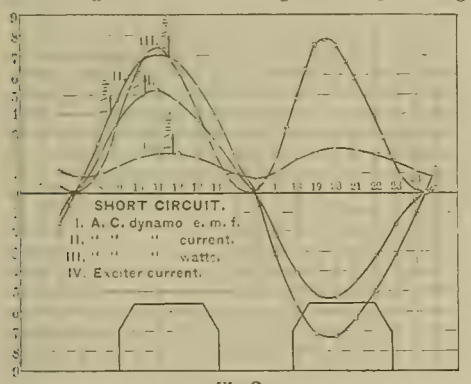


Fig. 2.

diagrammatically half sections of the machine, will aid us in a description of the armature, which is built up of thin iron plates stamped in the form shown. It will be observed that a number of cores corresponding to the number of poles on the dynamo project radially from the armature, and from the sides of each core project overlapping lugs. The armature coils are not of the original "pancake" or oblong flat coil type, placed on the periphery of the armature, but are quite thick and placed around the core projections. The overlapping lugs serve the double purpose of preventing the coils from slipping off the cores and also aid in the regulation of the machine. All the armature

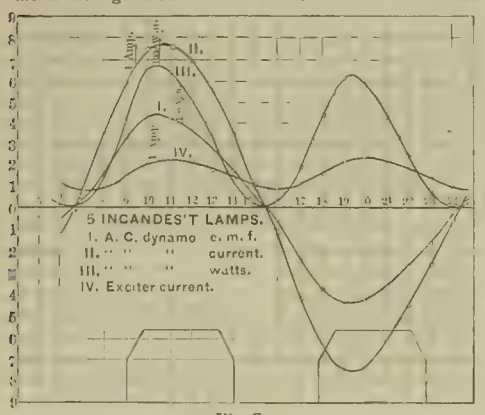


Fig. 3.

coils are connected in series and the terminals connected to the two collector rings, upon which bear the brushes furnishing current to the line. The field coils are also in series, so connected that the poles presented to the armature are of alternate polarity. The terminals of the field go directly to a small shunt wound exciter. Thus it is seen that the machine consists simply of an even number of field coils, corresponding to the number of poles on the machine, joined in series, and an equal number of armature coils also joined in series. That from such a simple combination of coils without any external regulating device an almost constant current is obtained for all loads, from short circuit to the maximum output of the machine, seems incredible, but such is the case.

Through the kindness of Mr. Stanley, a complete 40-

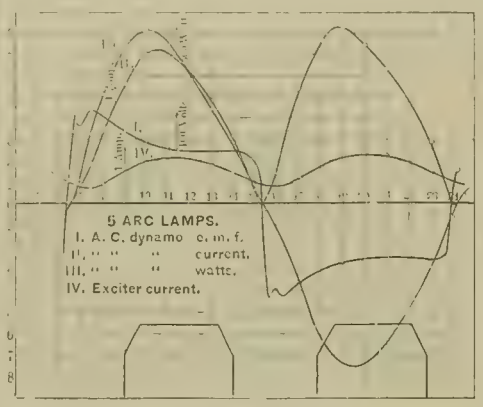


Fig. 4.

light plant was sent the writers at Cornell University, at which institution we were then students. Later, the Westinghouse company made the university a gift of the entire plant. It has been our aim to show how the regulation takes place; also, to determine the actual electrical output of the machine, and from the latter and the corresponding dynamo meter readings to calculate the efficiency of the dynamo.

The alternator was mounted on a Brackett cradle dynamometer calibrated to read in watts direct at 1,000 revolutions, the speed at which we were running.

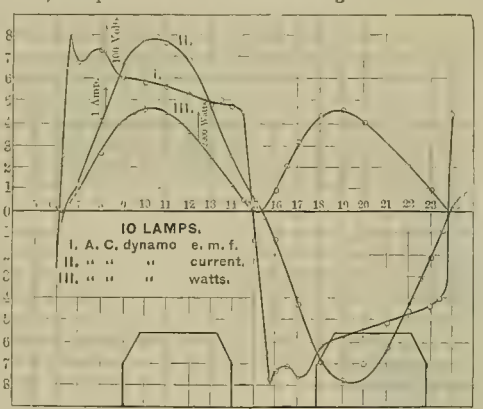


Fig. 5.

The general method has been to obtain instantaneous values of e. m. f. arc and exciter currents at a sufficient number of points to indicate by curves the performance of the dynamo at every part of a revolution. For this purpose runs were taken with the dynamo at short circuit and with loads of 5, 10, etc., up to 40 lamps. The dynamo was run under normal conditions, viz., at a speed of 1,000 revolutions and with such excitation as to cause an output of approximately 10 amperes. For obtaining values of e. m. f. at low loads, pressure wires were run from the terminals of the dynamo and for larger loads were taken from around 10 lamps. At all points where instantaneous

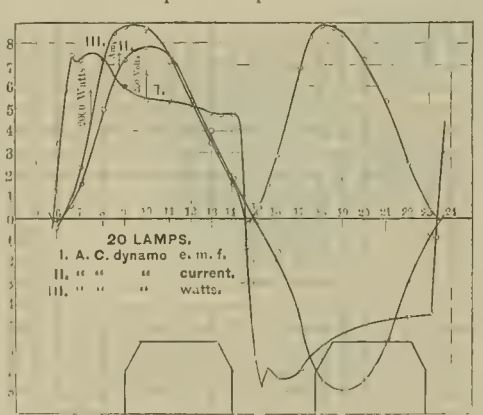


Fig. 6.

values of e. m. f. were taken corresponding values of arc and field, or exciter currents, were obtained by "fall of potential" method. Pressure wires were brought from the terminals of each of two non-inductive resistances of german silver wire placed in arc and field circuits, Fig. 1. These resistances being constant, any pressure around the terminals corresponds to a certain current. The terminals of the three pairs of pressure wires were connected to the contacts of the triple-throw switch, so that by placing the switch on any pair of contacts desired, those terminals could be put in circuit with a line in which was a condenser and the revolving contact or commutating device by means of which the condenser was charged. The revolving contact used was similar to the one described in detail by Prof. Ryan in his article on "Transformers" read before the institute last December. It consisted essentially of a knife edge of steel fastened by a wooden clamp to the collector end of the armature, and revolving with it through a circle of about eight inches diameter. The center of the knife edge was in line with the center of one of the armature coils. Upon a frame at the same end of the armature was held a wooden semicircle, upon the

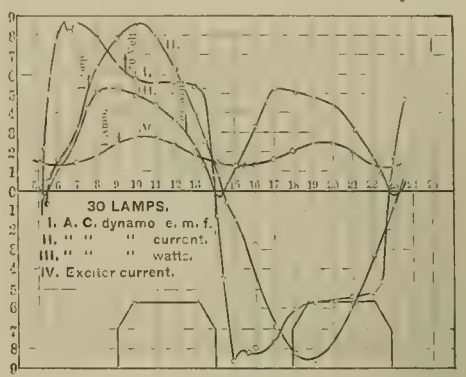


Fig. 7.

periphery of which was a wooden scale, divided to millimeters. At the center of the semicircle was pivoted an arm carrying a brush holder, in which was a steel spring. The brush holder was so adjusted that the revolving knife edge made contact with the spring several times per second. The arm carrying this spring could be clamped wherever desired and its position designated by means of a pointer over the scale.[2] Thus, the condenser, placed in series could be brought to the same difference of potential that existed between the spring and the knife edge. The arc circuit was, as shown by the diagram of connections, Fig. 1, taken from one brush directly to a Westinghouse ammeter through a switch, by means of which a Thomson

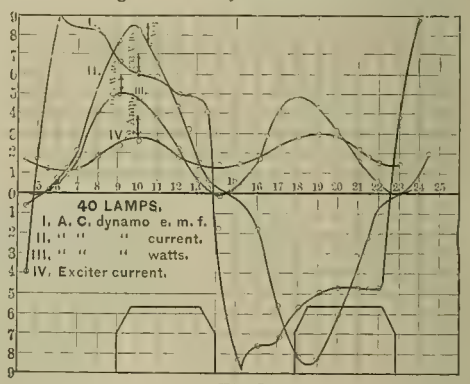


Fig. 8.

balance, or gravity ammeter, could be put in circuit when desired. From the Westinghouse ammeter the current was taken through the non-inductive resistance to the dynamo short-circuiting switch, where the other terminal of the machine was directly connected. The exciter current was measured by a Ryan gravity ammeter, and a Hartmann and Braun type voltmeter indicated the potential around the terminals of the field. The arm of the commutating device being clamped at some desired position, the spring was adjusted so that the revolving knife edge made contact; then the switch was thrown on any one of the three pairs of terminals, for the circuits of which we wished to obtain instantaneous values. The half microfarad condenser was so connected that by closing a key it could be charged. Opening this key and closing one in circuit with the galvanometer sent the charge through the galvanometer, and the throw was noted.

The galvanometer used was of 5,000 ohms' resistance, and consisted of the coil of a Sir Wm. Thomson marine galvanometer, in which was suspended a small concave

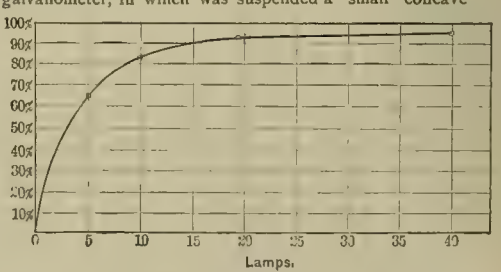


Fig. 9.—EFFICIENCY CURVE.

mirror, having several very small magnets constituting the needle fastened on the back. The controller was a large horseshoe magnet. A simple wooden frame supported the coil. A narrow slit in a screen, behind which stood an incandescent lamp, allowed an image of part of the filament to fall on the galvanometer mirror, and be reflected back to the screen, on which was a graduated scale. By placing a resistance box in shunt around the galvanometer, the throw of the needle was reduced when it was desired to read the arc e. m. f. When current readings were taken

[1] Read before the American Institute of Electrical Engineers, New York, Oct. 21, 1890.

[2] Much trouble experienced by other investigators in this line, due to breaking of the spring, was entirely obviated by us by putting a piece of thin rubber packing above the spring where it was clamped in the brush holder.

the whole charge of the condenser was passed through the galvanometer. The galvanometer was calibrated for e. m. f. by putting the condenser and a standard potential instrument in multiple around the terminals of a storage battery giving about 120 volts. Readings were then taken of the voltage, and the corresponding throw of the needle was noted. The calibrations for currents were made by running the exciter alone and passing the current through both of the non-inductive resistances, determining its amount by an ammeter, and observing the corresponding throw of the galvanometer needle for each non-inductive resistance.

So much for a description of the dynamo, the instruments and the methods used. We now come to that which

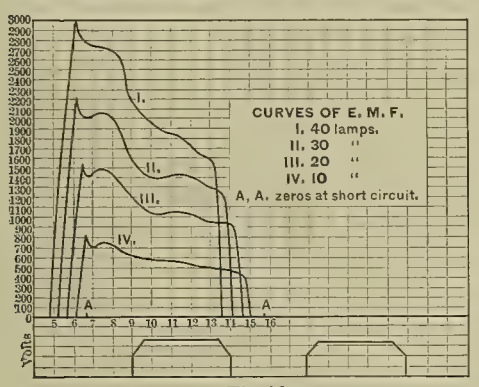


Fig. 10.

is of most interest, viz., the results obtained. In order that the curves may be more easily followed we will give a brief general explanation of them.

The figures on the zero line, always commencing with 5, correspond to the divisions on the scale of the wooden semicircle, a part of the commutating device. Under each plate of curves will be seen two rectangular figures, repre-

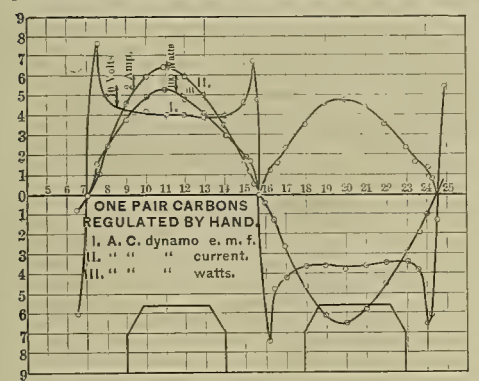


Fig. 11.

senting pole pieces, which show the relative position of the curves with respect to the poles. From each curve projects a vertical arrow, always equal to one or two divisions, and its value marked near it. In all curves the direction of motion of the armature relatively to the poles is from left to right.

Fig. 2 represents the performance of the machine at

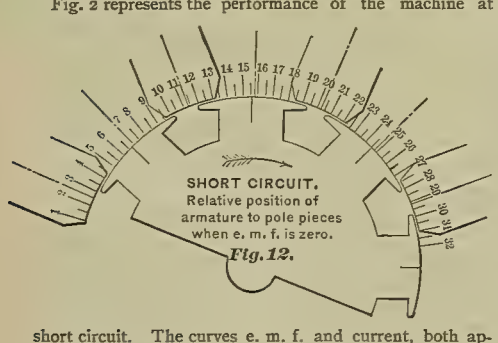


Fig. 12.

short circuit. The curves e. m. f. and current, both approach sine curves; the current rising almost in unison with the e. m. f., there being no perceptible lag. The curve of exciter current in this, as in all cases, exhibits a wavy form. Fig. 12 shows the position of the armature relatively to the poles when the e. m. f. is zero, and the machine running on short circuit.

Fig. 4, representing the curves for a load of five arc lamps, shows a radical change in the e. m. f., which now approaches more nearly to the form of a rectangle than a sine curve, and immediately after passing the zeros exhibits very sharp peaks. In this case the current continues to rise after the e. m. f. has begun to fall, and also lags slightly with respect to it. A shifting of the zeros has also taken place. Comparing this e. m. f. curve with that for short circuit it is seen that the first zero shown occurs at about 6.35 instead of 6.85. The curves for all loads of arc lamps are quite similar in form, as will be seen by referring to Figs. 5, 6, 7 and 8. As the load is increased, however, the zeros occur earlier with respect to the poles, and the current lag increases slightly. The efficiency curve, Fig. 9 tells the story of the dynamo from a commercial point of view, reaching as it does an efficiency of between 93 per cent. and 94 per cent. at full load, while at half load it is 92 per cent.

A most interesting set of curves is shown in Fig. 10, giving a comparison of the forms and values of e. m. f. for 40, 30, 20, and 10 lamps, their position with respect to the poles, and also the position of the zeros of e. m. f. at short circuit.

Figs. 13 and 12 show respectively the positions of the armature relatively to the poles for full load and short circuit.

An apparently remarkable feature of the machine is that it may be short circuited when running at full load, without the slightest injury, and it may be run at short circuit indefinitely. That the machine regulates with great rapidity is proven by the fact that upon short-circuiting it, the ammeter indicates but a slight increase of current.

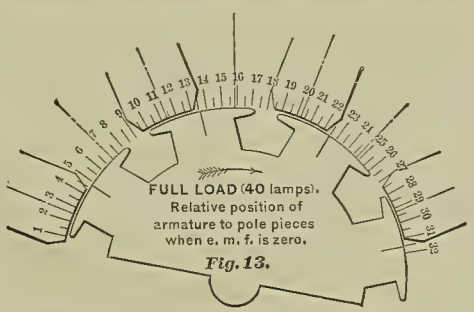


Fig. 13.

The peculiar form of the e. m. f. curve for arc lamps led us, so far as time would permit, to an investigation of the cause, to ascertain which the following runs were taken:

First, with a non-inductive resistance of five large incandescent lamps, but no arcs in circuit; each lamp consuming about the same amount of energy as an arc lamp. Second, with nothing but an inductive resistance, consisting of a solenoid having 440 turns of No. 10 wire. The curves in both cases were similar and approached sine curves, proving the rectangular form to be due entirely to the action of the arc. Fig. 3 shows the curves obtained from the load of incandescent lamps. To more fully determine this action with no other resistance in circuit, an arrangement was made whereby an arc could be regulated by hand with the aid of a hot wire voltmeter. We took no curve for a single lamp under normal conditions with which to compare the one taken in the above manner; but the latter (see Fig. 2) has very high and abrupt elevations of e. m. f. immediately before and after passing the zeros. The theory advanced to explain the high point of e. m. f. in all the arc curves is, that when the arc breaks, the rush of cold air adding resistance to the circuit, prevents the arc forming again until the potential has risen to a point considerably higher than that required to maintain an arc once formed. To test this we attempted to heat an arc by means of an alcohol blast, and thus prevent in a measure the rush of cold air. This means of heating proved inadequate, so that the result was not all that could be desired. As before stated, we had no one-lamp curve with which to compare it, but as compared to the one lamp regulated by hand, the sharp corners of e. m. f. were much modified. It is not certain, however, whether this was due to the action of the lamp-regulating coils, or to the action of the flame. The current curve in all cases approaches a sine curve in form, but is always slightly steeper on the left or front side; direction of rotation being from left to right. Although the current lag is practically nothing at short circuit, or for any load except arc lamps, it increases slowly as arc lamps are added. For forty lamps it is about 4½ per cent. of the time of an alternation. The wavy form of the exciter current is probably caused by the variable resistance of the magnetic circuit, due to the projecting cores and lugs of the armature as they approach and recede from the poles. The values of e. m. f. and current were found by taking the square root of the mean square of 36 ordinates of a curve, representing a complete cycle. Although the current lag was very small, the product of the values of current and e. m. f. obtained as above did not give the watts. The watts were obtained by plotting a curve, the points of which were the products of the instantaneous values of e. m. f. and current; then integrating by a planometer. Dividing the value of the watts thus obtained by the current, we obtained a value of the e. m. f. which was usually about seven volts lower per lamp than the corresponding value obtained from the square root of the mean square. This difference was no doubt due to the extremely high values of the e. m. f. when the current was very low, as the negative work was negligible. To distinguish between the two values we have called the one obtained from the square root of the mean square the "actual" e. m. f., while the one obtained by the second method has been called the "effective" e. m. f., it alone being effective in doing work on the circuit.

It is very much of a question in our minds whether the square root of the mean square, obtained from the rectangular e. m. f. curves for arc lamps, gives the actual e. m. f., but for the lack of a better term the values thus obtained have been called the "actual" e. m. f's.

For arc current values we have assumed the square root of the mean square to be correct, and if not actually the case, they are certainly very close approximations, as the current curves are practically sine curves.

The exact values of e. m. f. or current are of little consequence, however, except as a matter of interest, since the electrical output in watts is known, this alone being required to determine the efficiency.

In conclusion we can simply state what our investigations have shown, that the dynamo, aside from being very efficient and of most excellent regulation, is as stated at the beginning an extremely novel and interesting type of machine.

Table of Data.

	√mean sq. of e. m. f.	Volts per lamp, "Actual."	√mean sq. of current.	Volts per lamp, "Effective."	Mean watts, electrical.	Watts excitation.	Mean watts by dynamometer.	Efficiency.
Short circuit	3.53	.....	9.78	.....	35	155	1780	.....
5 Incandescent	289	57.8	10.32	59.3	3060	158	3900	75.3%
5 Arc	285.	57.	9.98	50.	2500	165	3584	66.6%
10 Arc	.....	.....	10.7	53.3	5700	190	6630	83.5%
20 Arc	1100.	55.	10.36	48.3	10000	190	10680	92.3%
30 Arc	.....	.....	.....	.....	.....	204	12120	.....
40 Arc	....	... .	9.82	41.	16000	240	16950	93.2%
1 pr. carbons	42.	42.	8.86	35.5	314	.....	.....	..

Electric Power at Kearney, Neb.

The development of the electric interests in Kearney, Neb., has been phenomenal. Two years ago the power house of the Kearney Electric company consisted of a little wooden structure 18x28 feet in dimensions. Adjoining was a smaller building which served as a covering for a 350-horse power water wheel, with which the company began business. The first dynamo was a Thomson-Houston machine with a capacity of 30 arc lights. It was about a year after that the company added two Edison dynamos, each with a capacity of 650 incandescent lights. The popularity of the new light was so great that six months later two more dynamos of the same make were added to the plant, each of these being capable of supplying 1,000 lights. A large 95-horse power dynamo was also added, which is now used to supply power for the electric street railroad. The company has in reserve a Thomson-Houston dynamo. Of course all these machines could not be accommodated in the 18x28 foot building, and a year ago the Geo. W. Frank Improvement company constructed the handsome three-story pressed brick building, 65x84 and 70 feet high, adjoining the wooden wheel house. This house contains not only the power plant but repair shops and store rooms. The plant furnishes current for 30 arc lights and 3,200 incandescent lamps and a large number of electric motors for manufacturing purposes. The principal motor installations are at the Kearney brick yards, where a 75-horse power is utilized; the Kearney Canning company, which has a 30 horse power machine, and at the woolen mills, which also uses a 30-horse power. The company is now negotiating with the Kearney Milling and Elevator company for supplying 100-horse power to take the place of the steam plant. The street railway company receives its power from this station, and many small manufacturing companies, together with printing establishments, depend upon electricity. The electric street car line, operated from this station, is 5½ miles in length.

Patent Litigation on Fire Alarm Apparatus.

A dispatch from Indianapolis Oct. 29th says: "A decision was rendered by Judge Gresham of the Federal Court, today, in the suit of Walker & Olters of the city of Terre Haute, charging infringement of patent in the use of the Bragg fire alarm device. The invention consists of a gong and a contrivance that unfastens the halters of the horses and drops the harness upon them by electricity when an alarm is sounded. Several years ago Walker & Olters purchased the right to make and use the device in Indiana, Ohio, Illinois and Michigan; and a number of other States, and introduced it into a number of fire departments. The owners then discovered that without authority from the patentee the device was used by nearly every city in the Union having a paid fire department. Suit was entered in 1887 to enjoin the city of Terre Haute and to recover damages and Judge Gresham to day decided in favor of the plaintiffs and appointed Master in Chancery Fishback to investigate and fix the measure of damage due by Terre Haute and report to the court. Suits will now be filed against every city in which the invention is used. Walker recently offered to allow the device to be used in Terre Haute permanently for $6,000." City Electrician Barrett of Chicago, says the device is not as generally used as the dispatch would indicate. Mr. Walker endeavored to introduce it in Chicago and asked $50,000 for the privilege, but the city did not want it. "At that time," said Prof. Barrett, "there was no arrangement for lowering the harness as referred to in the dispatch. I do not think that it is practicable. If the harness was lowered when the gong was struck it would be on the ground by the time the horses got around to their places." This is not the first action that has grown out of the patents on this device.

The Chicago City Railway company has for several years been using a Thomson-Houston incandescent dynamo for lighting the power house and offices near the corner of Twentieth and State streets, and has decided to adopt the system for lighting the new power house at the corner of Sixty-first and State streets.

A New Method of Analyzing the Magnetic Reactions of Armatures Applied to the Stanley Arc Light Alternating Current Machine.[1]

BY THOMSON REID.

This analysis is a result of looking at an old and well known phenomenon from a new point of view, and is merely a development of the principle of the magnetic circuit a little further than has heretofore been usual. Hopkinson, I find, has used much the same method in his analysis of the transformer, and seems vaguely to have foreseen its application to dynamos, if I may judge from a part of a sentence which I ran across in one of his articles a few days ago. This same principle has been discussed at some length in the English electrical journals lately, but I am not aware that any analysis has been attempted by means of it.

By this conception dynamos are considered to consist of a magnetic circuit composed partly of iron, or steel, and partly of air, one part being at rest and the other in motion, generally rotary. Magnetism is induced in this circuit by means of two or more coils of wire carrying an electric current, wound around some part or parts of the circuit. One or more coils may be wound on the fixed part of the circuit and one or more on the moving part, and the magnetism induced will be that due to the sum of all the magnetomotive forces in all the coils divided by the sum of all the magnetic resistances. The magnetomotive forces in the fixed coils are generally approximately constant, except where they are varied for purposes of regulation. In the movable coils, however, the m. m. f. is generally variable. In direct current machines its effect on the total flux around the magnetic circuit is also almost inappreciable, chiefly

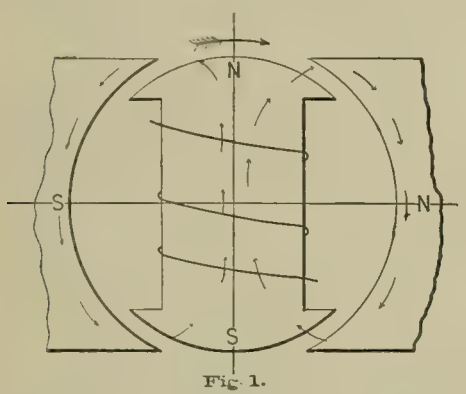


Fig. 1.

for the reason that it acts almost at right angles to the magnetic circuit. In alternating current machines, however, it is quite considerable, and is generally taken into account, but attributed to the self-induction of the armature.

The connection between the counter m. m. f., as it may be called, of the armature and its self-induction will be brought out more fully in a subsequent part of this paper.

To simplify our conceptions we will assume a two-pole dynamo with one coil on the armature as shown in Fig. 1.

Referring to the diagram, Fig. 2, let $ON = N$, represent the magnetic induction through the armature due to the field in magnitude and direction; let $\overline{CC'}$ represent the position of the armature coil at that instant; let $OA = A$ at right angles to CC', represent the magnetic induction due to the armature coil at that instant; let PP', at right angles to the field lines, be the neutral line; let $POC = \theta$, be the angle through which the coil has moved from its neutral position.

By completing the parallelogram, and thus compounding the two magnetizations, N and A, we obtain $M = OR$ as the resultant magnetic induction through the armature coil in amount and direction, at that instant, and $\overline{QQ'}$, at right angles to OR, as the neutral line with reference to this resultant magnetization. Then $2\,OC = \sigma$ is the angle through which the coil has turned from this new neutral line

Let the angle $NOR = ORA = X$. We are to deduce the value of M from the known quantities N, A, and the angle θ, in the triangle ROA. RO is perpendicular to OQ and OA is perpendicular to OC, therefore the angle $ROA = QOC' = \sigma$.

Also OA is perpendicular to OC and AR is perpendicular to OP; therefore $OAR = COP = 180 - \theta$.

From trigonometry we have

$$\frac{M}{\sin(180 - \theta)} = \frac{N}{\sin\sigma} = \frac{A}{\sin x} \text{ or}$$

$$\frac{M}{\sin\theta} = \frac{N}{\sin\sigma} = \frac{A}{\sin(\theta - \sigma)} \tag{1}$$

therefore,

$$N\sin(\theta - \sigma) = A\sin\sigma$$

expanding $\sin(\theta - \sigma)$, dividing by $\cos\sigma$ and solving for $\tan\sigma$, we have

$$\tan\sigma = \frac{N\sin\theta}{N\cos\theta + A} \tag{2}$$

whence by trigonometry

$$\cos\sigma = \frac{N\cos\theta + A}{\sqrt{N^2 + 2AN\cos\theta + A^2}} \tag{3}$$

[1] Read before the American Institute of Electrical Engineers, New York, Oct. 21, 1890.

$$\sin\sigma = \frac{N\sin\theta}{\sqrt{N^2 + 2AN\cos\theta + A^2}} \tag{4}$$

therefore from equation (1)

$$M = N\frac{\sin\theta}{\sin\sigma} = \sqrt{N^2 + 2AN\cos\theta + A^2} \tag{5}$$

This last expression gives us the actual value of the induction through the armature coil at that instant in terms of

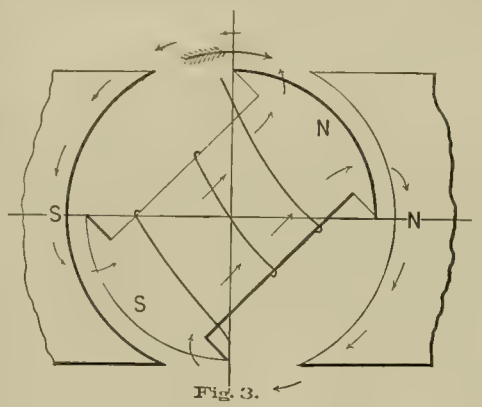


Fig. 3.

the field strength, the armature strength and the angle θ through which the coil has been turned from the position perpendicular to the field line. The direction of this resultant magnetization is along $\overline{OR}$, and the neutral line has been shifted from $\overline{OP}$ to OQ and the number of lines actually passing through the coils is $M\cos\sigma$.

From equations (3) and (5) we obtain $M\cos\sigma = N\cos\theta + A$.

The e. m. f. at any instant is then

$$E = -\frac{d}{dt}\left\{SN\cos\frac{2\pi t}{T} + SA\right\} \tag{6}$$

where S is the number of turns in the coil.

Now t is the time which has elapsed since the coil passed the position $\overline{OP}$ and T is the time of one revolution, therefore

$$E = \frac{2\pi SN}{T}\sin\frac{2\pi t}{T} - S\frac{dA}{dt} \tag{7}$$

The armature magnetization A depends on the number of turns in the coil, on the current flowing through it, and on the magnetic resistance offered to its lines of force; or

$$A = \frac{Si}{\rho} \tag{8}$$

where ρ is the magnetic resistance, and i the instantaneous value of the current.

Letting $\frac{S^2}{\rho} = L$ dividing through by R, the resistance in the main circuit and collecting the terms, we have

$$\frac{di}{dt} + \frac{R}{L}i = \frac{2\pi SN}{LT}\sin 2\pi\frac{t}{T} \tag{9}$$

This equation may be reduced to the following form

$$i = e^{-bt}\int a\sin pt\, e^{bt}\, dt \tag{11}$$

which may be integrated by parts thus:

$$i = a\,e^{-bt}\int e^{bt}\sin pt\, dt$$

Let $u = \sin pt$ and $dv = e^{bt}dt$ then $du = p\cos dt\ dt$ and $v = \frac{1}{b}e^{bt}\int dv = \frac{1}{b}e^{bt}\sin pt - \int\frac{1}{b}e^{bt}p\cos pt\ dt$ $i = \frac{a}{b}\sin pt - \frac{ap}{b}e^{-bt}\int e^{bt}\cos pt\ dt$.

Let $u = \cos pt$ and $dv = e^{bt}dt$ then $du = -p\sin pt\ dt$ and $v = \frac{1}{b}e^{bt}\int u\,dv = \frac{1}{b}e^{bt}\cos pt + \int\frac{1}{b}e^{bt}p\sin pt\,dt$;

Therefore, $i = \frac{a}{b}\sin pt - \frac{ap}{b^2}\cos pt - \frac{p^2}{b^2}i$, or

$$i = \frac{a}{\sqrt{p^2 + b^2}}\left\{\frac{b}{\sqrt{p^2 + b^2}}\sin pt - \frac{p}{\sqrt{p^2 + b^2}}\cos pt\right\}$$

Let $\tan^{-1}\phi = \frac{p}{b}$. Then substituting for a, b, and p, their values, we have

$$i = \frac{2\pi SN}{\sqrt{R^2T^2 + 4\pi^2L^2}}\sin(\theta - \phi) \tag{12}$$

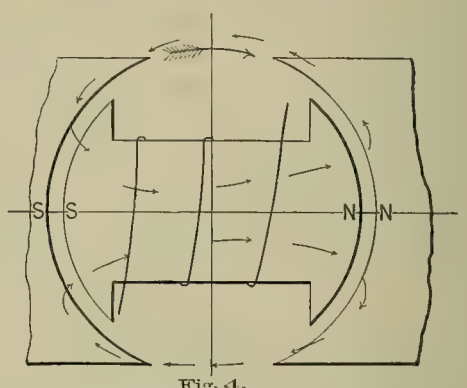


Fig. 4.

where ρ is the angle of lag, or by the angle by which the effective e. m. f. lags behind the impressed e. m. f.

This is the instantaneous value of the current at any instant. Since the average value of the square of the sine of any angle is $\frac{1}{2}$, we have, calling C the square root of the average square of the current;

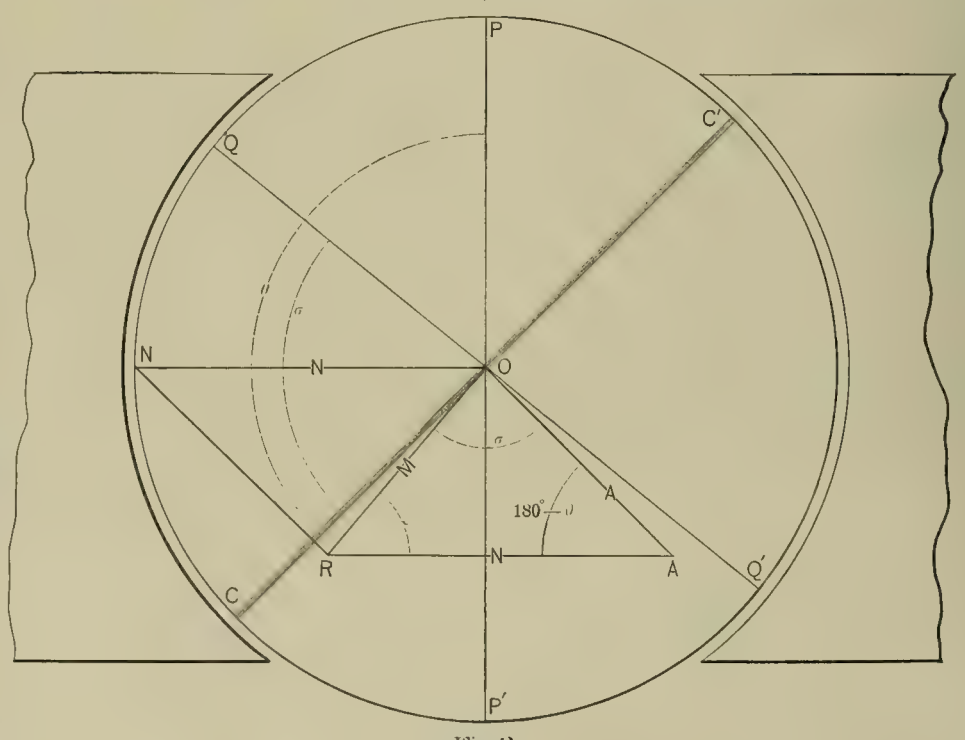


Fig. 2.

Let

$$\frac{2\pi SN}{LT} = a,\quad \frac{2\pi}{T} = p \text{ and } \frac{R}{L} = b$$

and we have

$$\frac{di}{dt} + bi = a\sin pt \tag{10}$$

a differential equation which must be integrated.

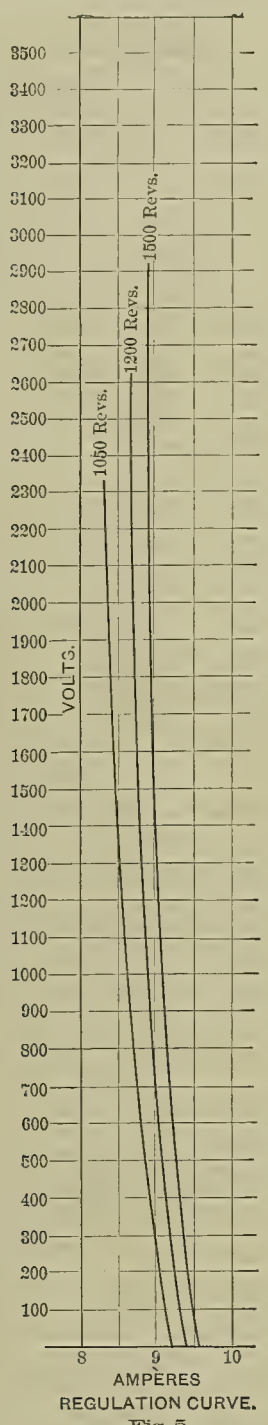
$$c = \frac{\frac{1}{2}\cdot 2\pi SN}{\sqrt{R^2T^2 + 4\pi^2L^2}} \tag{13}$$

$$E = \frac{\frac{1}{2}\cdot 2\pi SNR}{\sqrt{R^2T^2 + 4\pi^2L^2}} \tag{14}$$

You will no doubt have already recognized this equation as the ordinary equation of the alternating current dynamo,

when the self-induction of the armature coils is taken into account. This analysis so far has taken no account of the self-induction in the armature coils. There has, however, been introduced into the discussion a factor not generally treated in this connection, namely the counter m. m. f. of the coil. This factor occurs in the equation as the expression for which I have used the letter L. L is ordinarily used to denote the coefficient of self-induction, and I chose it for that very reason. The connecting link is shown by the value given to L in our equation; namely $\frac{S^2}{\rho}$

We shall now show that L, the coefficient of self-induction of a coil. is equal to the square of the number of turns in the coil, divided by the magnetic resistance of the circuit,



REGULATION CURVE.
Fig. 5.

through which the lines of force of the current flowing in the coil must travel.

There are several ways of getting at a definition of L and perhaps the simplest is the following:

The counter-e. m.f. of the self-induction of a coil, in which a varying current is flowing is $L \frac{di}{dt}$ where $\frac{di}{dt}$ is the rate of change of the current at the instant considered; or more simply, if the current is changing at a constant rate, it is the number of amperes through which the current is increasing or decreasing in a second. If the current is changing at the rate of one ampere in a second, $\frac{di}{dt}$ becomes unity and $L \frac{di}{dt}$ becomes equal to L; Therefore, L = the counter e. m. f. of the self-induction of a coil, in which the current is changing at the rate of one ampere in a second.

Now selecting suitable units, the number of lines of force which will be sent around a magnetic circuit of magnetic resistance ρ by a current of one ampere flowing through a coil of S turns, will be $\frac{S}{\rho}$. Therefore, if the current is increasing at the rate of one ampere per second, $\frac{S}{\rho}$ lines of force will be inserted or taken out of the coil in a second, and the e. m. f. set up will be $\frac{S}{\rho} \times S = \frac{S^2}{\rho}$ but, since the current is changing at the rate of one ampere per second, the e. m. f. set up $= L$, therefore $L = \frac{S^2}{\rho}$.

These equations, (13 and 14) might have been arrived at a little differently by revolving the counter m. m. f. of the coil parallel to the induction due to the field and then considering the comparative values of the resistances through the inside of the coil and around the outside; but this method is more complicated than the one I have chosen, and a little consideration will show that it is precisely the same thing, merely looked at from a different point of view.

Now let us see how the equation must be modified to suit the conditions obtaining in the Stanley alternating arc machine. This machine is of the multipolar type, with the coils laid flat on the armature core. It differs from the ordinary Westinghouse alternating machine mainly in the facts that each coil consists of a large number of turns, and is laid in longitudinal grooves in the armature core in such a manner as to be almost entirely surrounded by iron, and that the number of alterations per second is large. As a result of this arrangement, the machine maintains a nearly constant current throughout wide variations of resistance and speed.

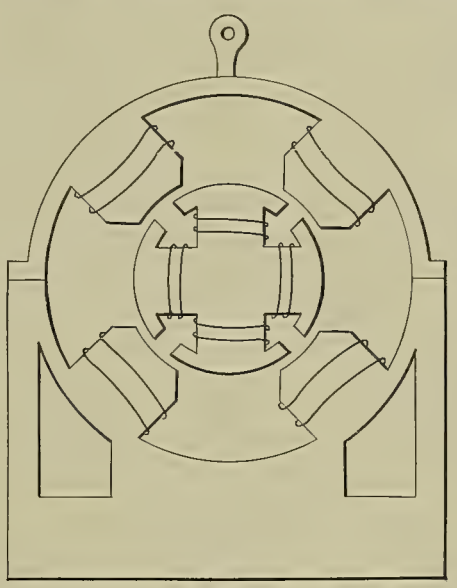


Fig. C.

To explain this phenomenon we will use equation (13), first substituting for L its value $\frac{S^2}{\rho}$ and we have

$$C = \frac{\sqrt{2}\,\pi\, S N}{\sqrt{R^2 T^2 + 4\,\pi^2 \frac{S^4}{\rho^2}}} \qquad (15)$$

since there is a large number of turns in the armature coil, S is very large, and S^4 correspondingly larger. Then since the coil is almost completely surrounded by iron, ρ is very small and accordingly $\frac{S^4}{\rho^2}$ is exceedingly large. Then since the number of alterations is very large, $S\,T$, the time of one alteration is a very small fraction and therefore, $R^2 T^2$ may be neglected as compared with $4\pi^2 \frac{S^4}{\rho^2}$. Neglecting this term then and reducing, our equation becomes

$$C = \frac{N \rho}{\sqrt{2}\, S} \qquad (16)$$

This equation shows that C is dependent on the magnetic induction through the coil due to the field, on ρ the magnetic resistance to the line of force of the coil, and S the number of turns in the coil. *Resistance and speed are conspicuous by their absence.* We must remember, however, that if R and T are increased enough in value, $R^2 T^2$ will cease to be negligible as compared with $4\,\pi^2 \frac{S^4}{\rho^2}$ and therefore, every increase in R will increase the denominator of equation (15) and C will decrease. If, therefore, we fix the limits between which the current may change, while the resistance in the main circuit is changing from its lowest to its highest value we may determine the speed below which the machine must not run. Any increase of the speed above this point merely tends to lessen the fluctuation of the current between the highest and lowest resistances. Again, any increase in the speed above this point will widen the range throughout which the resistance may vary, without the fluctuation in the current passing the prescribed limit. R will have its lowest value when the armature is short-circuited and will then equal the resistance of the armature coils and the current will be at its maximum value. The minimum value of the current then being fixed the maximum value of R, it will depend on the value of $R^2\ T^2$ as compared with $4\ \pi^2\ \frac{S^4}{\rho}$, or R (maximum) may vary inversely with T, or directly as the number of alternations per second. Returning now to equation 16, we see that C varies directly as N (the field is separately excited) and N varies directly as the exciting current. Therefore, any increase in the magnetizing current will correspondingly increase the main current. This is in fact the method by which the main current is brought to its proper value. The machine is short-circuited and the main current brought to its proper value by varying the magnetizing current. The main current will then remain practically constant throughout the prescribed range of resistance.

Secondly, the current varies directly as ρ. This, too, has been shown to be true, for in one of the first machines built the coils were wound in cylindrical longitudinal holes in the armature core so that they were entirely surrounded by iron, and as a result the current obtained was too small to be measured. Longitudinal slots were then cut in the armature core so as to increase ρ, and by widening these slots to the proper amount, the desired current was obtained.

Finally C varies inversely as S, the number of turns in the armature coil. That is, the more turns in the armature coil the less the current delivered. This, too, was found to be true in the experimental stage of the work. But it must be remembered that S must not be made so small that the term $4\ \pi^2 \frac{S^4}{\rho^2}$ becomes comparable with $R^2 T^2$.

We may, perhaps, obtain a simple conception of the reaction by slightly changing the form of our equation. We may write equation (13) thus:

$$C = \frac{\sqrt{2}\,\pi\, S N}{R T \sqrt{1 + \frac{4\,\pi^2 L^2}{R^2 T^2}}} = \frac{\sqrt{2}\,\pi\, S N}{R T \sqrt{1 + \tan^2 \phi}} \qquad (17)$$

where ϕ is the angle of lag.

Neglecting one under the radical sign, we have

$$C = \frac{\sqrt{2}\,\pi\, S N}{R T \tan \phi} \qquad (18)$$

The tan. ϕ varies inversely as $R\ T$, and therefore the product of the tan. ϕ and $R\ T$ in the denominator remains constant. Referring to Fig. 1, and remembering that ϕ is the angle by which the effective e. m. f. lags behind the impressed e. m. f., we obtain that if there is no lag. The effective e. m. f., or the current will reach its maximum value when the coil is in the position shown in Fig. 1, and therefore the largest possible number of lines will flow through the coil and will be taken out of it during the revolution. As ϕ increases, the current is delayed in reaching its maximum value, until the coil has passed the position shown in Fig. 1, and when ϕ is nearly 90° the coil will have nearly attained the position shown in Fig. 4 before the current reaches its maximum value; but in this position the m. m. f. of the coil almost exactly opposes that of the field, thus largely reducing the number of field lines which will pass through the coil. As ϕ increases the e. m. f. decreases. Then we have: a decrease in R tends to increase the current. But decrease in R tends to increase ϕ which in turn decreases the effective e. m. f. and reduces the current. ϕ must be nearly 90° so that the demagnetizing effect of the coil may vary inversely as R, which it will not do if ϕ is small. This result may be viewed in still another way, we may write our equation thus:

$$C = \frac{\sqrt{2}\,\pi\, S N n}{\sqrt{R^2 + 4\,\pi^2\, L^2 n^2}} \qquad (19)$$

where n is the number of complete waves per second. The numerator of this fraction will then represent the e. m. f. which would be set up in the coil, if there were no self-induction, x. The denominator consists of the ohmic resistance R, and of another term due to self-induction which is equivalent to an added resistance and has been called the inductance. This quantity $2\,\pi\, L\, n$ multiplied by C will equal the counter e. m. f of self-induction of the coil. As long then as the inductance or induction resistance of the coil is very large as compared with the ohmic resistance, any change in the ohmic resistance will only very slightly affect the total resistance which is the sum of the two.

Let us now consider what light these equations will throw on the question of designing the machine. The problem is, to obtain a current of the desired strength and constancy, with the least expenditure of energy and at the least expense, and the quantities with which we may work to obtain this result are N, S, ρ (or L) and T. We see immediately that it is advantageous to make T as small as mechanical considerations will allow, since the smaller T is the more constant will the current be throughout the range, or the wider the range the resistance may have without causing the current to vary below the prescribed limit. This points then to a multiplicity of poles or high speed or both.

N on the other hand should be as large as possible; for the output of the machine varies directly with that factor, and its increase does not at all affect the fluctuation of the current. S again should be as small as it can be made without affecting too much the regulation of the machine; ρ is the one indeterminate quantity in this equation. It is almost impossible to calculate its value beforehand to any reasonable degree of accuracy, for several reasons. The magnetic circuit of which it is the resistance varies in cross-section throughout its whole length, and this variation is not uniform, but has several points of discontinuity. Furthermore ρ varies during the revolution of the armature, for when the armature pole is half way between two field poles, part of the path of the lines of force is through the field pole, and when the armature pole is opposite the field pole, that same part of the path of the lines of force will be made up of the air gap between the two field poles, and ρ will be

much increased. An approximate value might be obtained by determining L with the armature in different positions and taking an average of the values thus obtained; but if in actual practice the iron is worked anywhere near the saturation point this method would be of doubtful utility, unless the currents used in determining L were the same as those used in practice. Probably the best method for practical work would be by means of a curve of current and e. m. f., where, all the terms being known except ρ and probably N, we can obtain ρ from one point on the curve and both ρ, and N from two points. This method, while it would probably not give us very accurate values of these two terms, would be of value for purposes of comparison, so that by means of a large number of determinations we might obtain data which would be very useful in designing future machines. Another useful thing to know is what is the highest value to which the e. m. f. will attain on open circuit. This may be obtained from equation 14 thus, dividing both numerator and denominator by R we have

$$E = \frac{\sqrt{2}\,\pi S N}{\sqrt{T^2 + \frac{4\pi^2 L^2}{R^2}}}$$

On open circuit R is infinite and the second term under the radical sign vanishes, leaving

$$E = \frac{\sqrt{2}\,\pi S N}{\sqrt{T^2 \times \frac{\pi^2 L^2}{R^2}}} = \sqrt{2}\,\pi S N n \qquad (20)$$

where n is the number of complete periods per second.

This e. m. f. will of course be very high, since there are very many turns in the armature coil, and n, the number of periods per second is very large. As a consequence of this, if the machine is allowed to run on open circuit, the armature insulation will soon break down, thus producing a ground which will speedily burn out the machine.

The following is the complete formula where all the terms are expressed in practical units:

$$C = \frac{\sqrt{2}\,\pi S N}{10\sqrt{10^{16} R^2 T^2 \times \frac{12.768^2 \pi^2 S^4 \mu^2 A^2}{l^2}}} \qquad (21)$$

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 1.—The adoption by the Western Union Telegraph company of a system of interior conduits for electrical conductors in its remodeled building is a significant fact. The object of the company to reduce the dangers of fire to a minimum and at the same time to have an electric system whereby useless wires can be replaced easily will also bring about a great reduction in the insurance rates of the company by forming an absolute protection against fire.

The electric railway corporation of Amsterdam, N. Y., has been having a difficulty with the officials of the Farmers' National Bank regarding the erection of a wooden pole for the trolley wires in front of the Bank building. It was stated to-day by an official of the railway company that the differences had been amicably settled. The franchise granted the railway company the permission to erect wooden poles yet the bank president and treasurer insisted upon the replacement of the stone flagging which had been removed by the workmen of the railway company, declaring that no wooden pole should be placed in front of the bank.

The final action of the Supreme Court of the United States on the question of the constitutionality of the New York electrical execution law was begun by a motion last Monday at Washington. That the Kemmler execution demonstrated the fact that electricity inflicts a cruel and unusual punishment was the point for motion to obtain a stay and get a hearing in the case of the Japanese murderer Jugiro now under sentence to death by electricity. The counsel for the murderer claims that the "carrying out of the sentence in the Kemmler case was not scientifically successful." It was moved that the case be advanced and set down for a speedy hearing.

The influence of the paper by Lieutenant Fiske is extending to Washington and the government has been asked to consider his suggestions that an electrical corps shall be formed for active service in the standing army.

A stay of proceedings has been granted in the case of Joseph Wood, convicted of murder and sentenced to death under the new law. The execution had been set for the week beginning Nov. 3.

The West Brooklyn Electric company, capital stock, $50,000, has been incorporated. It will construct an electric railway on the following named streets: Commencing at Thirty-ninth street and Second avenue and running along Thirty-ninth street to the division line between Brooklyn and New Utrecht; thence along Thirty-ninth street through the town of New Utrecht and Flatbush to the highway known as the road from New Utrecht to Flatbush; thence along the latter road to and along Eighteenth street in New Utrecht, to and terminating near Cropsey avenue. The road will be about five miles long. The company has as directors Richard Hawley, Charles Bellows Jr., Allen N. Spence, and John S. Kennedy of West Brooklyn; Herbert N. Curtis, and Henry C. Radford of New York, and Thomas G. Spence, Andrew D. Baird, Joseph P. Puels, William P. Rae, William Wish, and John Morris of Brooklyn.

W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Minn, Nov. 1.—The discharge of four Brotherhood telegraphers by the Western Union company at St. Paul precipitated a strike early in the week which threatened at one time to result in serious complications. In discharging the four men in question the chief operator assigned no reason, and Brotherhood men believed the act to be but a further expression of the policy of the Western Union to break up organizations among its operators which render strikes possible. The trouble culminated Monday evening at 8 o'clock, when nearly all of the night force in the general office at St. Paul walked out, remaining however, in close proximity to the office with the expectation of being recalled. The company simply drew upon its reserve resources, and in a very short time had a full force at the instruments, selected from the regular day crew, most of whom are non-union men. Business was only interrupted by the occurrence an hour or two. It is now announced that the matter has been amicably adjusted, and that the striking men have agreed to renounce the Brotherhood and return to the employ of the Western Union as vacancies occur. The strikers were very evidently misled by reports from other cities which indicated that the Western Union was taking vigorous steps to crush their organizations, and expected co-operation at other points—particularly Chicago and Minneapolis. There were no signs of a disturbance in this city. Immediately before the strike at St. Paul, the operators sent a committee consisting of three Western Union operators, one North American operator, and one United Press association operator, to interview Superintendent Isaac McMichael of this city, with reference to the discharge of the four Brotherhood men; but Mr. McMichael refused to treat with them as representatives, of any organization and ordered the North American and United Press operators from the room. He was willing, he said, to talk over the matter with the men as individuals, but not otherwise. Interviewed upon the occurrences of the week, Supt. McMichael said:

"The Brotherhood of Telegraphers is a secret organization, gotten up to precipitate a strike when it becomes strong enough, and in discharging these men we are simply taking the bull by the horns. Paragraphs from its constitution read as follows: 'To establish and maintain the right of telegraph employes to combine for the purposes of protection and advancement of their own interests. To defend and protect its members against unreasonable reduction of wages.' They also take exceptions to our employing students or apprentices, all of which principles are, of course, objectionable to us."

The work of E. L. Randall, the Kansas City Brotherhood organizer, has had no results in Minneapolis. He first attempted to organiae the railroad men, but became involved in party disagreements which frustrated his work in this direction. He then endeavored to organize the commercial men, and a well-attended meeting was held for the purpose last Sunday. The claim that the Brotherhood has sixty members here is denied, and it is apparently a matter of doubt as to whether any practical organization has been secured. The strike and its results will unquestionably have a blighting effect upon Mr. Randall's work in Minneapolis and St. Paul.

The council committee on streets in St. Paul is wrestling with the problem of making the Western Union company bury its wires, and has thus far had little if any success. Supt. McMichael made an appointment recently to meet and consult with that body, but did not appear on the occasion specified. At the next regular meeting of the committee the matter will be again revived, and the city clerk has been instructed to give official notice to the superintendent that the matter will be brought before the committee at that time.

President Thomas Lowry of the St. Paul Street Railway company, has found it necessary to go before the city council of St. Paul and ask an extension of time. When the company made the contract with the city for the change of the street railway system from horse to electrical power, a bond for $200,000 for the faithful fulfilment of its obligation, was exacted and given. If the council sees fit to take it, $100,000 of this amount may be required as a penalty for the failure of the company to have all of its lines finished by the 1st of November. Mr. Lowry explains that the company has been subjected to serious delays in securing its material, and that in the matter of engines alone, three months have been lost. So far as has been learned there is nobody in the city council of either city who favors taking advantage of this clause in the contract and when the matter comes up any reasonable extension of time which the company may require will undoubtedly be granted. Mr. Lowry expresses confidence that the entire system of electric lines in Minneapolis and St. Paul will be in successful operation within four months. Work is being rapidly pushed now, and before winter is upon us the principal lines in each city will be operated by electricity.

The electric line is finished out to Minnehaha Falls and the wires will be strung within a few days, thus enabling the company to do away with horses on that line altogether. The Sixth street line is practically finished, and nothing will interfere with its operation next week. It is now announced that the Washington avenue bridge is completed and that the connection will be made on the inter urban line during the week, and the new service regularly instituted between the two cities.

There was an interruption of an hour or two in the operation of the Sprague system on Washington and First avenue the other day occasioned by a break in a trolley wire which necessitated turning off the current. The broken wire fell upon and instantly killed a horse, and occasioned considerable excitement for a time.

N. O. F.

Indianapolis, Ind.

INDIANAPOLIS, Nov. 1.—The Indianapolis *News* has just put in a Jenney constant potential motor, of 20 horse power, to run its presses. The Perry Incandescent Electric company will furnish the current for the motors and for lighting the entire building of four floors.

There are about fifty Jenney motors in use in the city of from one-eighth to thirty horse power.

M.

Louisville, Ky.

LOUISVILLE, Ky., Oct. 29.—Steps will be taken at once to have Louisville lighted by electricity. Mayor Jacob a few days ago said that he would advertise for sealed proposals for furnishing electric lights at once. He intends giving two weeks' notice. The common council's committee on water finance and gas met Tuesday to consider the lighting question. Several members of those committees opposing the plan were absent. They argue that the general council has no right to take up the matter now, as it is almost time for a new mayor and a new council.

It is likely that the only bidder on the electric lights will be the Louisville Gas company, which owns the electric light plant of the Louisville Electric Light company. M. Muldoon, who owns the Brush Electric Light company, will not bid. Hite Barrett, chief engineer of the Gas company and president of the Electric Light company, has all his plans ready for the building of the new electric light plant which is to take the place of its Louisville Electric Light company, but it is said the plant cannot possibly be finished for six months. Consequently some of the local papers are cautioning the council not to make haste in letting contracts.

J. W. L.

Pittsburg, Pa.

PITTSBURG, Nov. 1.—Unavoidable delays have necessitated the postponement of the time proposed for starting the electric cars of the Birmingham Traction company. The first was the tearing away of the contractor's false work at the Smithfield street bridge during a storm. This mishap was followed by others which threatened to delay the starting of the road until next spring. One of the recent causes is the slowness in getting the structural iron material to finish the work on the south end of the bridge. It will be remembered that the Birmingham traction road had to construct an addition to the Smithfield street bridge in order to make it of use to the electric road.

In view of these circumstances, the company has decided to make use of some temporary arrangements pending the completion of the delayed work, and will begin to run cars during the first week of December.

The new track has been completed up to either end of the Smithfield bridge, and as soon as the poles and wires have been put up the new cars will be sent for. Only a few poles are yet to be put up, and the wires have about all been strung. Much of the work is only temporary, and will only be used until the new portion of the bridge is completed. During that time the old bridge will be used, and until the company's own power house is ready for operations the road will be supplied with power from the Allegheny County Light company's plant.

At the foot of Juniata street, Allegheny City, work has been started on the power house of the Pittsburg, Allegheny & Manchester Traction company. The contract calls for the completion of the foundation by Dec. 15, so that the engine can be placed. The entire building is to be finished by Feb. 1, 1891.

McKeesport, Braddock and Wilmerding capitalists are now organizing a company for the construction and opera-

tion of an electric railway from McKeesport to Wilmerding, a distance of five miles.

The usual brilliancy of the electric lights in Pittsburg, which caused this city to be known as one of the best lighted in the world, has been somewhat diminished of late. Upon investigation it was found that a lack of fuel was the cause of the trouble. The company has three natural gas mains leading to the boilers, eight, six and four inches in diameter. The company has been using high pressure burners, but as it was found that they would not do any longer they are now being changed for low pressure burners, which will do away with the trouble, and the Pittsburg electric light will shine as brightly as ever. E. H. H.

Kansas City, Mo.

KANSAS CITY, Nov. 1.—The council of Kansas City, Kan., recently extended the time for the construction of the West Side Railway company's line from December of this year until May 1, 1891. This line is the one for which J D. Husted of Kansas City, Kan., and W. S. Woods of this city, secured a franchise nearly two years ago. No work was done and in the spring of this year the franchise and good will of the company were sold to W. E. Lambkin, the contractor. A new company was at once organized with E. D. Browne as president and W. E. Ewart secretary. Lambkin took the contract to build the road and the newly organized company at once authorized the issuance of $150,000 worth of bonds. W. N. Coler & Co. of New York bought the bonds and will furnish the money for the construction. Work on the line will begin within fifteen to twenty days, or just as soon as the steel can be ordered. Coler & Co. specify that seven cars shall be put in immediate operation. The system of the Detroit Electrical Works will be used. Arrangements have been made with the Metropolitan Street Railway company for transferring to and from its line.

"In preparing the plans for the new city hall basement," said Superintendent of Building B. E. Chamberlain, "a system has been followed which will make it possible for the city to put in an electric light plant as proposed by Councilman Humphrey in his resolution which was referred to the committee on charter amendments." The south line of the city hall will be nearly eighty feet from the north line of Fifth street. The idea is to construct a huge basement under this, supporting it by columns and eye beams, to light it from above and to use all this space for dynamos and the machinery necessary for the operation of the plant. By this means a splendid machine room can be obtained 80x115, and at least 17 feet from floor to ceiling. In this space can be located an engine of 1,000-horse power and pumps and machines of 400 arc lights and 1,000 incandescent lights capacity, which will constitute the plant should it be put in. Just east of this is another basement room 50x115, which will be used for the city hall machinery and engines. All this will be entirely underground, not affecting in the slightest the approaches to the hall.

The Consolidated Electric Light & Power company of Kansas City, Kan., will rebuild its plant and will make additions with a view to putting in machinery for making ice on a large scale. On Oct. 3 this company executed a trust deed to the Commonwealth Loan & Trust company, of its plant and franchises, for which it is to receive $175,000 to be spent in enlarging the plant. The ice plant part of the deal has been quietly kept until recently.

A large number of business men of Kansas City, Kan., have signed a petition asking the Missouri & Kansas Telephone company to reduce the quarterly rate on instruments in that city from $27 to $18, the same as accorded subscribers in Kansas City, Mo.

The Ogden, Utah, City railway company has transferred all of its properties to H. C. Gilbert, vice-president of the Jarvis-Conklin Mortgage Trust company of Kansas City. The instrument vests in him the powers of a trustee in the interest of his company, which floated the first mortgage bonds of the railway company to a considerable amount. This will insure the almost immediate introduction of electricity and the most improved method of rapid street transportation.

The city council of Rich Hill, Mo., at a recent meeting decided to accept the award as follows for the erection of a complete arc and incandescent light plant: The arc light part of the plant is to be installed by the Excelsior Electric Light company of Chicago, for $3,125. The incandescent light plant will be put in by the Westinghouse Electric & Manufacturing company for $2,605.40. The construction work will be done by Ira C. Hubble of Kansas City, for $5,544.60. The engine will be purchased from Fairbanks, Morse & Co. of Kansas City, for $3,630. The carpenter work was let to N. W. Ballfinch for $1,095. The total cost of the complete plant will be about $16,000

The city council of Hannibal, Mo., has decided to submit to a vote of the people a proposal to issue bonds to the amount of $20,000 to increase the power of the electric light plant from 100 to 300-horse power in order that an incandescent light plant may be put in and be operated in connection with the present arc light plant owned by the city. It was decided also to grant a franchise to the Union Electric Street Car company to operate a line three and one-half miles in length from the Hammetal cave to the extreme northwestern limit of the city through the residence portion, in addition to the line already in operation on the business streets.

Lebanon, Mo., is now lighted with electric lights. The arc system is completed, and in full operation. Work is being rapidly pushed on the electric street car line.

The Moberly, Mo., Electric Street Car company has commenced surveying for its road. Work on the power house is also under headway. Cars will be running by January 1, 1891.

There is a prospect of trouble between the Metropolitan and Springfield Street railways at Springfield, Mo, over a crossing at the corner of Campbell and Commercial streets. The Springfield company in laying its track some time ago took up the track of the Metropolitan. The latter in relaying its track for the electric motor along Commercial street a few days ago, took up the track of the Springfield company. Charters are being consulted and a council of war is being held. The Springfield company is building a car house 18x60 feet and a barn 24x80 on the corner of Grant and Scott streets. Switches are being constructed on Campbell street north of Commercial. Track laying is delayed on account of not getting ties. G. M. P.

THE ELECTRIC LIGHT.

The Excelsior company will install an electric light plant at Washington, Ga.

E F. Slater is president; O. R Lowman, vice-president, and Charles Copes, secretary, of the Orangeburg, S. C., Electric Light & Power company, recently formed.

The Pocomoke City, Md., Electric Light & Power company has been organized with E. G. Polk, president; W. S. Dickinson, vice-president, and F. H. Dryden, secretary, and purchased Young & Colburn's electric plant. The capital stock is $10,000.

The Evening *Standard* of Woodstock, Canada, in its issue of Oct. 27, charges that C. A. Mohler, who for the past year has been superintendent of the local electric light station, is a defaulter. The defalcation was not discovered until after Mohler's departure for parts unknown.

The Owosso Electric company of Owosso, Mich., has its plant nearly ready for operation. A brick building has been constructed and the machinery is being put in position. The apparatus consists of a compound condensing engine and Thomson-Houston arc and incandescent dynamos.

L. N. Cox, agent of the National Electric Manufacturing company of Eau Claire, Wis., has closed contracts for an electric light plant for the Newberry Oil mills, Newberry, S C., and for central station outfits for Chester, S. C., and Tarboro N. C. The company will also install a street railway at Tarboro.

The Brush Electric Light company of Baltimore, Md, has received the contract from the municipal authorities of that city to light the streets and public buildings for a period of five years. The contract calls for 800 arc lights and 5,000 incandescent lamps. The Brush company operates the Westinghouse alternating current arc and incandescent systems of electric lighting.

J. W. Johnson, manager of the Western Isolated lighting department of the Thomson-Houston Electric company reports the following sales: Schneidewend & Lee, Chicago, 300 incandescent lights; Johnson Lock Mercantile company, San Francisco, Cal., for the California Pumice company, at Napa, Cal., 50 incandescent lights; Fecker Brewing company, Chicago, 50 incandescent lights; Chicago Anderson Common Brick company, Town of Lyons, near Chicago, 48 arc lights; Compound Lumber company for 70 incandescent lights. The McCormick Harvester Machine company has placed an order with this department for a 16-light second hand outfit for the blacksmith shop.

The Westinghouse Electric & Manufacturing company received during the week preceding October 22 contracts for the installation of alternating current incandescent light plants at the following places: Manchester, N. H., 1,500 lights; Cohoes, N. Y, 750 lights; Amesbury, Mass., 500 lights; Arkansas Pass, Tex., 750 lights; New Cumberland, W. Va., 750 lights; Rich Hill, Mo., 750 lights. In addition to this, the alternating current central station plant at Havana, Cuba, is again compelled to increase its capacity. The Havanese intend to furnish all the suburbs of the city with electrical illumination. They purpose to extend the plant for eight miles around the city and to this effect, the Westinghouse Electric & Manufacturing company has been contracted with to furnish a 2,000 volt 750 light plant. The Westinghouse alternating current arc light system is now being introduced in Norwich, N. Y.

The Westinghouse Electric & Manufacturing company during the first three weeks of October recorded orders for the furnishing of alternating current incandescent electric lighting apparatus approaching a capacity of 25,000 16-candle power lamps. Contracts for central station alternating current incandescent apparatus were received from the following places: Evanston, Ill., 750 lights; Baltimore, Md., 6,000; Elmira, N. Y., 1,500; Oswego, N Y., 750; Durango, Colo., 750; Lincoln, Neb., 1,500; Orange, N. J., 750; Uxbridge, Mass., 750; Tampa, Fla., 750; Cohoes, N. Y., 750; Manchester, N. H., 1,500; Amesbury, Mass., 500; Arkansas Pass, Tex., 750; New Cumberland, W. Va., 750; Mason City, Ill, 500; Havana, Cuba, 750; Rich Hill, Mo., 750; Clearfield, Pa., 500. Among the places where Westinghouse alternating current arc apparatus was installed during the month are: Oswego, N. Y, 60 lights; Clearfield, Pa., 25; Washington, Pa., 60; Norwich, N. Y., 25; Baltimore, Md., 250.

Last month the Illinois Steel company ordered of the Western Isolated lighting department of the Thomson-Houston Electric company, a 30-arc light plant for the works at South Chicago. It has recently placed another order for a 35-arc light plant to be installed at the same place. This plant was delivered and set up ready for operation on the day following that upon which the order was given. A representative of the Thomson-Houston company says that the day is not far distant when a man can drop into an electric light company's office in the forenoon, place his order, and find upon his arrival at home in the evening, that the wiring is finished and lights ready to be turned on to furnish illumination for his dinner table. Dernberg, Glick & Horner recently who purchased of the Thomson-Houston company, a 45 arc light plant, have ordered an incandescent plant. The Western Isolated department has also closed contracts with the East St. Louis Packing & Provision company, East St. Louis, Ill,, for 300 incandescent lights; and Montgomery, Ward & Co., Chicago, for 400 incandescent lights. The Missouri Car & Foundry company of St. Louis, Mo., has bought of the Thomson-Houston company, through their St. Louis agent, the arc light dynamo which was exhibited during the recent exposition.

THE ELECTRIC MOTOR.

The Lincoln, Neb., Street Railway company, owning the principal lines in this city, has been granted a charter by the city council to use electricity. Orders for electric supplies have already been placed by telegraph and $300,000 will be expended in putting in an electric motor system.

The Cicero and West Chicago Electric Street railway company was incorporated last week at Chicago to construct and operate electric street railways on West Forty-eighth street in Chicago and the town of Cicero; capital stock $1,000,000; incorporators, Joseph Feldman, Hiram Vanderpoel and James B. Heffernan.

The Ottawa, Canada, city council has broken off negotiations with W. H. Howland in relation to the construction of an electric street railroad and accepted the offer of Ahearn & Soper to do the same work. The construction of the power house and equipment of the road will be begun immediately.

The Baldwin Electric Railway company has asked the council of Lyons, Ia., for a franchise to build and operate an electric street railway line between the towns of Lyons and Clinton, Ia., and in each of the cities. The Clinton and Lyons horse car system will be changed to an electric system, embracing ten miles of track, if the franchise is granted.

The Edison General Electric company has entered into a contract with the Louisville Railway company of Louisville, Ky., for a large station equipment, including four generators of 150,000 watts (200 h. p.) each. It will be remembered that this road is now the property of the great street railway syndicate which is operating roads in Buffalo, Pittsburg, Louisville, Newark, Rochester and elsewhere.

The North Lincoln Street Railway company of Lincoln, Neb., has recently completed its road, five miles in length, built for suburban travel, and now has its line in successful operation. The equipment consists of three Westinghouse motors, which are deemed sufficient for immediate wants, but with the opening of next season others will be added. G. A. Bush is president of the company.

A clause in the ordinance adopted by the Chicago city council, last week, granting a franchise for an elevated road on the West Side provides that "in case electricity is used" the conductors shall be inclosed in tubes, etc. It is not now the intention of the projectors of the enterprise to adopt electricity, but they deemed it advisable to provide for it. Electric railway men have an opportunity to exercise their persuasive powers in this case. It would be an excellent opportunity to test electricity on an elevated road and Chicago would be a good city in which to make the experiment.

The Consolidated Railway company has announced its intention of constructing a network of electric railways in Oakland, Cal. The capital stock is $1,000,000. M. J. Kellar has a petition before the supervisors for a franchise for an electric road beginning at the intersection of Telegraph avenue and Evoy street, near Berkeley, through McCourtney street and across the Western Tract to New Broadway; thence on Booth, Gilbert and John streets to Piedmont avenue and Mountain View Cemetery. The new road is to be run in connection with that now running from Peralta street. If built, this will give a cross town road north of Oakland, from the Bay to Piedmont.

The C. & C. Motor company of New York has just installed a motor in combination with a Blackman ventilating wheel in the Union Trust company building on Broadway, New York city. It comprises a thirty inch disk exhaust fan and electric motor mounted directly on the shaft and supported by the fan brackets. It revolves at a speed of 600 revolutions and delivers 20,000 cubic feet of air per minute. This combination overcomes the objection to noise and dirt, which applies to a motor belted to a pulley on the fan. Another advantage that it presents particularly to electric light men and contractors is the ease with which it may be installed and placed in any position without regard to belting and shafting. Another requirement of a machine of this kind is compactness of form, in order that the motor my obstruct the draught of air as little as

possible, and it is believed that this combination attains these objects.

Fargo, North Dakota and Moorhead, Minn., cities on opposite sides of the Red river, are the latest to figure on an inter-urban electric railway line. The Thomson-Houston Electric company is now figuring on the cost of construction and, it is understood, that if the estimates are satisfactory a franchise will be given to local capitalists who are ready to establish the new enterprise. At present there is no street railway in either city, though there is a population of not less than 10,000 in the two towns.

Judge Johnston of Milwaukee has decided that the city has no right to grant an exclusive franchise for the use of its streets to any street railway company. When the Milwaukee and Whitefish Bay railway company some months ago secured a franchise to build an electric line, the Cream City company, now controlled by the Henry Villard syndicate, secured an injunction restraining the new company, from operating a line on certain streets on which the Cream City claimed an exclusive right under an older franchise. Judge Johnston dissolved the injunction. In his decision he says that the doctrine seems to him to be well established that the right to create a monopoly will never be assumed in favor of a municipal corporation unless it be granted by express terms. In concluding his opinion the judge says that he has no doubt that the common council, in the exercise of its control of streets for public good, may require the joint use of railroad tracks to a reasonable extent and upon reasonable terms where the public convenience demands such use, and especially where it is absolutely necessary to enable a meritorious corporation engaged in an acceptable public service to complete its system of railways, ordinances and resolutions to that effect being always subject to the test of reasonableness and justice. The Villard syndicate will undoubtedly appeal to the Supreme Court.

Miscellaneous Notes.

C. P. Paine, L. L. Jackson, George Cator and others have incorporated the Pneumatic Fire Alarm Telegraph company at Baltimore with a capital stock of $150,000.

W. D. Ray of Oak Park, Ill., is the accredited agent of the census bureau for collecting electrical statistics in Chicago. Manufacturers can very materially aid in making Mr. Ray's work thorough and complete by giving him as full information as possible.

The Westerland Electric Conduit company has been organized at Atlanta, Ga., with J. M. Stephens, president; A. Beck, vice-president, and J. W. Janes, secretary, to construct underground conduits for conveying electric power for the use of surface and elevated railroads. The capital stock is $600,000.

Business Mention.

St. John Day has opened an office at 125 Adams Express Building, Chicago, as an electrical and mechanical engineer.

D. Chalmers, formerly sales agent of the Empire City Electric company of New York, has accepted a similar position with Alexander, Barney & Chapin of New York.

The Universal Arc Lamp company of New York, is manufacturing arc lamps for incandescent circuits. J. H. McClement is president, and E. S Mendels is general manager.

Chas. A. Schieren & Co., 46 South Canal street, Chicago, are making a specialty of perforated leather belting for electric plants. It is claimed that these belts are especially adapted to electric railways and power plants.

The Electric Exchange, established by Alexander, Barney & Chapin, at the Telephone Building, 20 Cortlandt street, New York, is becoming a popular institution, and a large number of visitors registered there during last week.

The Schuyler Electric company which removed its factory from Hartford to Middletown, Conn., last month, has already been obliged to enlarge its quarters and double the capacity of its shops The company's regular working force will be 500 hands when the additions to the factory are ready for occupancy.

The Baxter Electric Motor company of Baltimore reports that the several sizes of the new design of arc motors are ready for the market, and their assortment of incandescent motors for 110, 220 and 500 volt power circuits will be ready for the market in a very short time. Many radical improvements, it is stated, are incorporated in the machines,

The Electrical Supply company of Chicago is doing an enormous business at the present time. In spite of lively competition its sales are increasing every month. The company claims to carry the largest stock of electrical supplies in Chicago. The company has put on the market within the last few months many new devices, which have had a large sale.

The recently organized Electric Construction & Repair company, Chicago, has secured premises, with power, in the new Springer building, 205 Canal street. This location brings the works into close proximity to the center of the city and the various railway depots. Recognizing the difficulty street railway companies encounter in having repairs done in a prompt manner and at reasonable cost, the company has equipped a repair department, where armatures and field coils of any system can be overhauled. This department will be under the management of J. G. Hart, who has had many years' experience and whose work is well known. It may be mentioned also that the concern will do general construction work and will give special attention to street railway construction. Several employes of the late and well-known Sprague Electric Equipment company have been retained for this department, which will be under the immediate charge of W. O. Sharpe. C. M. Barclay, who represented the Sprague Electric Railway & Motor company for several years in Chicago and the West, and who was also secretary for the Sprague Electric Equipment company, will be general manager. W. A. Kreider, who has been for some years with the Sprague company, will act as secretary.

The Knapp Electrical works of Chicago have just issued a handsome catalogue describing and illustrating the devices of which they make a specialty. This company manufactures all kinds of electrical devices, telegraph outfits, signal systems and annunciators, and always has on hand a full line of supplies. The company has long made a specialty of telegraph instruments and has established an excellent reputation. In the manufacture of hotel and elevator annunciators they have introduced many improvements, and the latest production in this line is pronounced the most complete device of this kind the company has yet presented.

The electrical fraternity will be interested to learn that the Great Western Supply company is transferring its business to an Illinois corporation of the same name. Manager George Cutter, through whose indefatigable efforts the concern was brought to its present flourishing condition, has sold out his interest to E. R. Gilman, president of the Northwest Thomson-Houston company. Mr. Cutter will remain with the company as manager. The growth of the Great Western Supply company has been surprising. A little over a year ago Mr. Cutter severed his connection with the Thomson Houston company and started in the electrical supply business. From the very beginning, when the business was carried on in the somewhat limited quarters on Adams street, the prospects seemed most encouraging, and it was not long before Mr. Cutter found himself in possession of a trade which could not be satisfactorily handled without greater facilities. This state of affairs led to the organization of the Great Western Supply company. Of the new company's work in its rapidly extending field nothing need be said. A walk through the handsome suite of offices on Fifth avenue, Chicago, and a glance at the immense and varied stock in the warehouse will give one a good idea of what a progressive spirit and hard work can accomplish in a short time.

The Taylor Manufacturing company, of Chambersburg, Pa., have established a branch office at 26–28 W. Randolph street, Chicago. H. S. Walker so well known from his long connection with the Payne and other companies, is manager of the new office. His acknowledged ability and large acquaintance will enable him to build up a large business for his company in this section. The Taylor company still reports an active demand for the popular Beck automatic engines and has effected the following sales within the past few weeks: One engine to Taylor Bros. & Hall, Macon, Ga.; two engines through Gregory & Co., of California; one engine with complete plant to Curwensville, Pa., Light & Power company; one to the Union Feed company; Chattanooga, Tenn.; one engine to the Singerly Paper & Pulp company, of Elkton, Md.; one engine, with complete steam plant, to Citizen's Heat, Light & Power company, Blairsville, Pa.; one engine with complete steam plant to Schuler & Co., Meridian, Miss.; one engine for the Western Electric company of New York; one engine for Chas. Gossage & Son, Chicago; one engine for Anglo-American Powder company, Oakland, N. J.; one engine to Niles Electric Light & Power company, Niles, O., two engines for Manhattan Bank company, New York; one engine for Steamer Susquehanna, New York; one engine for McKeesport Light company, McKeesport, Pa.; two engines through Boughen Engraving company, of Cincinnati, O. The company has also sold vertical automatic engines to the Western Electric company of Chicago, for driving dynamos for lighting a circus tent, to Robt. Soltan of Mamaroneck, N. Y., for lighting private grounds, and to Hipley & Son of Allegheny, Pa., for lighting their brewery. For all kinds of isolated electric work this engine is highly recommended. The Taylor company has also received orders for a fourth 125 horse power engine, with two boilers, from the Watervliet Turnpike & Railroad company, of Albany, N. Y., where it has a 400 horse power steam plant now operating one of the most satisfactory and paying electrical railroads in the country.

Electrical Patents.

Issued Oct. 28, 1890.

439,092. Guide for Trolley Arms. Arthur F. Bardwell, Boston, Mass.

439,102. Electric Motor. Charles S. Bradley, Yonkers, N. Y.
The third claim follows:
"In an alternating current electric motor, the combination of a multipolar field-magnet having its winding inclosed in loops, an armature, and a commutator adapted to selectively pass the operating current through only a portion of the field circuit."

439,151. Dry Battery. Wilhelm L. F. Hellesen, Copenhagen, Denmark.

439,164. Perforator for Automatic Telegraphing. Frank D. Mack, Chicago, Ill.

439,178. Method of Repairing Incandescent Electric Lamps. Casimir Pauthonier, Paris, France.

439,180. Electric Elevator. Francis B. Perkins, Boston, Mass.

439,182. Trolley Pole. Louis Pfingst, Boston, Mass.

439,192. Trolley Pole for Electric Cars. Benton C. Rowell and Francis E. Galloupe, Boston, Mass.

439,213. Electro-magnetic Clutch. Curtis H. Veeder, Lynn, Mass.

439,237. Apparatus for Transferring Electric Car Batteries. Frederick G. Corning, New York, N. Y.
Of the nine claims the sixth is given:
"The rack for recharging secondary batteries, consisting in several benches composed of rotary sections ranged in vertical series and vertical pillars or shafts supporting the rotary sections forming their axes of rotation."

439,238. Electro Dental Heater. Luther A. Faught, Philadelphia, Pa.

439,240. Method of and Apparatus for Preparing Electrodes for Secondary Batteries. Charles D. P. Gibson, Jersey City, N. J.

439,262. Electric Railway. Laurence Westerland, Atlanta, Ga.

439,295. Recording Signaling System. William J. Fraser, Milwaukee, Wis.

439,301. Secondary Electric Battery. Jacob F. Mehren, Chicago, Ill.

439,304. Electric Lamp Socket. John O. Phillips, New York, N. Y.

439,308. Automatic Wire Finder for Trolley Heads. George S Slocum, Newport, R I.
The invention consists in the combination, with a trolley carrier, a finder pivoted thereto, and means for causing said finder to rock by the making or breaking of an electric current through contact of the trolley wire and finder.

439,324. Secondary Battery. Edward J. Mason, Waterford, Canada.

439,345. Electric Locomotive. Francis W. Dean, Cambridge, Mass.

439,347. Electric Belt. John F. Fields, St. Ignace, Mich.

439,363. Electric Lamp. Alfred Swan, Orange, N. J.

439,364. Incandescent Lamp Socket. Alfred Swan, Orange, N. J.
The socket consists of a base and contracted neck, a lamp support on the base at the end opposite the neck, and a switch moving about said neck within the circumferential area of the base.

439,365. Incandescent Lamp Socket. Alfred Swan, Orange, N. J.

439,366. Incandescent Electric Lamp Socket. Alfred Swan, Orange, N. J.

439,367. Incandescent Electric Lamp Socket. Alfred Swan, Orange, N. J.
The last claim reads:
"3. In an incandescent electric lamp holder, the combination with the base or body formed of insulating material, and provided with a metallic socket for receiving a line wire of a plug clamping the line wire against the socket and forming a contact for the lamp."

439,381. Electric Meter. William H. Bristol, Hoboken, N. J.

439,389. Electric Lighting System. Thomas A. Edison, Menlo Park, N. J.

439,390. System of Electric Lighting. Thomas A. Edison, Menlo Park, N J.

439,391. Junction Box for Electric Wires. Thomas A. Edison, Menlo Park. N. J.
The invention consists in the combination, with insulated electrical conductors inclosed in tubes, of boxes joining the tube sections, the joints between the boxes permitting expansion and contraction of the tubes.

439,392. Electric Lighting System. Thomas A. Edison, Menlo Park, N. J.
The second claim is given:
"The combination, with the safety catch between the translating devices and the generator, of an alarm arranged in a shunt circuit around said safety catch."

439,393. Carbonizing Chamber. Thomas A. Edison, Menlo Park, N. J.
The method consists in placing uncarbonized filaments in a carbonizing chamber and placing a carbon or hydrocarbon compound within said chamber, and finally applying a carbonizing heat, whereby a hydrogen atmosphere is produced in the chamber during the carbonization.

439,395. Velocipede. Richard J. Fleischer, Tisch Mills, Wis.

439,398. Thermal Cut-out. Calvin Goddard, New York, N. Y.

439,409. Railway Track Electrical Annunciator. Jacob W. Lattig, Easton, Pa.

439,416. Method of Making Storage Battery Plates. William Morrison and Louis Schmidt, Des Moines, Iowa.

439,417. Automatic Regulator for Electric Currents William Morrison, Des Moines, Iowa.

439,428. Electric Railway. Charles Richter, Camden, N. J.

439,441. Fire Alarm or Fire and Heat Indicator. Chas. W. Summerskill, Hockley Heath, England.

439,459. Synchronous Alternating Current Electric Motor. Charles Zipernowsky, Maximillian Deri and Otto T. Blathy, Buda-Pesth, Austria-Hungary.

439,477. Automatic Vending Apparatus. Charles L. Coffin, Detroit, Mich.

439,478. Automatic Vending Apparatus. Charles L. Coffin, Detroit, Mich.

439,516 Porous Cup for Galvanic Batteries. Charles A. Hussey, New York, N. Y.

439,577. Electric Motion Transmitter. Mark W. Dewey, Syracuse, N. Y.

439,584. Electric Railway Motor Car. Edmund Wagemann, Little Rock, Ark.

439,591. Secondary Battery. William B. Hollingshead, Bronxville, N. Y.

439,597. Conduit for Electric Railways. Rudolph M. Hunter, Philadelphia Pa.

439,602. Electric Switch. John A. K. McGregor, New York, N. Y.

439,614. Bell. Benjamin E. Vaughn, Hill's Grove, R. I.

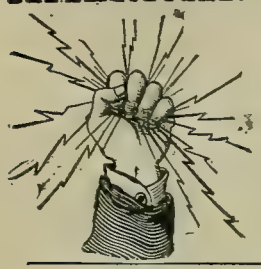
EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,



Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

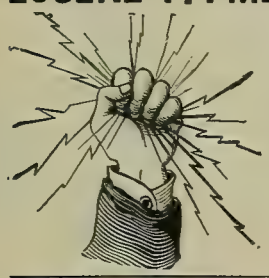
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

Cheaper than Overhead Wires,

MORE THAN TEN TIMES AS DURABLE.

Guaranteed to stand a pressure of 100,000 volts when used for Electric Light Mains. Write for Estimates to the

Brooks Underground Telegraph Co., 207 Walnut Place, Room 5, Philadelphia.

THE TURNER BRASS WORKS
4 LASALLE AVE
MAKE ANYTHING IN BRASS
CHICAGO.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

FOR SALE.

One 8½x10 Armington & Simms Automatic Engine.

One 20-Light Fuller-Wood Arc Light Dynamo and Lamps.

A. L. IDE & SONS,

SPRINGFIELD. ILL.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

ELECTRIC LIGHTING,

FRANKFORT, INDIANA.

PROPOSALS are wanted until December 19, 1890, for lighting by electricity and gas, the Public streets, etc. of this city for a period of five years.

Address **S. A. COOK,**

City Clerk as above.

By Order of Committee. J. H CHAMBERLAIN, J. W. HAMMOND, J. S. VANARSDAL.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

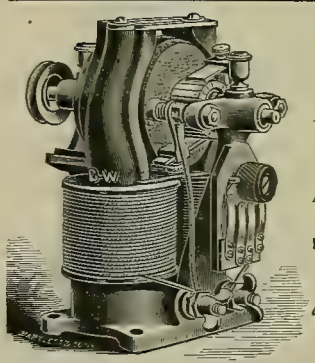
Binders FOR THE Western Electrician $1.00.

YOU make a mistake if you don't buy your Electrical Supplies from F. & P., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1 00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.



THE **CROCKER-WHEELER**

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields. Let into Base—Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies o be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

AMMETERS AND VOLTMETERS

REPAIRED AND RECALIBRATED

Our laboratory is specially fitted up for this class of work, and all instruments sent to us will receive prompt attention.

Send for Catalogue *1-66* of Electrical Test Instruments.

QUEEN & CO., PHILADELPHIA.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL **OKONITE COMPANY,** Limited, - - 13 Park Row, NEW YORK.

BRANCHES: Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

STANDARD ELECTRICAL WORKS,

—CINCINNATI, OHIO,—

MANUFACTURERS OF AND DEALERS IN

Electrical Instruments and Supplies.

OKONITE WIRE, BATTERIES, LINE WIRES, CROSS ARMS, PINS, BRACKETS, INSULATORS. ANNUNCIATORS, BELLS, BURGLAR ALARMS, ETC., ETC.

—— Electric Light and Street Railway Goods a Specialty. ——

SEND FOR CATALOGUE AND SPECIAL PRICES.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental **MACHINERY.**

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

FOR SALE.

One 15-light	50 volt	Dynamo
One 25-light	50 volt	Dynamo
One 50-light	50 volt	Dynamo
One 75-light	110 volt	Dynamo
One 100-light	110 volt	Dynamo
One 150-light	110 volt	Dynamo

Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

A MODEL RAILWAY.

The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acide. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

C., M. & ST. P. R. R.

The Northern Summer Resorts

of Wisconsin, Minnesota, Iowa and Dakota, not forgetting the famous Excelsior springs of Missouri, are more attractive during the present season than ever before.

An illustrated Guide Book, descriptive of a hundred or more of the choicest spots of creation, on the lines of the Chicago, Milwaukee & St. Paul R'y, will be sent free upon application to A. V. H. CARPENTER, General Passenger Agent, Chicago, Ill.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

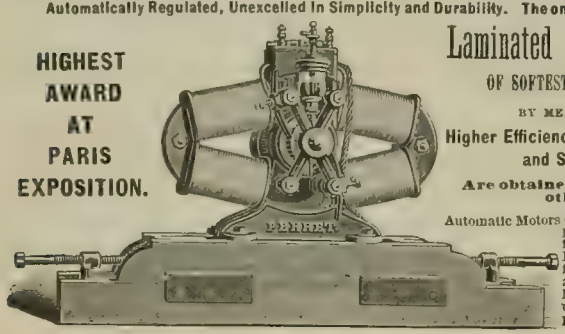
79 and 81 Washington St., Brooklyn, N. Y.,

—MANUFACTURERS OF THE—

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets

OF SOFTEST CHARCOAL IRON,

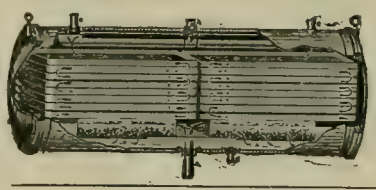
BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes. Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

C. B. HOLMES, Pres't. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.

G. W. GRIFFIN, Superintendent of Construction.

THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

A PUBLIC BENEFIT.

The traveling public has already been greatly benefited by the combination between the Chicago & Northwestern and the Union Pacific Railway systems and the establishment of what is now known as the "Chicago, Union Pacific and Northwestern Line," through greatly improved train service from the East to the Pacific coast. Features of the new service are solid vestibuled trains running through from Chicago to Denver and Portland without change. These trains carry through Palace sleeping cars from Chicago to Omaha in 15¾ hours, Denver 33½ hours, Portland 82 hours, San Francisco 85 hours, and for the benefit of passengers who do not wish accommodations in first-class sleepers, luxurious reclining chair cars are run through to Denver and Portland without change, in which accommodations are free. Colonist sleepers are also run through from Chicago to Portland, in which the charge for a completely furnished berth is nominal, and as all meals en route are served in the best of dining cars, the Chicago, Union Pacific and North-Western Line affords all classes of passengers the very best accommodations.

Another feature of the service provided by the Chicago & Northwestern Railway which is highly appreciated by the traveling public, is the fast vestibuled train (coaches, sleeping cars and dining cars) running daily between Chicago and St. Paul and Minneapolis, carrying through vestibuled sleepers between Chicago and Duluth.

The North-Western, which now operates over 7,000 miles of first-class railway, was the pioneer in railroad building in the West and is still in the lead in supplying the traveling public with all the benefits that are conferred by superiority of equipment, through train service and fast time between Chicago and all points West and Northwest.

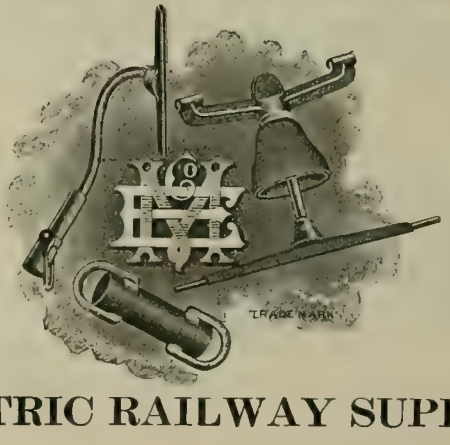
DYNAMO TENDERS' HANDBOOK.—By F. B. BADT.

100 pages; 70 illustrations flexible cloth binding; size of type page, 6x8 inches. Designed for Dynamo Tenders and Linemen; Stationary and Marine Engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language. Price, postage prepaid to any address in the United States or Canada, $1.00.

Address ELECTRICIAN PUBLISHING CO., 6 Lakeside Bldg., Chicago.

ELECTRIC MERCHANDISE CO.

Standard Devices for all Systems.



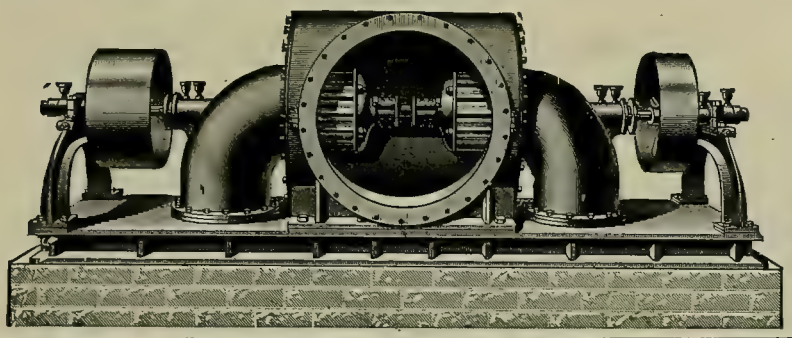
11 Adams St., CHICAGO.

CATALOGUES FURNISHED.

W. R. MASON, General Manager.

ELECTRIC RAILWAY SUPPLIES.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft, with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

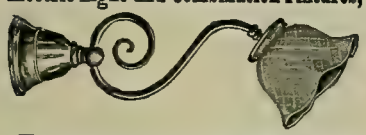
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

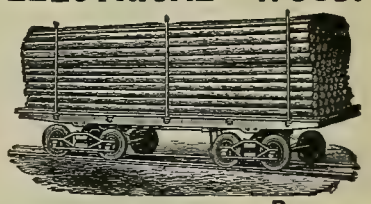
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS, POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.

Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Electric Fixtures. Combination Fixtures. Gas Fixtures.

Our Establishment is not Controlled by any TRUST or COMBINE.

Dealers are not asked to furnish Capital through the intimidating medium of **REBATES**, nor to submit to Dictation regarding where they shall purchase goods.

WE SELL EXCLUSIVELY TO THE TRADE.

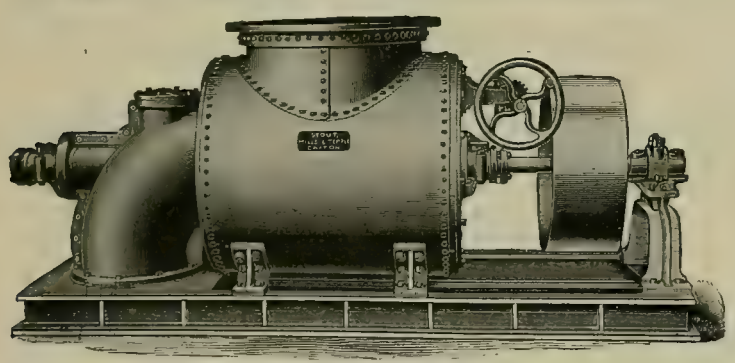
GIBSON GAS FIXTURE WORKS,

No. 1426 CALLOWHILL STREET, PHILADELPHIA, PA.

Electrical Testing Apparatus manufactured to order, repaired or calibrated.

WESTERN ELECTRIC COMPANY, - - NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

ADVANTAGES OF THE EVANS SYSTEM OF DRIVING DYNAMOS.

ECONOMY IN ROOM.

No loss of room by reason of long lines of belting. All the space is made available. More than double the number of dynamos can be put in the same space than by ordinary belting. In the erection of new stations, or the increase of old, an immense saving is realized.

EFFICIENCY.

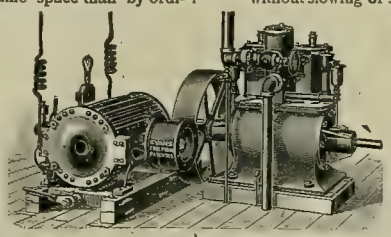
There is no slip. Consequently there is less loss of power in transmission, and a steady light is obtained. There is also less pressure on the bearings than by ordinary belting for the same amount of power.

SAVING IN BELTS.

Belts cost less than one-tenth of ordinary belts, and last over twice as long. The saving in belts alone nearly pays the royalty.

SIMPLICITY AND COMPACTNESS.

The dynamo pulley is placed in immediate contact with the driving pulley. No expensive clutches or complicated belt holders are necessary. The Evans Friction is a perfect clutch in itself.



PERFECT CONTROL.

Each and every dynamo can be stopped or started independently of every other without slowing or stopping the engine or other motive power.

FOR POWER GENERATORS.

Where the load is intermittent and subject to sudden changes, as in street railway work, the Evans Friction adapts itself promptly and effectively to the work without the "flop" or unsteady motion of ordinary belting.

CLEANLINESS.

The Evans System does away with long flying belts which carry a large amount of dust, and not only is the room cleaner but the bearings are freer from grit.

For SIMPLICITY, COMPACTNESS, ECONOMY, EFFICIENCY and CLEANLINESS, the EVANS SYSTEM surpasses anything yet devised for driving dynamos.

Send for Catalogue "D" to *The EVANS FRICTION CONE CO., 85 Water St., Boston.*

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

Manufactured by

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

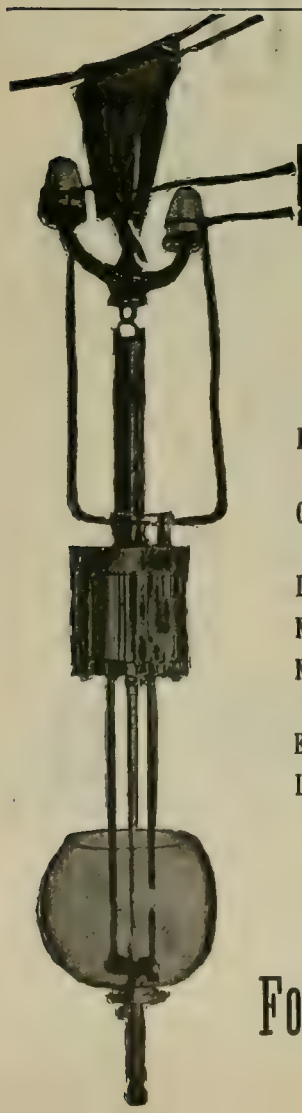
NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.



THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

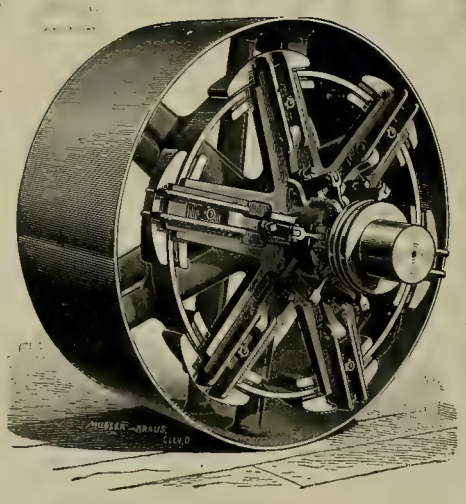
Ease of operation.

Low price

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt

ALL LEATHER. NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY. BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER

BRANCHES: 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St. Louis, Mo.

OKONITE TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators.
Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO,
KANSAS CITY,
OMAHA, DALLAS, TEX.,
SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,

MANUFACTURING ELECTRICIAN,

Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

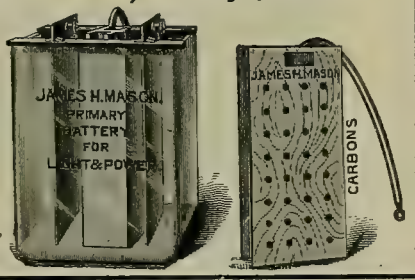
COMPLETE PLANTS FOR SMALL STORES.

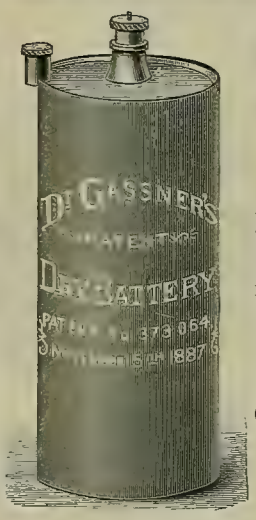
Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.





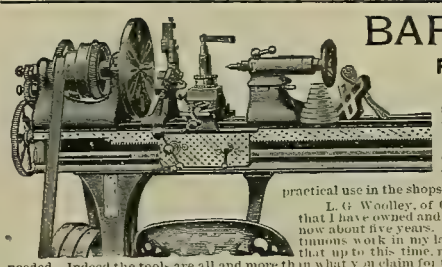
DR. GASSNER'S DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Ce l),	7½ in.	3⅜ in. x 3¼ in.
17.	"	7½ "	3⅜ " x 1⅝ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.



BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

DICTIONARY

—OF—

ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

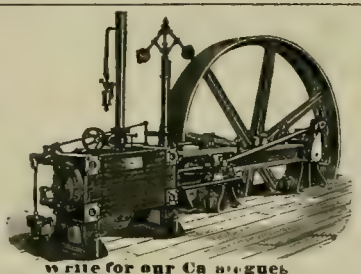
3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

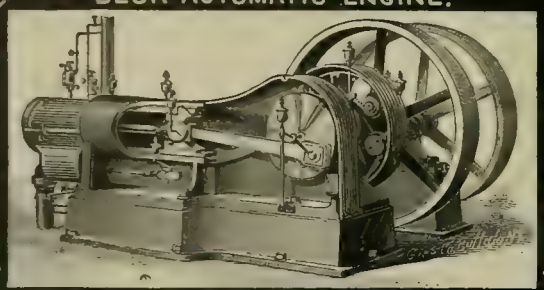
In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

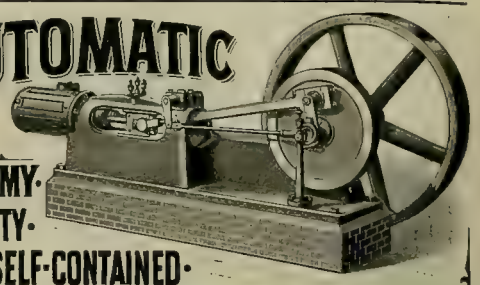
ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

THE REYNOLDS
IMPROVED CORLISS ENGINE
Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.
IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.


Write for our Catalogues

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.
Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.
CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.
ECONOMY UNEXCELLED
REGULATIONS PERFECT
HOT BEARINGS UNKNOWN
PRICES MODERATE

TAYLOR MFG CO. CHAMBERSBURG, PA.
COMPLETE STEAM PLANTS A SPECIALTY

THE RICE AUTOMATIC
GUARANTEED
ECONOMY · REGULATION · DURABILITY · SIMPLICITY · SELF-CONTAINED ·

8 TO 300 H.P. PAIR & TANDEM COMPOUNDS
THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

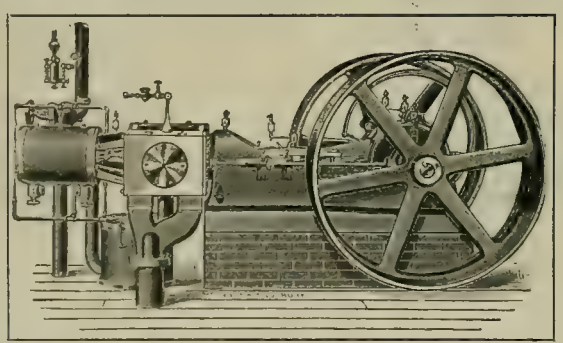
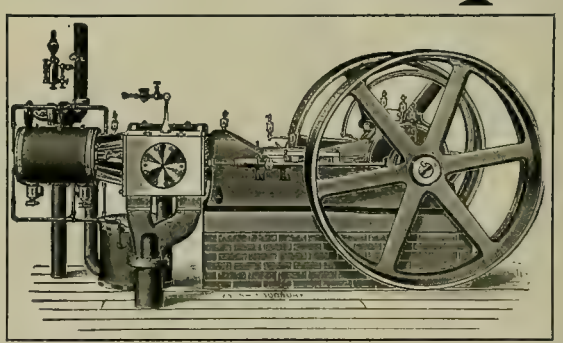
FAIRBANKS, MORSE & CO.,
St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul
SELLING AGENTS.

Cleverly
1018 CHESTNUT ST. PHILA.
Electric Specialties.
—WE MAKE—
Electric Supplies Under Contract.

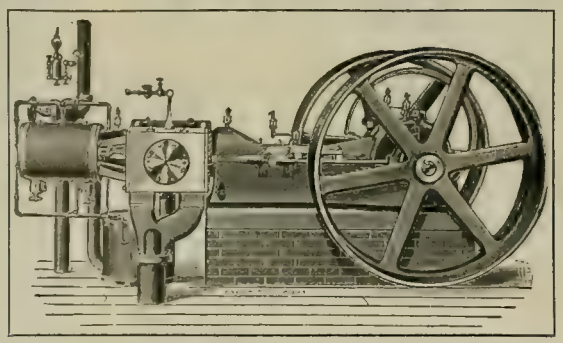
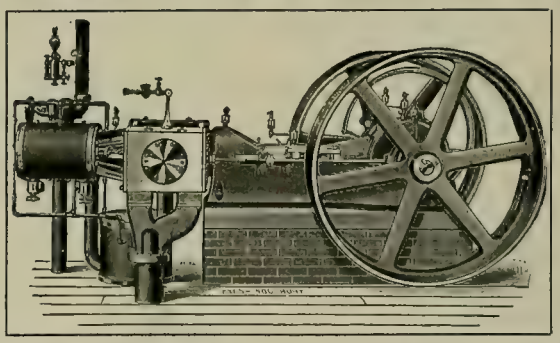
Chicago Electric Club
Will hold its next regular meeting at the Club Rooms, Monday Night, November 17.

CINCINNATI HEADQUARTERS
ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.
WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE ·
FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.
The JONES-BROS-ELECTRIC-CO. 28 30 & 32 WEST COURT ST.

None so Good, None to Equal.


TANDEM


McINTOSH & SEYMOUR.


COMPOUND


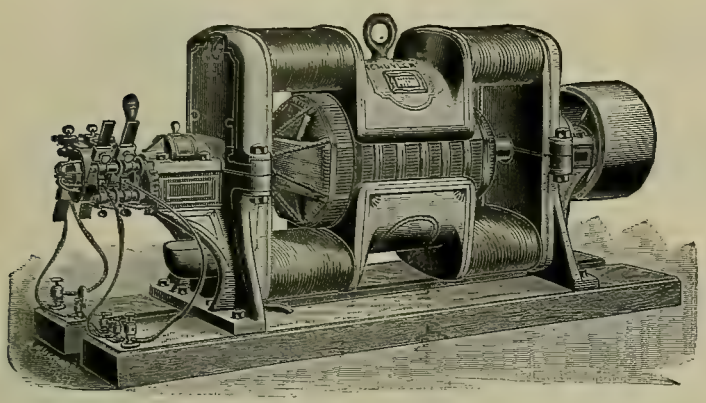
WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature. proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

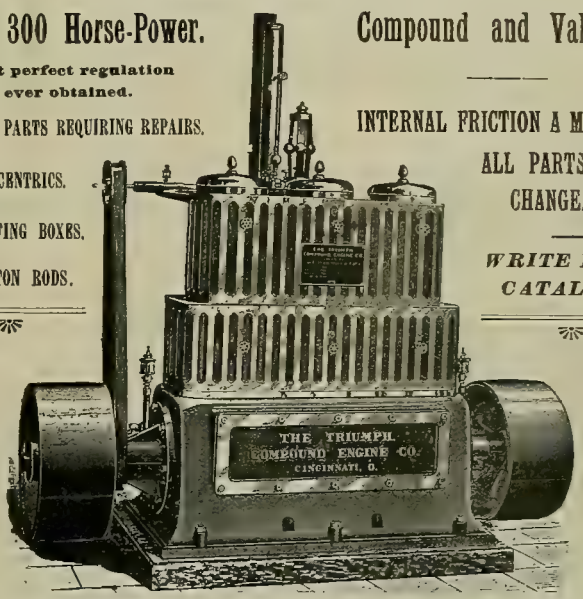
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

Trade Mark Registered.

For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

The LECLANCHE BATTERY CO., NEW YORK.

THE

THOMSON-HOUSTON ELECTRIC CO.'S

RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

o

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

o

Companies desiring Centre Pole Construction should see the Indianapolis Plant, illustrated below. Also Washington, D. C., Rochester and Brooklyn, N. Y.

Citizens' Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

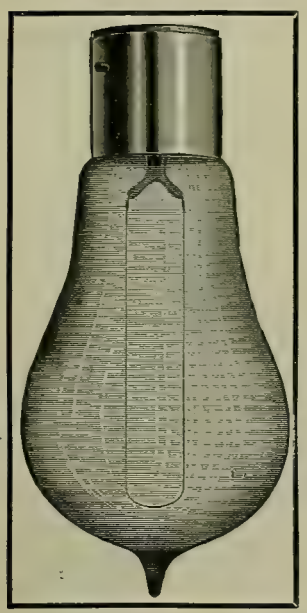
PRINCIPAL OFFICES:

BOSTON,
620 Atlantic Ave.

CHICAGO,
148 Michigan Ave.

ST. PAUL,
408 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

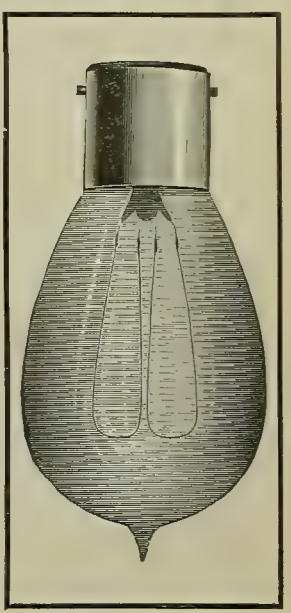
THE

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

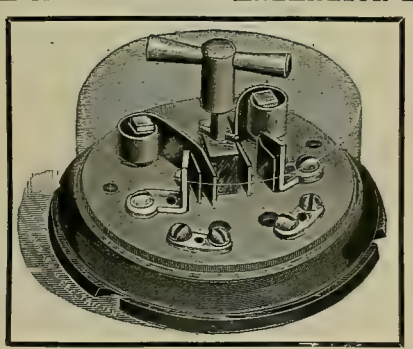
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

WE CALL SPECIAL ATTENTION TO

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

—FOR—

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

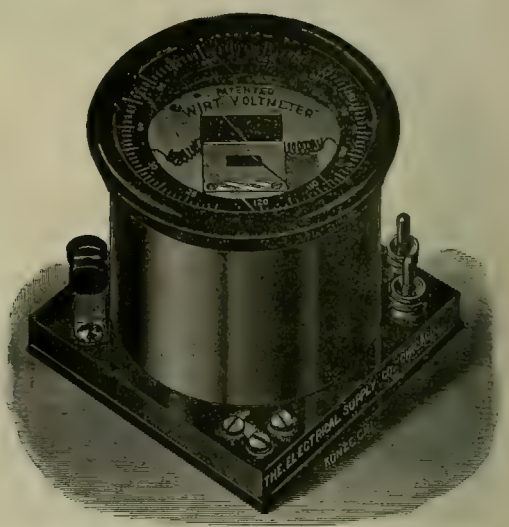
NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

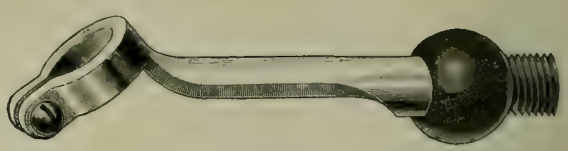
CHICAGO.



THE ELECTRICAL SUPPLY CO
SUNBEAM
INCANDESCENT LAMP
CHICAGO ILLINOIS U.S.A.

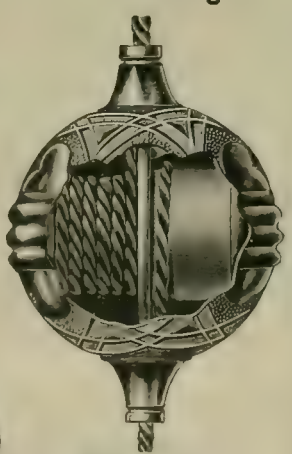
Try Them.

Lamp Cord.



Universal Gas Attachment.

The Bradner Adjustable Hanger.



With Cover Removed.

In Operation.

HABIRSHAW.

The best rubber covered wire.

SHIELD BRAND.

The best weatherproof and only moistureproof line wire.

THE AJAX.

The BEST and only reliable dry battery.

FUSE WIRE.

Guaranteed and accurately determined.

Habirshaw Duplex Fixture Wire.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES.
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.

WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK,	115 Broadway.
CHICAGO,	185 Dearborn St.
PHILADELPHIA,	907 Filbert St.
PITTSBURGH,	533 Wood St.
DETROIT, MICH.,	57 Gratiot Ave.
SAN FRANCISCO,	35 New Montgomery St.
TORONTO, CAN.,	138 King St. W.
DALLAS, TEX.,	McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.

SLATTERY ALTERNATING DYNAMO.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

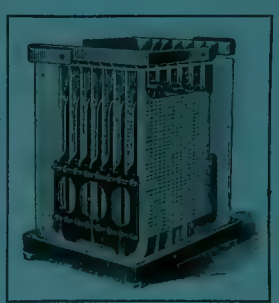
BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR CO.,

44 Broadway, NEW YORK.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 Carter Street, Philadelphia, Pa.
CHICAGO AGENCY:—239 La Salle St. SAN FRANCISCO:—220 Sutter St.
BOSTON:—HOLTZER-CABOT ELECTRIC CO, 111 Arch Street.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, NOVEMBER 15, 1890. No. 20

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin' ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

(2121)

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4⅞-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,

By W. M. Talcott, General Manager.

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

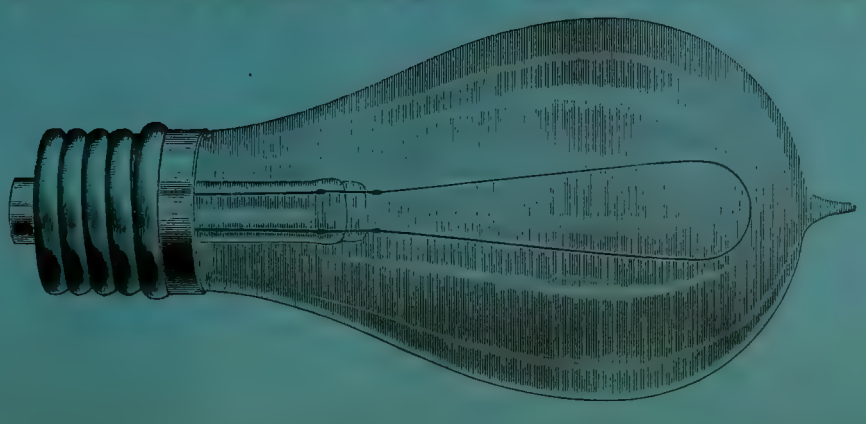
Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

EDISON GENERAL ELECTRIC CO.,

Edison



Lamps.

FOR PRICES SEE PAGE 8.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave., CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment. Electric Motors.

THE ONWARD MARCH!

Some Facts in Electric Lighting.

No. of Companies using Thomson-Houston Arc Apparatus, Jan. 1, '90	516	
No. of Companies using Thomson-Houston Arc Apparatus, July 1, '90	587	
Increase 6 months, ending July 1, '90		71
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, Jan. 1, '90	68,203	
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, July 1, '90	79,387	
Increase 6 months, ending July 1, '90		11,184
No. of Co.'s using Thomson-Houston Incandescent Apparatus, Jan. 1, '90	337	
No. of Co.'s using Thomson-Houston Incandescent Apparatus, July 1, '90	436	
Increase 6 months, ending July 1, '90		99
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, Jan. 1, '90	281,555	
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, July 1, '90	408,515	
Increase 6 months, ending July 1, '90		126,960

There are also in the United States Isolated Plants using in the aggregate
20,000 Thomson-Houston Arc Lamps,
and over 100,000 Thomson-Houston Incandescent Lamps.

ELECTRIC RAILWAYS.

Roads in Operation, July 1, 1890	80
Number of Motor Cars	1,069
Roads under Construction, July 1, 1890	43
Number of Motor Cars	408

Grand Total.

Number of Roads 123 Number of Motor Cars 1,477
Total Length of Track (in miles) 897

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co..... —
Abendroth & Root Mfg. Co.. xv
Alexander, Barney & Chapin. xii
Allis, E. P. & Co..... xxii
American Electrical Works.. xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co..... vii
Baggot, E..... xvi
Bain, Foree..... xvi
Ball Engine Co..... xvi
Barnes, W. F. & Jno..... xxi
Barton, Geo. P..... xvi
Baxter Electric Motor Co.....xxviii
Bernstein Electric Co..... xxi
Bleckert & Nelson..... xvii
Brown, Frank T..... xvi
Brush Electric Co..... xxvii
Bunnell & Co., J. H..... xiv
Butler Hard Rubber Co..... xx
C. B. & Q. R. R..... xvi
C. & C. Electric Motor Co... ix
C. & N. W. R. R. Co..... —
Central Electric Co..... xi
Chicago Electric Club..... xxii
Cleverly Electrical Works... xx
C. M. & St. P. R. R. Co..... —
Colburn & Co., I. W..... xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... xix
Consolidated Electric Storage Co..... —
Continental Dynamo Co..... iv
Cowles Electric Smelting and Aluminum Co..... xvi
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... —
Day s Kerite Insulation Co.... i
Dayton Globe Iron Works Co.xviii
Eastern Electric Cable Co. xv
Eddy, Henry C..... xvi
Edison Mfg. Co..... ix
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Lamp Dept..... xxii
Electric Construction & Sup. Co iv
Electric Merchandise Co..... xvi
Electrician Publishing Comp'y .....xx, xxi
Electrical Supply Co.....xxvi
Elektron Mfg. Co..... xx
Empire City Electric Co.....xviii
Empire China Works..... xvi
English, Morse & Co..... xvii
Eureka Tempered Copper Co.. xvii
Evans Friction Cone Co..... xix
Fibrone Mfg. Co..... xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works.... xx
Fort Wayne Electric Co..... xxviii
Globe Carbon Co..... xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S..... xiv
Harmount, G. A..... vii
Hawkeye Electric Mfg. Co.... iv
Hazelton Tripod Boiler Co... xvi
Heisler Electric Light Co..... xii
Hill Clutch Works..... —
Holmes, Booth & Haydens.....xvii
Holmes & Co., C. H..... xvii
Holtzer-Cabot Electric Co..... i
Humphrey, H. H..... xiv
Ide, A. L. & Son... xv
Illinois Electric Material Co.... xiv
India Rubber & Gutta Percha Insulating Co..... i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L.. i
Jewell Belting Co..... xv
Jones Bros. Electric Co..... xxii
Knapp Electrical Works..... xxv
Laminar Fibre Goods Co..... xvii
Law Telephone Co..... xv
Leclanche Battery Co.....xxiii
Magnolia Anti-Friction Metal Co i
Mason, James H..... xxi
Milliken & Co..... xx
Monitor Electric Co..... vii
Munsell & Co., Eug..... xv
Munson Belting Co., Chas..... xiv
National Carbon Co..... iv
National Electric Mfg. Co..... x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T... ... —
N. Y. Belting & Packing Co... xiv
Okonite Co..... xv
Ostrander & Co., W. R. xviii
Page Belting Co..... xvi
Palste, H. T..... xiv
Peckham Street-Car Wheel & Axle Co..... vii
Partrick & Carter xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co.....xxviii
Pond Engineering Co..... xxi
Powell Co., Wm..... xvi
Pumpelly Storage Battery Co. xviii
Queen & Co..... xvi
Roeblings' Sons Co., Jno. A.... xix
Sawyer-Man Electric Co..... xiii
Schieren & Co., Chas. A xiv
Schoverling, A xxi
Schuyler Electric Co.....xxiii
Shultz Belting Co..... .....—
Southern Electrical Supply Co. xxi
Sperry Electric Co..... xviii
Standard Electrical Works ... xvi
Standard Paint Co.....xiv
Standard Underground Cable Co. i
Standard Carbon Co..... xx
Stanley & Hall.....xiv
Star Electrix Co..... vii
Stephenson & Co., Jno..... ix
Stiff, E. D. & Co.... xvi
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xviii
Sunbeam Incandescent Lamp Co —
Taussig, S..... xvi
Taylor Mfg. Co..... xxii
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxiv
Triumph Compound Engine Co xxiii
Tripp Mfg. Co..... —
Turner Brass Works..... xv
Union Hardware Co.....xiv
United Electric Traction Co....xxiii
United States Electric Lighting Co..... xiii
Van Nuis C. S..... —
Wanted..... .. xv
Western Electric Co xviii
Western Power Construction Co. xxii
Westinghouse Electric Co..... xiii
Weston Electrical Instrument Co..... xiv
White, R. T..... iv
Wollensak, J. F..... xx
Woodbridge & Turner..... xvii
Wrigley, Thos.. xii
Writing Telegraph Co.....,.. xvi

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.
The River & Rail Electric Light Co.

Aluminum.
Cowles Electric Smelting & Refining Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.'
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.

Belting—continued.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
White, R. T.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison Machine Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D.
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.

Lamps, Incandescent—Con td
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Eddy Electric Manufacturing Co.
Elektror Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Light Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.
Writing Telegraph Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

ELECTRICAL BOOKS

OF ALL KINDS.

Send for New and Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO, ILL.

ELEMENTS OF ELECTRIC LIGHTING.

BY PHILIP ATKINSON, Ph. D.

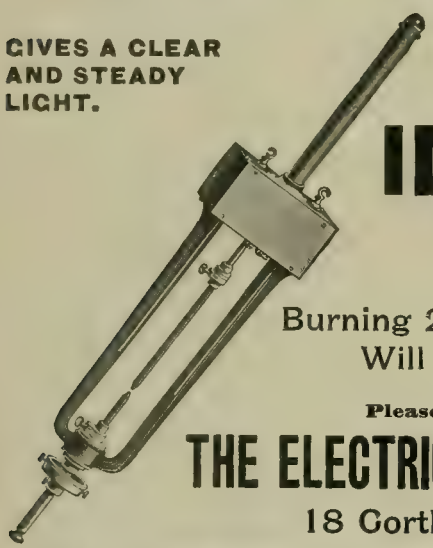
260 Pages, Cloth Binding, Illustrated, Price $1.50.

This book is an elaboration and revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. It treats of: Principles of the Dynamo; Alternate Current Dynamos; Direct Current Dynamos; Electric Terms and Units; Electric Measurements The Arc Lamp; The Incandescent Lamp; The Storage Battery; Electric Distribution.
Sent, postage prepaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, Chicago

GIVES A CLEAR AND STEADY LIGHT.



THE ONLY COMMERCIAL ARC LAMP FOR

INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT,
CLEAN,
EFFECTIVE,
SIMPLE,
COMPACT,
PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

87 and 89 South Fifth Avenue, - - NEW YORK.

THE HAWKEYE

ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station

AND

ISOLATED PLANTS,

ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps***, Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190-192 Fifth Avenue, CHICAGO.

DESIGNERS
—OF—
Electric Railway Specialties.

MAKERS
—OF—
Choice Electric Supplies.

DEALERS
—IN—
Standard Electrical Goods.

POLES

Of Extra Strength in all Sizes and Styles.

PLAIN WOOD POLES:

GET OUR PRICES.

OCTAGONAL WOOD POLES.

NEAT AND LOW PRICED.

POLES

ANGLE-IRON POLES

Superior to pipe poles at about half the cost.

Our 28 foot pole will stand a strain of 3,000 pounds without deflection.

LATTICED CORNER POLES.

Extra strong and stiff. Will stand all strains met in practice without appreciable deflection.

BRACKETS

Of angle iron. Stronger and neater than those made of piping. Maintain their shape perfectly.

Try us on

BRACKETS AND POLES.

IF YOU WANT MATERIALS

That have the greatest strength,
That give the highest practical insulation,
That pay best in the end,

TRY US FOR YOUR SUPPLIES.

TREBLE CURVE INSULATOR.

Gives the Greatest Strength and the Highest Insulation. Try it and you will use no other.

RESISTS ABRASION AND GIVES THE HIGHEST LINE INSULATION.

SIMPLEX WIRE.

THE WIRE THAT PAYS BEST IN THE LONG RUN.

Try it for mains and you will always use it.

For lines in mines or among trees it is unequaled.

SEND FOR A SAMPLE.

ALL-COPPER RAILBONDS.

SEND FOR A SAMPLE.

Have practically no resistance. Are quickly and cheaply applied. Will not oxidize.

WATCH FOR NEW ADDITIONS TO OUR

Electric Railway Specialties.

We insist on having only the very best, and that at figures which will command your orders.

ALL OF OUR

SPECIALTIES

WEAR WELL.

Prove it for yourself by trying them.

Our place at 190-192 FIFTH AVENUE is the

HEADQUARTERS

For Electric Railway Supplies

In any quantity,
For any system,
And to meet any circumstance.

IMMENSE STOCK!!
BOTTOM PRICES!!

Electrical Supplies

OF ALL KINDS.

NORTHWEST
THOMSON-HOUSTON
ELECTRIC CO.,

403 & 405 SIBLEY ST., - ST. PAUL.

OUR POLICY:

First Class Goods, Small Margins and Quick Delivery.

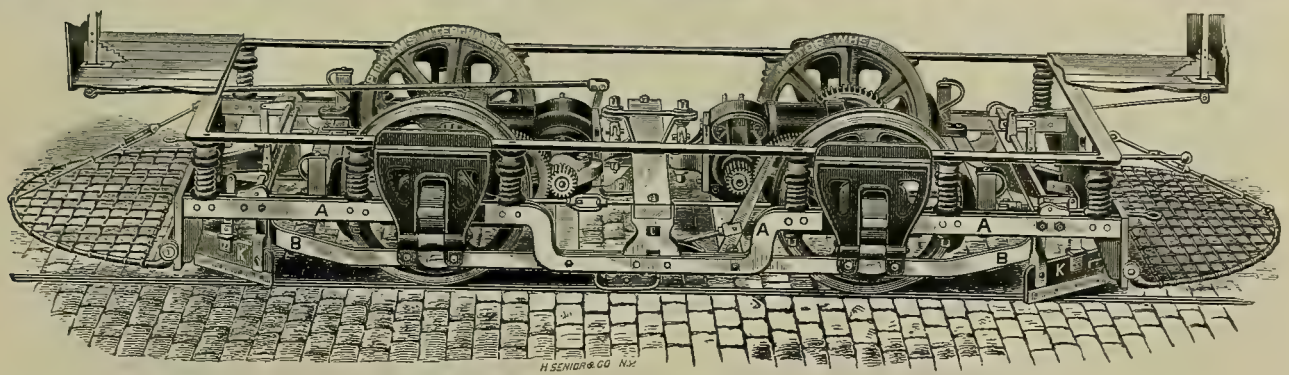
LARGE STOCK OF

Grimshaw White Core,
Holmes, Booth & Hayden's "K. K."
Underwriters' Line Wire & Magnet Wires.

FULL LINE OF PORCELAIN GOODS.

"ELECTRIC BLOCK", 403 & 405 SIBLEY STREET, ST. PAUL, MINN.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

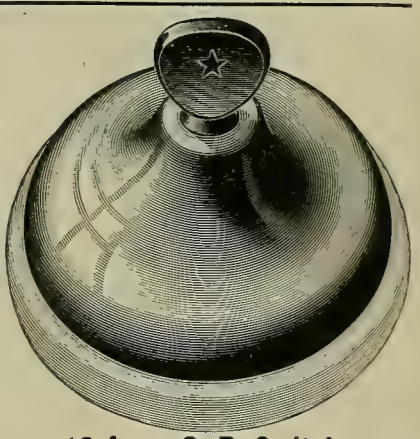
For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

ELECTRIX!

5 Amp. S. P. Switch.

"Nothing Succeeds like Success," and judging from the way orders come piling in for the ELECTRIX Switches, and other specialties, success expresses it but mildly. We are away behind on orders now, but have doubled our capacity in the past week and will catch up soon.—Ask your Dealer for our goods or write to us.



10 Amp. S. P. Switch.

STAR ELECTRIX CO., 1320 WALLACE ST., PHILADELPIA, PA.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM
AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

EDISON LAMPS

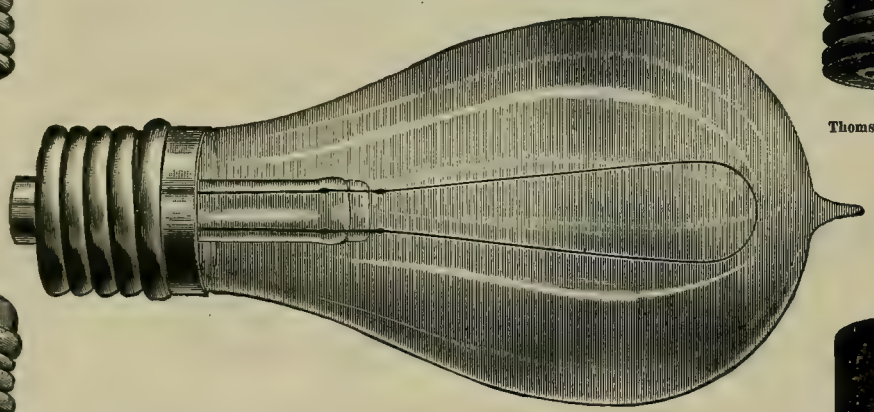
16 C. P. - - 44 CENTS EACH.

PRICE REDUCED ONE-THIRD!!!

16 C. P. Lamps. 12 to the H. P. 600 Hours Average Life.

No. 1, Edison Base.

The Edison Incandescent Lamp.



No. 2, Thomson-Houston Base.

No. 3, Westinghouse Base.

Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge.

No. 4, United States Base.

From Nov. 1st, 1890, Subject to Change Without Notice.

16 C. P. Lamps, List Price, 80 Cents Each.	Net Price.	Discounts for Larger Lots Quoted on Application.
Discount in Lots of 25 to 150,.....45%	44 cents each.	
" " 150 to 500,.....47½%	42 " "	
" " 500.....50%	40 " "	

Allowance for Old Bases, $1.35 per 100, f. o. b., Newark, N. J.

Write for Circulars and Price List to Nearest District Office or any Electrical Supply House.

EDISON GENERAL ELECTRIC COMPANY.

MAIN DISTRICT OFFICES.

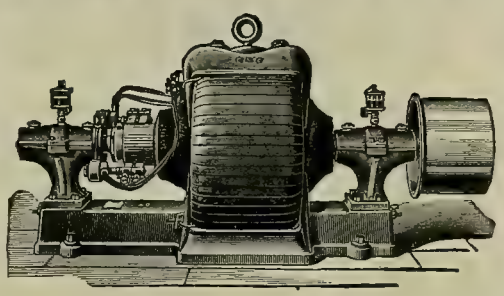
Eastern District, 16 & 18 Broad Street, New York.
Central District, Rialto Building, Chicago, Ill.
Southern District, Cotton Ex. Bldg., New Orleans, La.
Mountain District, 730 Seventeenth St., Denver Col.
Pacific Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Northwestern District, Fleischner Bldg., Portland, Ore.
New England District, 38 Pearl Street, Boston, Mass.
Canadian District, Bank of Commerce Bldg., Toronto, Can.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

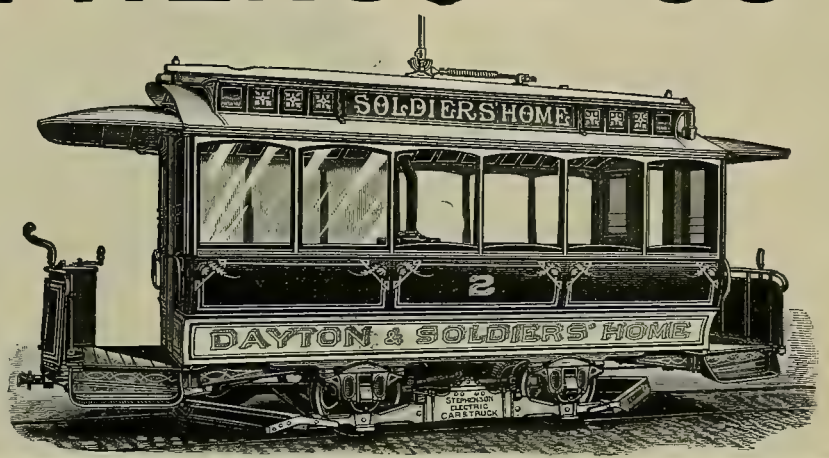
NEW YORK.

STREET CARS

FOR

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.



EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

—MANUFACTURERS OF—

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP ... and 1914 Olive ...

CORRESPONDENCE SOLICITED.

All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

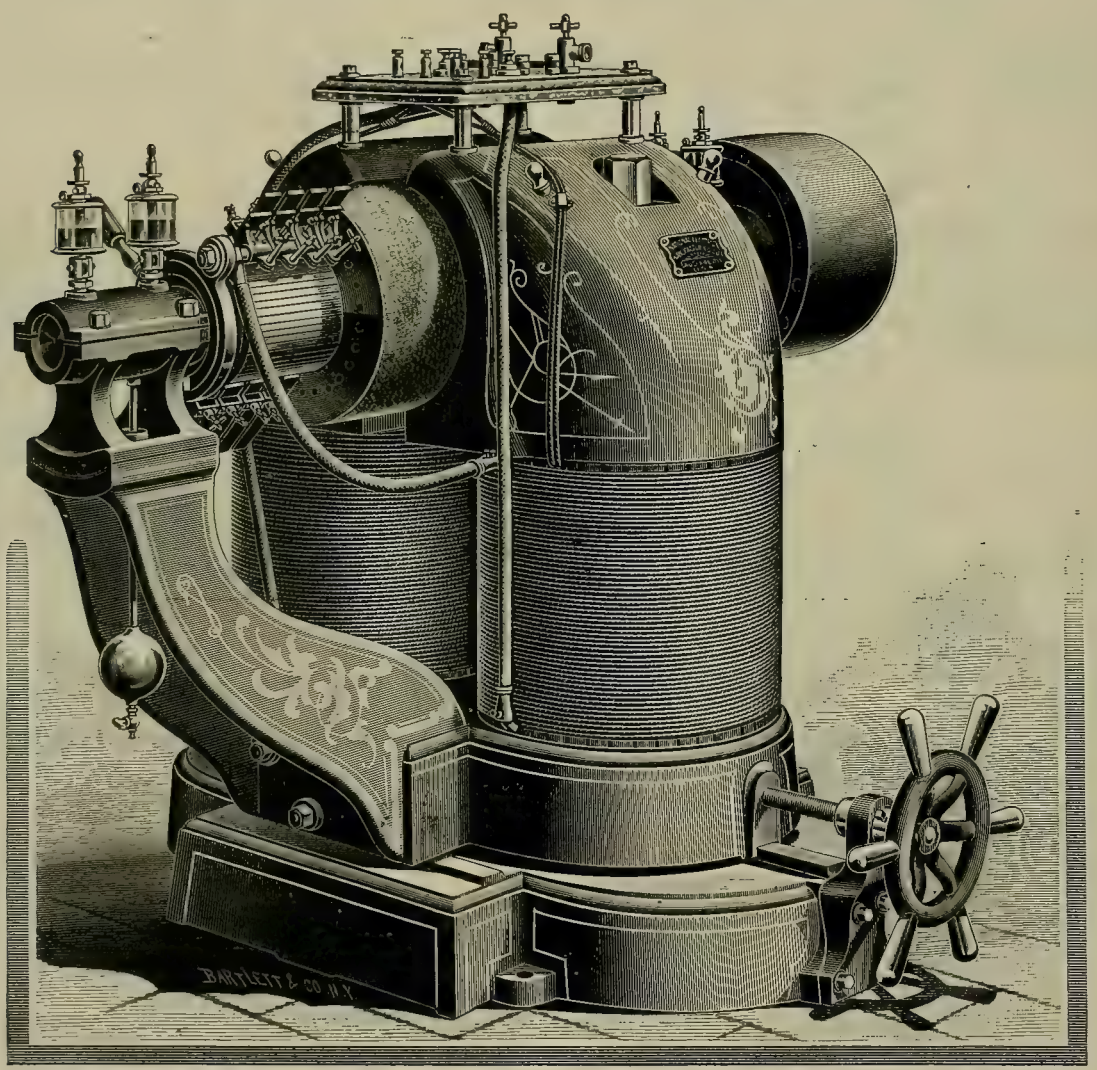
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMO—CAPACITY 500-16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building, St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BLDG.,
20 Cortlandt St.,

TRADE A.B.C. MARK

NEW YORK.

A NEW LAMP.

THE A. B. C.,

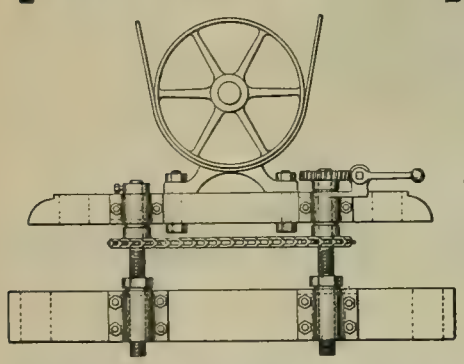
An Incandescent Electric Lamp made to fit any socket. Any Candle Power manufactured under new and improved processes.

EDISON LAMPS AT EDISON PRICES.

ELECTRIC RAILWAY SUPPLIES,
THOMSON-HOUSTON and EDISON.

GENERAL ELECTRICAL SUPPLIES.
BOOKS on ELECTRICAL SUBJECTS.

VERTICALLY-ADJUSTABLE DYNAMO SUPPORT.



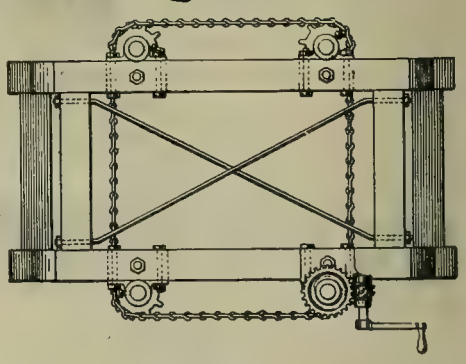
Patented August 12, 1890. For full description see article in WESTERN ELECTRICIAN of September 20, 1890, or Patent Specifications 434,011.

The Best and Cheapest Adjustable Support

In Stations where Dynamos must be placed either above or below the power. In use exclusively in the Chicago City Lighting Stations. Will license users to manufacture the apparatus on royalty, or will sell the patent outright.

CORRESPONDENCE INVITED.

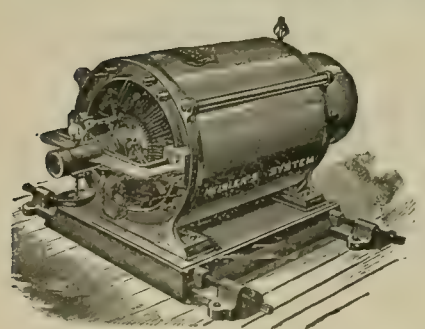
Manufactured and for Sale by



THOMAS WRIGLEY, 85 Fifth Avenue, CHICAGO.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



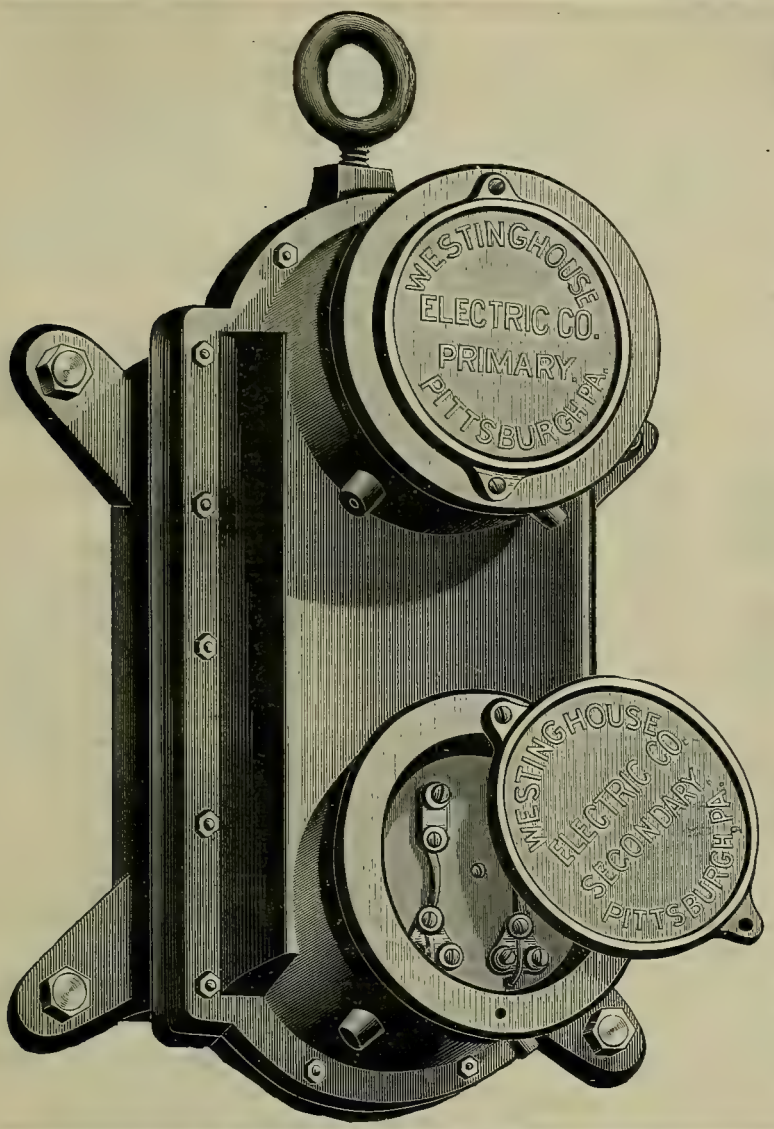
"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.



CONVERTER EFFICIENCIES

It will Pay You to Throw Out Your Present Converters, and Substitute Our Make.

COMPARISON OF CONVERTERS.

	Total Efficiency.	*Converter Capacity Tested.*
THOMSON-HOUSTON,	**87.50 Per Cent.**	**25.**
FT. WAYNE JENNEY,	**87.**	**25.**
NATIONAL,	**88.**	**20.**
WESTINGHOUSE,	**95.**	**20.**

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

INCANDESCENT ALTERNATING CURRENT

Dynamos, Converters, Meters, Motors.

325 CENTRAL STATIONS and 600,000 LAMPS.

Alternating Current Arc Lighting Apparatus.
Lamps burn 40 hours without renewal of carbon.
Arc Lighting revolutionized.

SEND FOR SPECIAL CIRCULAR.

55 Plants and 5,000 Lamps Sold Within a Few Months.

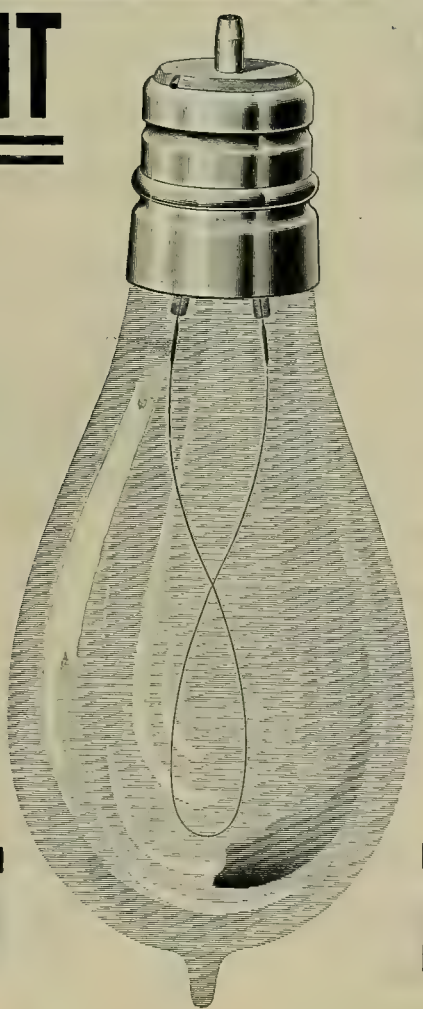
CORRESPONDENCE SOLICITED.

WESTINGHOUSE ELECTRIC AND MFG. COMPANY,

Pittsburgh, Pa., U. S. A.

Boston, New York, Chicago, Cincinnati, St. Louis, San Francisco, Portland.

INCANDESCENT LAMPS.



To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS

THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, **NEW YORK.**

620 Atlantic Avenue, **BOSTON, MASS.**

217 La Salle Street, **CHICAGO, ILL.**

BURNLEY DRY BATTERY

PATENTED January, 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:—Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia.

46 SOUTH CANAL ST., CHICAGO. ILL.

DUST-PROOF BELLS.

None Genuine Without the Washer.

STANLEY & HALL,

(Formerly **HAZAZER & STANLEY.**)

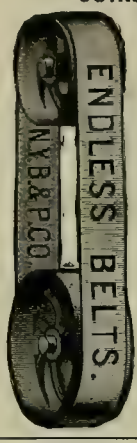
32 and 34 Frankfort St.,

NEW YORK.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.

DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
ST. LOUIS, 616 Locust St.

THE THING for Electric Railways. "CANVAS JACKET" FEEDER WIRES.

INDESTRUCTIBLE PATENT WOVEN INSULATION.

POLES. POLES.

ELECTRIC LIGHT SUPPLIES ELECTRIC RAILWAY.

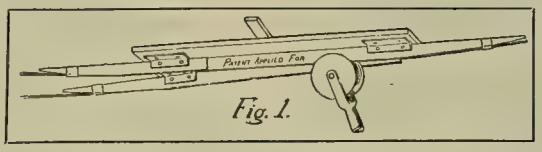


Fig. 1.

MURRAY OVERHEAD TROLLEY SWITCH.

CUSTOMERS REPORT:

"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."

Send for descriptive circulars, THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.

Edw. H. Johnson, President.

THE

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co

MANUFACTURERS OF

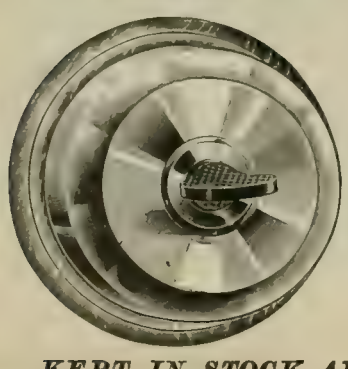
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH



FOR INCANDESCENT WORK

Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,

12th and Market Sts.,

Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES

GET THE BEST!

P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N.Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, NOVEMBER 15, 1890. No. 20

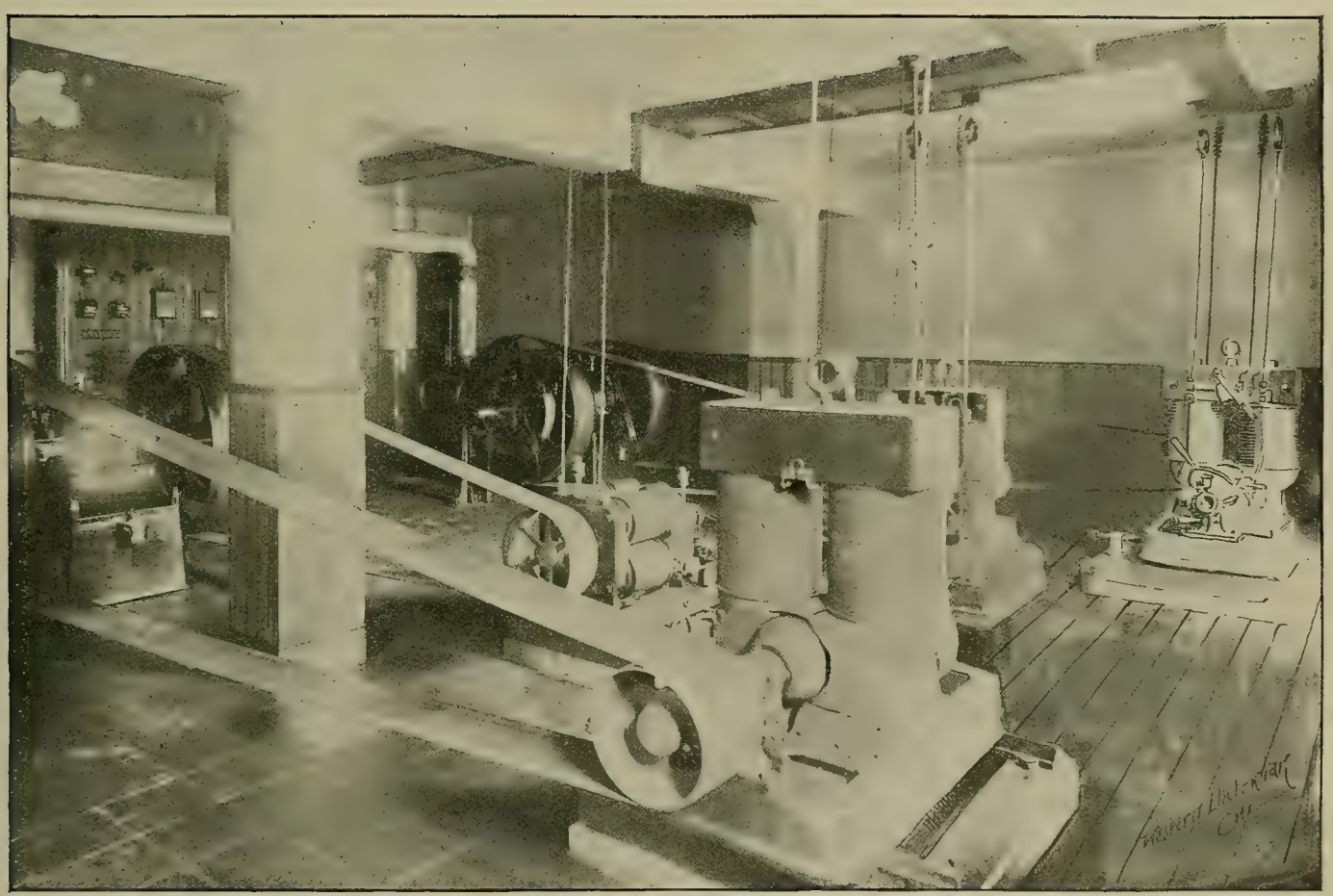
Electric Light Plant in the Guaranty Loan Building, Minneapolis, Minn.

The accompanying illustration gives an excellent view of the dynamo room in the Guaranty Loan Building, Minneapolis, Minn. This structure is one of the finest office buildings in the Northwest, and its electrical plant has been pronounced one of the most complete isolated installations in the country. Both arc and incandescent lights are used, a Sperry dynamo furnishing current for the former, while the Edison system is employed in the latter.

The dynamo room is located in the basement of the building. It is well adapted to the requirements and is well lighted and ventilated.

By reference to the cut it will be seen that there are three Edison machines, two of 600 lights' capacity and the other 400. The arc machine is a 20-light Sperry dynamo. These machines are belted direct to two 100-horse power engines of the Ball type, speeded at 300 revolutions. A partial view of the switch-board is also given.

There are fifteen arc lamps arranged in the arcade of the building and in front of the main entrance, brilliantly illuminating the passages. The incandescent lamps are distributed about the offices and restaurant, the fixtures being of special design. The building is wired for 3,000 incandescent lamps. Okonite and Grimshaw wires are used throughout the building. The installation was made by the Chicago department of the Edison company. The plant is in charge of J. L. Weinert.



ELECTRIC LIGHT PLANT IN THE GUARANTY LOAN BUILDING, MINNEAPOLIS.

National Electric Light Association.

At a meeting of the executive committee of the National Electric Light association held at the Electric Club, New York City, Nov. 7, the date for holding the thirteenth convention at Providence, R. I., was fixed for February 17, 18 and 19. Eugene F. Phillips of Providence, was appointed chairman of a committee of five on reception and arrangements, and was authorized to name the other members of the committee. Gen. C. H. Barney of New York was chosen chairman of a committee of three on electrical exhibits and transportation, and was authorized to appoint the other members of the committee.

The resignation of James English as a member of the executive committee was accepted, and Edward A. Leslie, manager of the Manhattan Electric Light company of New York City, was elected to fill the vacancy.

The committee on papers reported that it had secured the promise of several papers, and had named a person to open the discussion on each paper. The committee stated that the following papers had been promised:

"How can the National Electric Light Association Best Serve Central Station Interests." By C. R. Huntley. Discussion by A. M. Young.

"Distribution of Steam from a Central Station." By F. H. Prentiss. Discussion by Geo. H. Babcock.

"Distribution and Care of Alternating Currents." By T. Carpenter Smith Discussion by C. H. Blaxter.

"Municipal Control of Electric Railroads." By W. M. Mead. Discussion by M. J Francisco.

"The Ferranti System." By C. B. Haskins. Discussion by C L. Edgar.

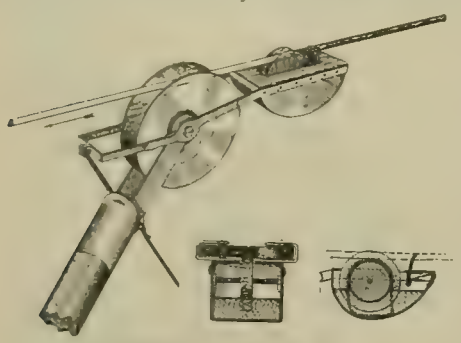
South End Electric Railway, Chicago.

The Chicago city council has a petition under consideration for the extension of the electric railway in the southern part of the city. The proposed ordinance authorizes the extension of the lines on Ninety-fifth street, along Michigan avenue and running south on Michigan avenue to One Hundred and Sixteenth street; also commencing at State street on Ninety-fifth and running east on Ninety-fifth street to Stony Island avenue; also commencing on State street at One Hundred and Third and running east on One Hundred and Third street to Lake Calumet; commencing on State street, near One Hundred and Eleventh and running east on One Hundred and Eleventh street to Lake Calumet; commencing at State street on One Hundred and Fifteenth and running east on One Hundred and Fifteenth street to Lake Calumet. The ordinance was referred to the committee on streets and alleys, South.

The city of Gallatin, Tenn., will erect an electric plant for public lighting.

Greasing the Trolley Wire.

The formation of a coating of ice on an overhead trolley wire is, to say the least, an annoyance. Not only does the ice prevent a good and firm contact between the trolley wheel and the wire, but at the same time it endangers the safety of the overhead work by greatly increasing the latter's weight. One has only to glance at any aerial electric line on a sleety day to appreciate the fact. To overcome this difficulty and prevent the adhesion of any considerable amount



GREASING THE TROLLEY WIRE.

of moisture to the wire, J. T. Whittlesey of Lynn, Mass., proposes the plan of greasing the conductor. The apparatus by means of which the coating may be applied, is illustrated in the cut. The figure in the lower right hand corner is a sectional view of the grease pan which is attached, as shown in the upper figure, to the trolley pole of a car. The sectional cut at the center shows the construction of a modified form of the device designed to apply the thin coating of grease over the entire surface of the wire.

The construction of the appliance is very simple. The ends of the journal of the trolley project slightly outside of the fork in which the trolley is mounted. On these projecting ends rest the arms of a frame which extends before and behind the trolley. This frame is made of heavy sheet metal, but is flexible enough to permit the arms to be spread apart when they are to be slipped over the journals. The front ends of the arms are bent toward each other and fastened together.

The rear ends of the frame support the pan. Inside the receptacle is a wheel or roller adapted to take up the moisture-repellant substance and spread it upon the conductor. This grooved wheel is made of wood or hard rubber, and is covered with thick felt so as to be adapted to carry up and smear upon the wire the contents of the pan. In case a semi-liquid substance is used for coating the conductor, an endless belt or chain may be passed over the wheel, as indicated, to assist in carrying up the grease.

The Waco, Tex , Dummy Street Railway company has increased its capital stock for the purpose of enabling it to equip its lines with electrical apparatus.

Allan C. Durborow, Jr., M. C.

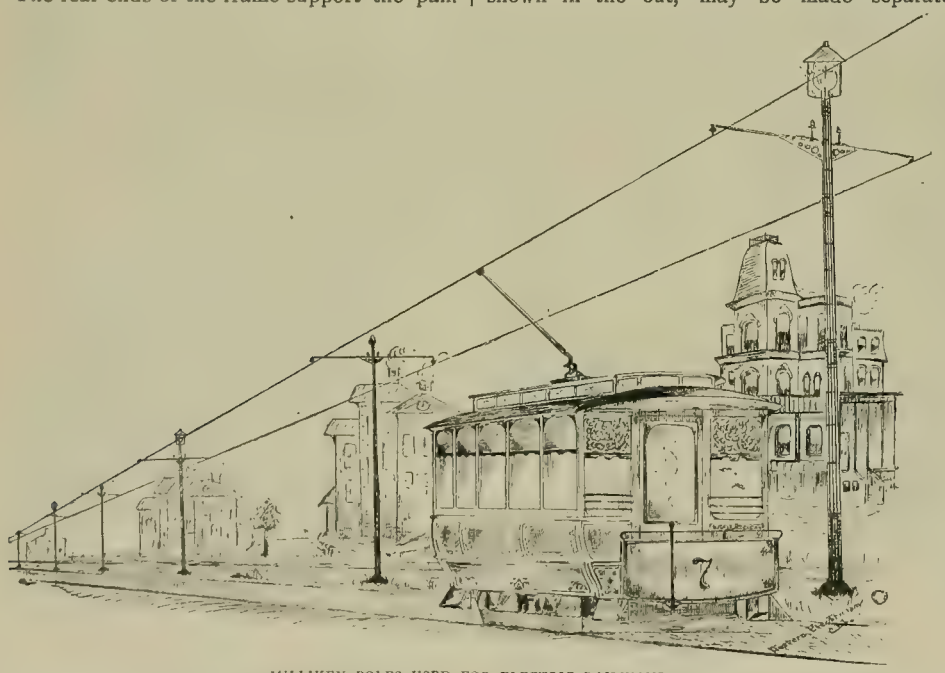
The Chicago *Evening Post* has the following to say in reference to the election to Congress of Allan C. Durborow, Jr., business manager of the WESTERN ELECTRICIAN:

A broad smile of satisfaction is now engaged in disfiguring the large electric faces of a certain class of Chicago's solid citizens, for without making any great parade of their intentions, they have taken unto themselves a helpmeet in the person of a member of the Fifty-second Congress. Allan C. Durborow, Jr., will go to the house of representatives, not only with the enviable prestige gained in his gallant fight against the odds ot 3,000 votes and one of the strongest campaigners in the camp of the enemy, but he will go as the accredited representative of an interest aggregating $600 000,000. This may seem to be a good deal of money and undoubtedly is, but electricity in its many ramifications has come to be a very big interest, and it is hardly too much to say that three-fourths of this amount has headquarters in Chicago. It will be understood, therefore, what it means to so great an industry as this is to have a friend at court.

In addition the *Post* speaks of Mr. Durborow's energy, determination and unflinching integrity. It is with no little satisfaction that Mr. Durborow's colleagues on the WESTERN ELECTRICIAN, irrespective of political affiliations, take this occasion to indorse heartily all that has been said in his behalf. From a personal acquaintance, extending almost from the date on which this paper was established, they are fully qualified to testify to his many admirable qualities. Mr. Durborow is a man of more than ordinary promise and character; he possesses marked energy, and better than all he has a conscientious regard for duty. His associates unite in extending their heartiest congratulations, and in expressing their sincerest wishes that his political career may be useful and successful.

Milliken Poles Used for Electric Railways.

In the construction of the electric railway shown in the cut Milliken iron poles are used. The poles are formed of four sections of iron of the Phœnix shape, riveted together with the tie plates, which are equidistant. Lacing is inserted at the point of greatest strain. A taper is given at the same point. This construction, it is stated, gives the pole great strength for the weight of material used. The cross arms used with poles, set in the center of the street as shown in the cut, may be made separate and bolted on after the upright portion is in position. A cast iron bumper, to prevent injury as a result of wagon wheels striking the base is provided at the base of the poles. In the cut it will be noticed that every alternate pole is so constructed that provision is made for an arc lamp at the top. This is a new feature in the construction. Fixtures suitable for a cluster of incandescent lamps are manufactured to be attached to the poles. The poles are used on many electric railways, among them the Pittsburg & Birmingham Traction company, Pittsburg, Pa., and the Rapid Transit Street Railway company. The manufacturers, Milliken & Co., are represented in the West by D. Forsythe Morris, Chicago.



MILLIKEN POLES USED FOR ELECTRIC RAILWAYS.

Bergmann's Thermal Telephone.

The instrument illustrated in the cuts contains neither a permanent magnet, electro-magnet nor a coil. In this telephone which is the invention of S. Bergmann of New York, movement of the diaphgram is produced it is claimed, by the expansion and contraction of constantly-touching electrodes caused by the thermal effect of the current at the points of contact. A

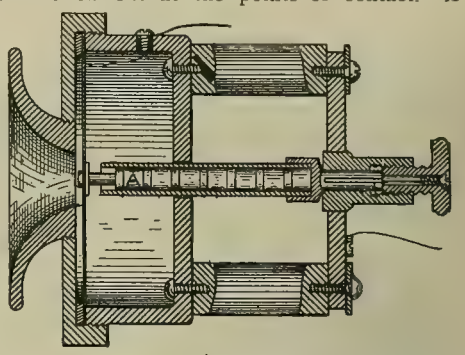


FIG. 1. BERGMAN'S THERMAL TELEPHONE.

glance at Fig. 1 will give the reader a good idea of the construction of the device. Mr. Bergmann employs a series of electrodes or contact pieces of such character as to be readily affected thermally by the current. One electrode *A* is attached to the diaphragm, and the others are all arranged that they may be adjusted so as to be in loose contact. The buttons are cylindrical as indicated and are composed of or faced with tellurium. They are placed together in a tube of insulating material behind the diaphragm. Means are provided for adjusting them in the tube to proper degree of loose contact. The current passes through the series and at the contacts variations in expansion or contraction of the tellurium are produced by the changes in the current transmitted to the instrument. Vibrations of the diaphragm

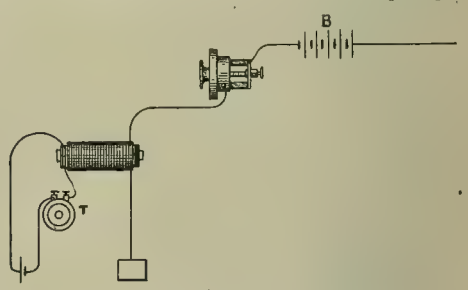


FIG. 2. BERGMAN'S THERMAL TELEPHONE.

corresponding to the current vibrations it is claimed are thus produced.

Fig. 2 illustrates one of the methods of heating the electrodes, which the inventor proposes to employ in connection with this receiver. *T* is any ordinary transmitter with an induction coil and battery. *B* is an extra battery to be placed in the line to furnish current to the contacts.

Western Engineering Society, Chicago.

At a recent meeting of the Western Society of Engineers, Chicago, L. P. Morris, land commissioner of the Illinois Central, read a paper in which he favored the plan of placing the telegraph under the control of the government. John W. Weston, the secretary, presented a report for an International Engineering Congress to be held during the World's Columbian Exposition. The plan proposes the establishment and maintenance of a joint engineering headquarters which will be a rendezvous for members of the engineering societies of this country, as well as for foreign engineers.

The congress is to last six days, and will be conducted in the English language. The various branches of civil, mechanical, mining, metallurgical, electrical, military and naval engineering will be considered. All papers which will be contributed are expected to treat of such new and recent constructions, machines, processes, methods, experiments and investigations, including proposed standards of tests and measurements, as are of engineering importance.

Illustrating the Phenomena of Electrolytic Action.

H. Fourtier, a French scientist, not long ago designed the apparatus shown in the cuts for illustrating to a company of students the phenomena taking place in water when an electric current is flowing through the liquid. The plan is simple. Fourtier simply employs a stereopticon so constructed that the rays of light pass through a transparent vessel containing the liquid and project the image upon a large screen. The phenomena accompanying chemical reaction are beautifully shown in this way and may become visible to a large number of spectators.

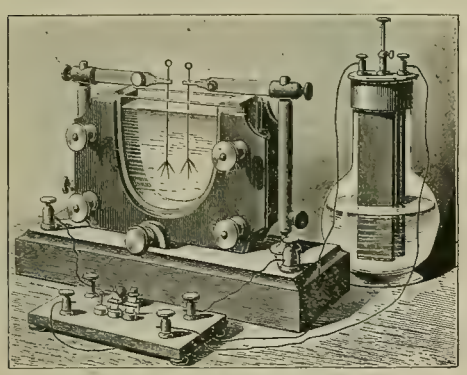


FIG. 1. ILLUSTRATING THE PHENOMENA OF ELECTROLYTIC ACTION.

The Fourtier method may be adopted to advantage by professors or lecturers in their experiments designed to instruct or entertain.

Fig. 1 shows the form of containing vessel used which is formed by clamping two small plates of glass on each side of a thick U-shaped piece of rubber. Fig. 2 shows on the left the containing vessel mounted in front of the stereopticon. On the screen at the right is the image showing the phenomena accompanying the decomposition of water by electricity. A lense is placed in front of the containing vessel in order that the image may not be reversed on the screen.

In Fig. 3 are shown several little appliances which Mr. Fourtier has found useful for the illustration of the phenomena of liquids. The wires shown at No. 8 and at No. 9 are used in the electrolysis of liquids as indicated in Fig. 1. The most beautiful effects can be produced on the screen. At No. 10, Fig. 3, is represented an electro-magnet of which the core is prolonged. The containing vessel is filled with glycerine, and the electro-magnet connected to the battery, is inserted in it. On the top of the glycerine

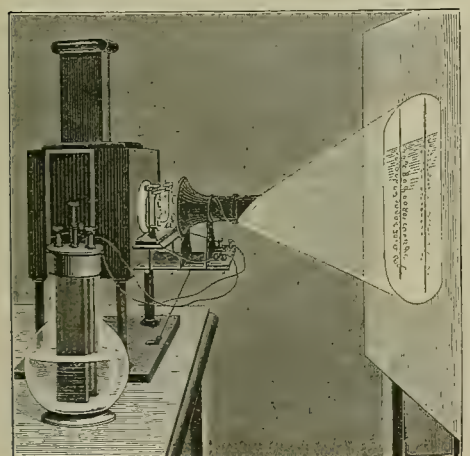


FIG. 2. ILLUSTRATING THE PHENOMENA OF ELECTROLYTIC ACTION.

are sprinkled iron filings which sink very slowly in the heavy liquid. They are attracted by the magnet, and are grouped in varied forms. The effect which is shown on a large scale on the screen is exceedingly beautiful. The cuts are reproduced from *La Nature*.

Superintendent Beach and the Central Union Telephone Company.

F. G. Beach, president of the Chicago Electric club, will make a trip through the West and Southwest during the next two months. During that time his duties as general superintendent of the Central Union Telephone company will be performed by J. E. Zeublin, assistant general superintendent, who has heretofore been located at Columbus, O. Mr. Beach's long service in the company has earned the vacation he is now enjoying, and his many friends hope he will return from his trip with improved health.

Wisconsin Electric Club, Milwaukee.

The Wisconsin Electric club held its first literary meeting of the season at its rooms in the Plankinton building, Milwaukee, Oct. 31. A paper was read by Alex. Bevan on "Storage Batteries." Mr. Bevan said there had been considerable activity displayed by the projectors of storage batteries and that 4,000 patents had been granted in this department. He did not believe, however, that the problem had been solved, and that the storage battery of the future would be radically different from the present forms.

The club has arranged for a number of excellent papers to be read at the meetings this winter.

The Australian Cable.

"We of Vancouver are getting interested just at present in the proposed cable to connect us with Australia," Henry McKey of British Columbia, who was in Chicago last week, said. "It is a mammoth undertaking to lay a cable 9,000 miles long, and that considerable work is involved can easily be imagined. The cost is estimated at $9,000,000, and the British govern-

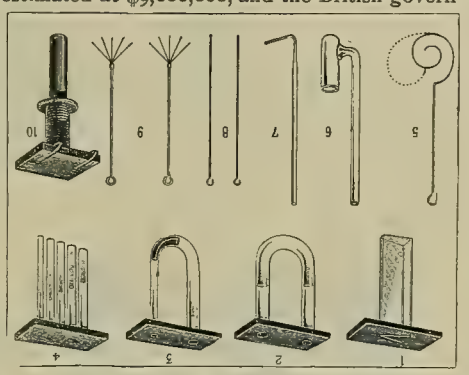


FIG. 3. ILLUSTRATING THE PHENOMENA OF ELECTROLYTIC ACTION.

ment will guarantee a 3 per cent. dividend of $270,000.

"When the task shall have been completed Vancouver will receive a material boom, for its importance to the British government, as a place from which invaluable information may come from the Southern continent in case of war with European powers, will require a formidable fortification. At present the declaration of war by England and any European power would be followed at once by the severing of the cable that now connects England with Australia, and intelligence of the situation in the southern colonies must be delayed at a terrible cost. The failure of the British government to realize this fact long ago seems strange; however, it has after all awakened in time, and the period when the world will be encircled by wire is not far distant."

Chicago City Electric Light Plant.

The city comptroller of Chicago has advertised for bids for electric lighting apparatus to be submitted to City Electrician Barrett at the City Hall before Nov. 15. Specifications are now on exhibition at Prof. Barrett's office in the City Hall. It is intended to purchase seven arc light machines of 60 lights' capacity each and 350 arc lamps. The city hopes to have the South Side station, in which this apparatus is to be installed, completed and the plant in operation Christmas eve.

Electric Light and Gas Interests.

The convention of the American Gas Light association at Savannah, Ga., was one of the largest and best represented meeting of gas men ever held in this country. About 150 delegates participated in the proceedings and enjoyed the hospitality of the local gas company. The list of papers read before the convention included one of special interest to those connected with the electric lighting industry. It was read by A. E. Boardman of Macon, Ga., and was entitled "Hints on Electric Lighting by Small Gas Companies." Although Mr. Boardman did not favor the operation of electric light plants in connection with gas companies, he evidently recognized that the natural antipathy of gas men to the electric interest, if permitted to direct them, would inevitably lead them to ruin. Mr. Boardman, it appears, has had considerable experience in the management of electric lighting plants, and the result of his observation and experience was presented.

Portable Lamp with Renard Primary Batteries.

In the WESTERN ELECTRICIAN of April 26 last was described the Renard battery, which

FIG. 1. PORTABLE LAMP WITH RENARD PRIMARY BATTERIES.

was designed originally for the propulsion of a balloon. Recently the batteries have been used with considerable success for furnishing light on a small scale in houses in Paris. Seven cells are grouped in an ebonite case and furnish current for a lamp of small candle power. Fig. 1 shows a view of one of these portable lamps, and Fig. 2 gives a sectional view. The cells which are grouped as shown, are composed of a cylinder of carbon and a pencil of zinc. The elements are placed in a glass tube-shaped vessel sealed to the cover of this air-tight containing jar. When air is forced into the jar by means of the rubber bulb *P*, the depolarizing liquid, which is composed of a solution of chromic, hydrochloric and sulphuric acids, rises in the several cells. There is a stop-cock at *r* so that the height of the liquid, and consequently the internal resistance and the amount of current can be controlled. When not in action the liquid is at the level *nn;* the battery attains its greatest activity when the fluid reaches *n'n'*. The lamp shown in the cut is of 15-candle power. The battery, it is stated, will furnish current for five hours at a cost of about two-fifths of a cent per candle per hour.

Thomson's Constant Current Motor.

To the Editor of the WESTERN ELECTRICIAN:

The new method of governing adopted by Prof. Elihu Thomson in his recent constant current motor, described in the WESTERN ELECTRICIAN for Nov. 1, is not a strictly novel treatment of the magnetic circuit. Its novel feature is the controlling device which is placed as a shunt to the

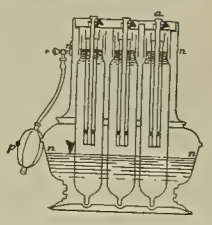


FIG. 2. PORTABLE LAMP WITH RENARD PRIMARY BATTERIES.

armature and which operates with increase of counter e. m. f. developed by increase of speed.

The main idea involved is the magnetic shunt to the field. This is fully described in Thomson's Dynamo-Electric Machinery, third edition, p. 445. It is there employed as applied to a generator for automatic regulation for constant current. It will be seen by reference to Thomson that the idea was first suggested by Prof. J. W. Langley, formerly of the University of Michigan, but the form described by S. P. Thomson and employed by Elihu Thomson, was devised by Trotter.

In both the generator and motor the magnetic shunt is wound in series with the field magnet coils, and an electrical shunt is thrown round this controlling coil so as to cut off current from it and permit it to short-circuit or divert magnetic lines from the armature.

In the generator this electrical shunt is worked by an electro-magnetic device placed in the main or working cir-

cuit. It acts, therefore, responsively to changes in the current of the generator. In Thomson's motor the electrical shunt is controlled by an electro-magnetic device placed in a derived circuit connected with the two brushes. The device on the generator responds to changes in the main current and operates to keep this current constant. The corresponding device on the motor responds to changes of speed in the motor and operates in such a way as to tend to keep this speed constant. Both employ the magnetic shunt in the same way. The divergence between the two lies entirely in the controlling or responsive device. S. P. Thomson points out that it has been found necessary to cut a gap in the short-circuiting bar to prevent sluggishness in the descending magnetizations since the magnetic circuit is a closed one.

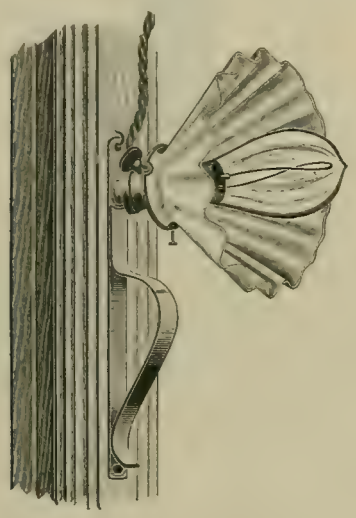
Doubtless this method of regulation has not been employed heretofore to the full extent of its capabilities.

H. S. CARHART.

Ann Arbor, Mich., Nov. 4, 1890.

Portable Desk Clamp.

The accompanying cut illustrates a portable desk clamp for holding incandescent lamps. By means of this device an incandescent lamp may be adjusted to any desired position over the desk, or can be hung on the wall at any height



PORTABLE DESK CLAMP.

that may be required. It is specially adapted to use in vaults in searching for papers or books. By slipping it on the back of a reading chair a lamp may be placed in the proper position for shedding its rays on the book or paper in hand. The device is manufactured by the Knapp Electrical Works of Chicago.

Weston's Standard Battery.

The cuts illustrate a battery of standard galvanic cells intended to yield a current of constant pressure under a given temperature, for use in making electrical measurements and comparisons.

The arrangement is the invention of Edward Weston, of Newark, N. J., and was designed with the view of producing a battery of con-

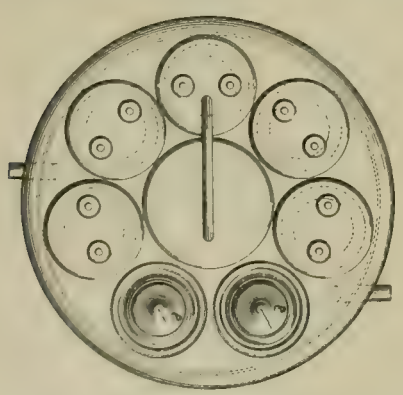


FIG. 1. WESTON'S STANDARD BATTERY.

venient form with means of maintaining the cells at a given temperature, and indicating that fact.

Referring to the illustrations, Fig. 1 is a plan of the battery complete. Fig. 2 is a sectional view. Fig. 3 is a vertical section of one of the cells showing a thermometer disposed in the center and coming out through the bell-shaped cover of the jar. Fig. 4 is a similar section showing the thermometer arranged in the enlarged lower portion of the cell and not protruding through the bell-shaped cover.

The battery as a whole is contained in a cylindrical vessel as indicated. The circular cover has in it a number of openings, each of which receives a small cylindrical case, Fig. 3. The upper edge of this latter vessel is flanged, as shown, and the flange rests on a shoulder formed in the hard rubber cover of the outer case. Under the flange there is a rubber gasket. After the smaller vessels are set in place they are also closed with insulating covers. These cases serve as receptacles for the cells proper, Figs. 3 or 4, as the case may be. Each cell has a lower bottle-shaped portion made of glass. Into the mouth of this bottle fits a bell-shaped cover, also of glass.

The zinc electrode of these cells is made in the form of a disk, having a central standard to which the terminal wire is secured. The wire from the zinc extends upward and is sealed in the center of the bell-shaped cover. After the electrode has thus been put in place, the interior of the glass cover is filled with a mixture of beeswax and gutta-percha. By means of this filling the electrode is rigidly held in its central position. In the bottom of the jar is placed a corrugated and perforated disk of platinum. The terminal wire leading from this plate, passes through the side of the jar, where it is sealed, and then leads upward and connects to a binding post. After the cell proper has been put together in the manner described, it is inserted in its particular case, and then the whole space between cell and vessel is filled with melted paraffine. In this manner the cell is rigidly held in place and prevented from moving about. The electrolyte employed in the cell is a solution of pure mercurous sulphate mixed with a solution of zinc sulphate to form a paste.

The arrangement of the thermometric portion

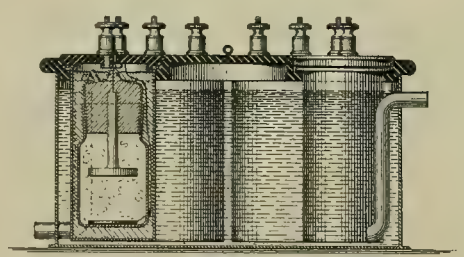


FIG. 2. WESTON'S STANDARD BATTERY.

of the cell is shown in Fig. 3. Instead, however, of inserting the thermometer through the bell-cover it may be inserted and sealed directly in the side of the cell, as shown in Fig. 4. The advantage of this latter construction is that the bell-cover can be removed without disturbing the thermometer.

To maintain a constant temperature the pipe shown at the right in Figs. 1 and 2 is connected with a source of water supply so that the outer case is filled and the water rises up around the cell-vessels to the level determined by the overflow pipe indicated at the left.

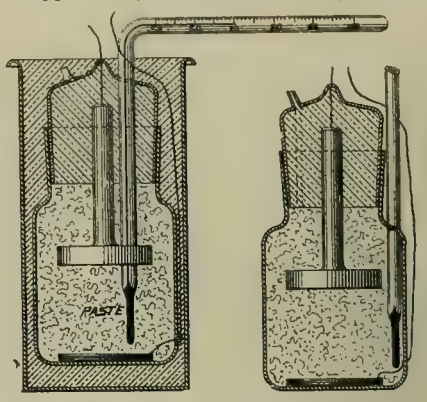
This standard battery, constructed as shown, it is stated, will yield a constant e. m. f. of ten legal volts and will maintain this pressure at a temperature of 67½ degrees Fahrenheit.

It may be mentioned that the materials contained in the cells, namely, zinc, platinum and a paste of mercurous and zinc sulphates, constitute what is already known as the "Clark standard cell." Mr. Weston's improvement consists merely in the peculiar arrangement of cells and the means for uniformly and simultaneously varying the temperature.

Electric Plant in an Aluminum Factory.

The Pittsburg Reduction company employs electricity in the operation of its plant and reduces aluminum by an electrolytic process. The power plant consists of several Babcock-Wilcox boilers, and the engines are three in number, two being of 200-horse power of the Westinghouse compound type and one a Westinghouse automatic engine of 125-horse power.

The electric plant consists of four direct current dynamos made by the Westinghouse Electric Manufacturing company and the United States Electric Lighting company of Newark, N. J. The armatures of these dynamos are shunt wound and all of them furnish the current for the reducing pots. Two of these dynamos are immense machines, wound to generate a current of 2,500 amperes at a pressure of fifty volts. The other two machines furnish a current of 1,000 amperes each, at a pressure of 25 volts. The conductors for the two large dynamos are two copper bars, each six inches by one-half



FIGS. 3 AND 4. WESTON'S STANDARD BATTERY.

inch. For the current from the small dynamos, a similar shaped bar, four inches by one-half inch is used.

Pantechnetheca Fixtures.

"Pantechnetheca" is the startling name under which the Markle Engineering company of Detroit is exploiting the novel electrolier illustrated in the cut. The particular feature of this new fixture is that it is made entirely of wood. In the fixture is embodied a switch socket, shade holder, ceiling rosette, fastenings, contacts, cut-out and canopy. The richest and most artistic designs are readily carved in wood as are also the plainest and cheapest articles. It is thus possible to obtain a wide range of decorative effects. These fixtures, it is stated, have been tested for some time, under various conditions, and have proven satisfactory. The company has provided special machinery and apparatus, and otherwise equipped a department in its factory for their manufacture. They will be first put on the market in the single pendant form, and will be made from walnut, oak and kindred woods. New designs of two, three, four and six-arm fixtures with stem of same style as the cut shows, are shortly to be introduced. It may be mentioned that the pendant illustrated is provided with a lamp key which is operated by a push instead of a twist, as is the case with the ordinary lamp switch. The advantage of this will be appreciated. The Pantechnetheca fixtures are handled by the Central Electric company, Chicago.

Chicago Electric Club.

The next meeting of the Chicago Electric Club will be held Monday evening, November 17. Theo. P. Bailey will read a paper on "Electric Street Railways." This will be the first street railway paper read before the club and it is expected that a large number of members will be present.

Peru, Ind., wants rapid transit and very naturally the business men of that city have decided to adopt electricity as a means of propulsion. The proposed route will be three or four miles in length and pass through the principal streets of the town.

United States Automatic Block Signal.

The illustrations presented herewith show the principal details of a new automatic electric block signal introduced by the United States Electric Railway Signal company of Chicago. In this system the track instrument is placed about 1,000 feet in advance of the signal, so that the entire train may pass the signal before operating it, thus keeping the last block passed through protected until the entire train has passed out of it. The signal case is made of substantial iron castings which afford complete protection from weather. It is mounted upon a well-braced tower built of wrought iron piping. These towers stand upon heavy cast iron foundations which penetrate the earth five feet. They are provided with spaces for a storage battery of sufficient capacity to supply current for six months without recharging. A single line of wire, encased in iron pipe and put underground, is provided for each track, but is so arranged that no two towers are connected except when one shows the red or danger signal; then it is automatically paired with one ahead.

The case, Fig. 1, is provided with a circular double window nine inches in diameter, which affords an unobstructed view through when the signal is clear, but when in the danger position a red transparent disc H^1 is moved over and completely covers the window, making it appear red. A lamp is placed behind this window at night.

The track instrument, Fig. 2, consists of a square iron box fitted to the rail and so constructed that it requires the weight of an engine or very heavy car to operate it. It is set in motion by the slight depression of the rail. Inside the box B is a crank shaft G, near one end of which is loosely fitted an insulated ratchet wheel M. The pin H of the crank engages a bar of iron I, eight feet long, which lies in the hollow side of the rail between the rail and the box, and is supported at the ends only. This arrangement admits of the rail springing downward directly where the box is fastened to it, and carrying the box along with it without springing the bar I. The relative change of position of the box and bar imparts an oscillating motion to the crank shaft. On the end of the crank shaft, next the

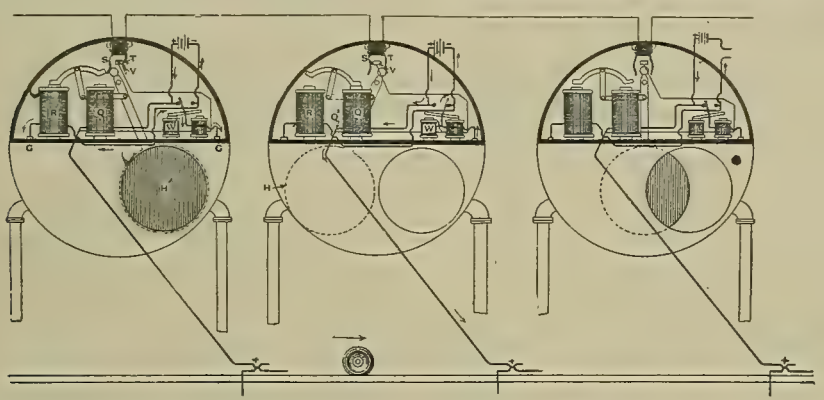


FIG. 1. UNITED STATES AUTOMATIC BLOCK SIGNAL.

ratchet wheel, is fastened a lever N, which carries an insulated spring pawl, which engages the teeth of the ratchet wheel M, and imparts to it a rotary step-by-step motion when the rail springs down and up. Two flat springs, one of which, D, is insulated, are fastened to the body of the box and also engage the surface of the ratchet wheel, as shown at XX. To the insulated spring D is fastened the wire, and from this point the circuit is completed through the ratchet wheel to the other spring, and from it to the body of the box, thence to ground. The momentary opening of the circuit by the snapping off of the springs produces the change in the signal to be described further on.

Fig 1 is a diagram showing three signal towers. Referring to the middle one, we find the disk H withdrawn from sight, and hence the signal is clear. The red disk is attached to the lower end of a pendulum as shown. This pendulum is connected by a short rod or link to a double rocking armature pivoted in its middle, and capable of being attracted toward either of the electro-magnets R or Q. As shown in the middle signal, the rocking armature is attracted by Q, hence the pendulum is drawn to the left, and the red disc H^1 with it.

Each has its own local battery and circuit, which latter is always closed. The circuit runs as follows: Commencing at the + side of the battery it runs to one of a pair of contact points in the relay W, thence through the coils of electro-magnet Q, thence to the track instrument, thence to ground. Beginning now at the — side of the battery, the circuit runs to the other contact point of relay, thence through electro-magnet R, thence to ground by fastening to the case. The relay W is polarized and provided with a rocking armature capable of being thrown in either direction, according to the direction in which a current is sent through its coils. To the rocking armature of the relay is attached a tongue which rests on one or the other of the contact points before mentioned, and to this tongue is connected a ground wire. It will be apparent that this tongue will "ground out" or short-circuit one or the other of the electro-magnets Q or R. In the middle signal R is grounded out, and the current, after passing through Q and the track instrument to ground, returns to the battery from the ground through the relay ground wire and armature tongue. Connected to the primary wire as described above, between the electro magnet Q and the track instrument, is a branch wire Q^2, which runs to the inside of the relay coils and thence out to a contact block v. On each side of contact block v are contact springs S and T. These springs are so formed that when nothing interposes, and they hang free, they touch each other. This should be their position in the right-hand signal; the drawing erroneously shows them apart. If one is slightly pushed away from the other, the one not pushed will rest on the contact block v. In the middle signal the spring T is pushed off by a pin in the upper end of the pendulum rod and spring S makes contact with contact block v. To the spring S is connected the line wire running back to the next signal, where it connects to spring T of that signal. Now this signal is the "danger" position and shows red, and

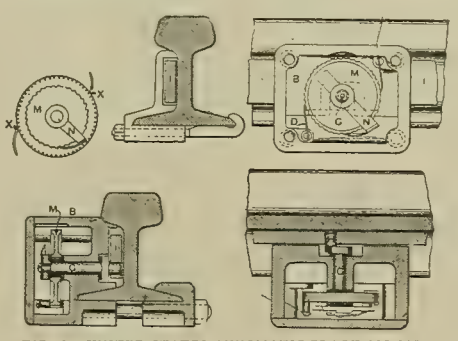


FIG. 2. UNITED STATES AUTOMATIC BLOCK SIGNAL.

the pendulum hangs at the other extreme, hence the spring S is here pushed off and T allowed to make contact with the contact block v. A wire runs from contact v to relay and from relay to the branching place in primary wire, precisely the same as in the middle signal Q^2. It is evident that a current sent through the line wire will have the engine to be where the wheel is shown going in the direction of the arrow. When it passes over the track instrument of the middle signal it causes a momentary break in the circuit. This causes the extra current to pass through the branch starting at Q^2 through the relay, through the line wire, back, to left-hand signal, through its relay through branch to primary wire to ground, through opposite effect upon one relay to what it has upon the other. The relays are operated by the electrostatic discharge, or extra current, caused by a momentary opening of the closed primary circuit. This discharge, though small in quantity is of high electromotive force and capable of overcoming high resistance. Suppose, now, an ground back to middle signal, through middle signal's primary wire to branching place, thus completing the circuit. The effect will be to reverse the position of the relay tongues in both signals and thus change the current to the idle electro-magnets in both and restore the left-hand signal to safety, and throw the middle one to danger.

Should the local circuit become inoperative from any cause such as exhausted battery or broken wire the red disk will show one-half, which is an indication distinct from either danger or safety; this is shown in the right-hand signal. When this takes place the springs S and T come together and close the line. This enables the next signal to act in place of the disabled one and prevents delay.

This signal has been, it is stated, in successful operation on the Wisconsin Central railway for three months. The cuts are reproduced from the *Railway Gazette*.

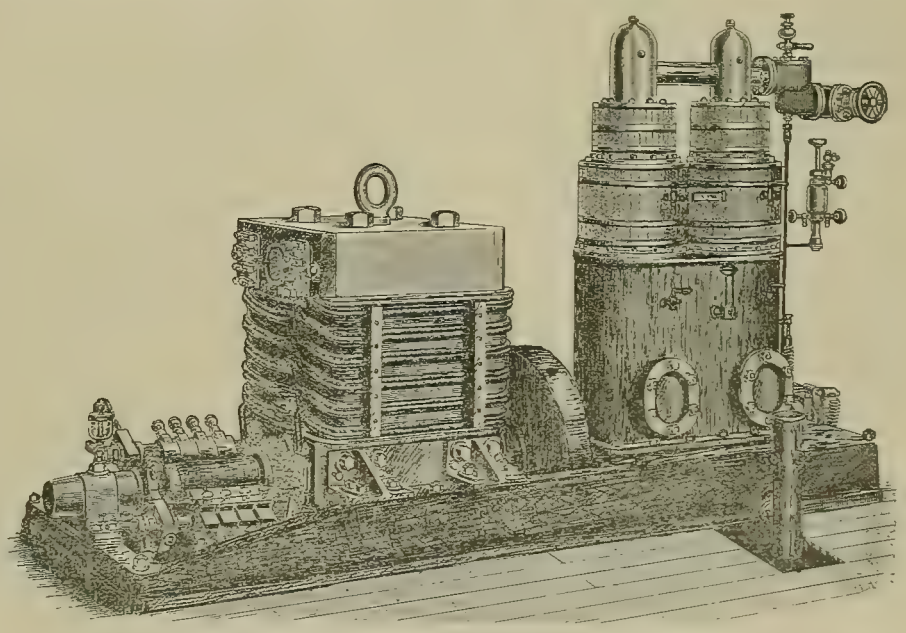
Efficiency of the Edison-Hopkinson Dynamo and Willans Central Valve Engine.

At a recent test made with a large Edison-Hopkinson dynamo, constructed by Mather & Platt of the Salford Ironworks, Manchester, England, a result has been obtained giving an efficiency superior to anything previously attained. The results show, it is stated, an efficiency of engine and dynamo combined, *i. e.*, the ratio of the electrical power available for useful work outside the dynamo to the indicated power of the engine of 86.7 per cent.

The following are particulars of the engine and dynamo shown in the accompanying illustration: Compound double crank engine with low pressure cylinders 14 inches diameter, stroke 6 inches, to work with 120 pounds steam pressure, driving direct an Edison-Hopkinson dynamo, constructed for an output of 110 volts 475 amperes at 430 revolutions per minute. The dynamo has a bar armature, and is shunt-wound only. It is fitted with a commutator of hard drawn copper with mica insulation, with four brushes on each rocking arm. The resistance of the magnets is 16 ohms and that of the armature 0.0055 ohm. The indicated horse power of the engine was 83.3, and the useful electrical horse power given out by the dynamo was 72.2. Hence the efficiency was 86.7 per cent. The consumption of water per indicated horse power was 21.6 pounds. The consumption of water per electrical horse power was 25 pounds.

In the test made on this combination both engine and dynamo were worked to a somewhat higher load than their normal or specified load, and this, no doubt, would be to a slight extent favorable to the efficiency. Another test was made on a similar combination working at its normal load, with the following results: Resistance of armature, 0.0058 ohm; resistance of magnets, 15.6 ohms; indicated horse power 85.3; electrical horse power, 70.0. Efficiency, 83.3 per cent.

The electrical losses in the first instance were: Loss in magnet coils, 756 watts = 1.4 per cent.; loss in armature coils, 1,386 watts = 2.6 per cent. Electrical efficiency = 96. per cent.



EDISON-HOPKINSON DYNAMO AND WILLANS CENTRAL VALVE ENGINE.

From this it follows that the loss in friction in the engine and dynamo combined is 10 per cent. of the indicated horse power.

The Savannah & Western Railway company is establishing an electric light plant at Opelika, Ga.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - } -Associate Editors.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - }
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted.

This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Electric Light Plant in the Guaranty Loan Building, Minneapolis, Minn. Illustrated 261
National Electric Light Association 261
South End Electric Railway, Chicago 261
Greasing the Trolley Wire. Illustrated 262
Allan C. Durborow, Jr., M. C. 262
Milliken Poles Used for Electric Railways. Illustrated 262
Bergmann Thermal Telephone. Illustrated 262
Western Engineering Society, Chicago 262
Illustrating the Phenomena of Electrolytic Action. Illustrated .. 263
Supt. Beach and the Central Union Telephone 263
Wisconsin Electric Club, Milwaukee 263
The Australian Cable 263
Chicago City Electric Light Plant 263
Electric Light and Gas Interests 263
Portable Lamp with Renard Batteries. Illustrated 263
Thomson's Constant Current Motor. (Communication from Prof. H. S. Carhart.) 263, 264
Portable Desk Clamp. Illustrated 264
Westoa Standard Battery. Illustrated 264
Electric Plant in an Aluminum Factory 264
Pantechnetheca Fixture. Illustrated 264
Chicago Electric Club 264
Chicago Electric Club 264
United States Automatic Block Signal. Illustrated 265
Efficiency of the Edison-Hopkinson Dynamo and Willans Central Valve Engine. Illustrated 265
Editorial 266
Underground Electrical Service. Discussion of F. E. Degenhardt's Paper by Members of the Chicago Electric Club 267, 268, 269
The Art of Electrolytic Separation and Refining of Metals. By Dr. G. Gore 269, 270

DEPARTMENTS.

Correspondence 270, 271
The Electric Light 271
The Telegraph 271
The Electric Motor 271
Electrical Patents 272

THE proprietor of the WESTERN ELECTRICIAN is not connected with any electrical manufacturing or selling concern. The gentleman whose name has lately appeared in connection with several new electrical corporations, and who has been appointed secretary of one of them, is W. A. Kreider, formerly identified with the Sprague company, and not W. A. Kreidler, proprietor of this journal. This explanation is made in response to a score or more of inquiries from different parts of the country.

IN this issue is given a description of a plan adopted by a French scientist to illustrate the phenomena accompanying electrolytic action. By the use of a stereopticon he is able to throw on a screen a representation of the effects taking place on an extremely small scale in a miniature electrolytic bath. The description may contain a suggestion of value to those who are called upon to deliver scientific lectures.

IT will be noted by an announcement in another column that the next meeting of the National Electric Light association at Providence, R. I., will be held February 17, 18 and 19. The committee on literary programme has already accomplished considerable work and has secured promises of a number of interesting papers. In all probability the electrical exhibit at the convention will be the most extensive ever made by manufacturers at a meeting of the association. A committee has been appointed on exhibits and the display will form one of the most interesting features of the convention.

A RECENT fire in St. Louis has caused the electric light companies of that city much uneasiness. It is reported that the firemen were greatly hindered in their work by the electric wires, and this fact has led to an agitation against overhead wires. Meetings have been held to discuss the question and plans are now under consideration looking toward the removal of the wires. As most of the electric light wires in the city are newly constructed lines and are conceded to be in first-class condition, the conservative element of the people opposes the radical movement of burying the wires. It is proposed to have the companies cut out all the lights in the vicinity of burning buildings hereafter so as to give the firemen full play. This will serve the purpose, and remove all danger to the firemen.

THE great advance in the application of electricity to mining work is referred to in a report recently made by the chief inspector of mines of the state of Ohio. He makes this statement: "The phenomenal feature of advancement in mining in the state during the year just closed, has been the introduction of electricity as a motive power in our mines. Its adaptability and many commendable features have enlivened a great interest among those who are engaged in the industry." The inspector says that a great many extravagant claims for electrical apparatus have been made and have not been substantiated; but he adds that "sufficient proof has already been furnished to demonstrate to any practical person who has given the matter any attention, that the production of coal by the use of electricity in many portions of the state is economical."

EVER since the telephone came into everyday use and it was realized that the Bell patents were, practically speaking, invulnerable, inventors have been at work seeking to devise a receiving instrument which would be radically different and yet as simple in construction and reproduce speech. While it is to be presumed that there are a number of inventions which have been brought forth only to be bought and hidden away for future use, a glance over the many efforts which have come to light would seem to reveal that, in the race for something new, little real progress has been made. In how many "new" telephones do we see embodied those all-important and most essential parts, the magnet, the coil and the diaphragm? Few indeed, apparently, are the devices, the principle and construction of which would indicate that the inventor had struck out a little from the one well-beaten track. It is refreshing to find an instance in which an inventor enters a field less thoroughly explored. A study of the principle of a receiver in which magnetism is not either directly or indirectly employed, can but be interesting. The reader will find such an instrument described in this issue. We do not vouch for its practicability as a rival to the Bell instrument. We give the inventor's claims for what they are worth. In this Bergmann thermal telephone the movement of the diaphragm is produced by the "expansion and contraction of the constantly-touching electrodes caused by the thermal effect of the current." In other words, the device consists of a diaphragm which is in contact with the first of a series of tellurium buttons placed in contact and in line directly behind the diaphragm. The buttons are adjusted to loose contacts throughout the series. Variations in temperature, caused by changes in the current passing through the series of electrodes, cause variations in expansion and contraction at the contact-surfaces of the buttons. It is in this manner that, the inventor claims, the sound-waves imparted to the transmitter, are reproduced.

In the Bergmann instrument, doubtless, the effects claimed to be obtained may be considered as being somewhat similar to one which has long been observed in the Blake transmitter. It is well known that the Blake instrument may be employed as a receiver, although perhaps not a very efficient one. Bergmann claims that his instrument operates through the "expansion and contraction of the constantly touching electrodes." In all probability the effects obtained in Bergmann's instrument are caused by an identical action to the one taking place in the Blake transmitter when used as a receiver.

THE discussion which followed the reading of the paper of F. E. Degenhardt at the last meeting of the Chicago Electric Club, is presented elsewhere in this issue. Underground electrical work, the topic under consideration, excited the liveliest interest and the remarks are well worthy of perusal, considered as the opinions of men who view electrical questions from an eminently practical standpoint. The discussion was opened by Prof. Barrett, city electrician of Chicago, who put himself squarely on record as the champion of underground work. He told the story of the burial in Chicago in 1876 of the first electric wires. That narrative is a matter of no small importance as an historical fact. The few wealthy citizens of the North Side of Chicago, who subscribed a few hundred dollars to prevent the disfigurement of a residence street by a line of poles, started the underground movement in the city, and thereby incurred the hatred of many an electric light and telephone man throughout the country. The success of that first piece of underground construction converted Prof. Barrett, and his steadfast opposition to aerial circuits has made Chicago famous in the electrical world. Since the removal of pole lines in the thickly settled portion of the city, Prof. Barrett says that the troubles of the city electrician have been greatly reduced, and that his service has been materially improved. It is not strange, therefore, that his views are pronounced on the question. It must not be forgotten, however, that the city of Chicago is behind Prof. Barrett and pays the enormous bills for underground work. Electric light companies have no such treasury to draw upon. It is not surprising, therefore, that they do not share in the professor's enthusiasm. B. E. Sunny in the discussion, represented the views of the electric light investor. It cannot be said that Mr. Sunny represents the most conservative element for he recognizes fully what has been accomplished with underground wires, and while he is by no means in favor of an underground system, he does not question the practicability of operating a station by means of buried circuits. His opinion as to the success attending the work in Chicago was by no means identical with that of Prof. Barrett. He questioned the statement that the service is more efficient now than when aerial lines were in use. Prof. Barrett and Mr. Sunny have had extended experience in the underground work, and a careful comparison of their views will be of interest to all who are contemplating engaging in underground construction. It is exceedingly unfortunate that city councils throughout the country hearing of underground work in Chicago, have jumped to the conclusion that the burial of circuits is proper and feasible under all circumstances and in all places. It is hard to convince them that nothing is farther from the truth. In the discussion President Beach referred feelingly to this fact. Underground construction generally is of such an expensive character that it is the height of absurdity to speak of it as suitable or necessary in a small city. Telephone men, however, will have an enormous amount of work to do to prevent the aldermen of small cities from following the example of Chicago.

Underground Electrical Work.

At the last meeting of the Chicago Electric Club F. E. Degenhardt read a paper on "Underground Electrical Work," which appeared in the last issue of the WESTERN ELECTRICIAN. After the presentation of the paper the following discussion took place:

PROF. J. P. BARRETT: That paper calls to memory a great many reminiscences. Some years ago when the question of removing poles was discussed in this city, I advocated before the city council the passage of an ordinance providing for their removal. The matter was referred, and some of the ablest electricians came here to discuss the subject before the committee. Among them was a gentleman who is now an electrician at the head of the largest commercial company in the world. The point that he raised was rather striking; among the number was the statement that it was utterly impossible to work a wire underground. That had been entirely demonstrated, it was stated, in this country and in Europe; in fact, there was more difficulty connected with attempting anything of the kind here than in Europe for the reason that the earth currents here were of such a character that retardation would set up; and a thousand and one reasons were given that nearly paralyzed the committee, so it voted to lay the matter on the table. It ran along for, I think, a year, when it was necessary to build a line of poles through a district in the neighborhood of the residences of the McCormicks and others along the Lake Shore. I knew that I would have a great deal of difficulty in getting over that neighborhood, so Saturday night I loaded several wagons with poles, and on Sunday morning, when the good people were at church, I erected my poles. When they came home I had my line up. They let the line stand there until Monday morning, when the residents came to the mayor's office and demanded, not only the removal of the poles, but the head of the gentleman who directed the construction. I was sent for, and in the language of the poker player, I made a bluff and I was called. I said: "Gentlemen, there is no question about the entire practicability of underground construction, but we haven't the money, and therefore those poles will have to remain where they are." One of the gentlemen said, "Well, Mr. Barrett, how much would this underground work cost?" I gave what I supposed was a pretty liberal estimate, $840, I think, as the sum required for taking down that line of poles and putting the wires underground. There wasn't any paving to do over there as the ground was mostly sand. The next morning at 8 o'clock the $840 was laid on my desk and I was told to take away those "infernal poles." Well, I directed the work to be done. After I had studied the matter carefully, I went to the precaution of reaming the two-inch pipe out carefully and making the joints of red lead, treating them to a bath of coal tar and linseed oil, making absolutely tight joints, and drew the wire in. The electricians were interviewed as to the possibility of that wire lasting. The general opinion was that at the first lightning storm that wire would disappear, and it was repeated so often that I began to think that possibly it would go. With the view of taking every precaution I located two men in that district for six weeks with an extra reel of cable to pull in if the other was burned out. The cable did not blow out, and I began to have more confidence in the underground service, and advocated it on all occasions. Eventually this ordinance that Mr. Degenhardt referred to was passed, and since that time we have had a good deal of experience that has taught us a great many lessons, and I am inclined to believe that the wire is safer underground than it is overhead. I am very well pleased with the results of underground work, judging from our experience in the fire alarm service, and particularly in our trunk lines. Formerly some old lady who had a hoop skirt that she didn't care to use longer would throw it in among the wires. A whole district would be cut out for a night as we couldn't get at it until morning. Again, some one would buy an old barn of a house, move it through the streets and slaughter everything in sight for a couple of hours. The fire department would come along and of course everything had to get out of its road. The result has been that with three-quarters of a mile of our trunk lines placed underground seven-eighths of our difficulties were removed. It was impossible, after we got these trunk lines underground, to cut out a district entirely. We started from the main office and ran to an engine house, as far as our money would permit us to go, and there branched out. Burying the wires has not only proved satisfactory to the working of the service, but the absence of poles has tended to beautify our streets, if that is possible. We manage to get rid of a great many of our poles every year, and our streets are thus widened out for the benefit of the good people.

MR. SUNNY: Prof. Barrett alludes to the fact that electricians from all over the country went before the council committee and said that wires could not be worked underground. I think they followed an illustrious example on that occasion, and made the same kind of a "bluff" that the professor was working on those North Side people. I do not now question that the underground work forced on the electric companies was a good thing; but I think in Chicago it was forced a little too hard and a little too prematurely. And I think the statement is borne out by the fact that for a large mileage of the telephone company's property more modern and more efficient cables must be substituted. The telephone company put down, perhaps five years ago, lead-covered cables in boxes filled with concrete. It was not a drawing-in system, but a fixed system, and it was not "get-at-able." The cables that were put in were single conductor cables. Now they are putting in double conductor cables so that the circuit can be changed to a metallic system. All these single conductor cables must be thrown away at a very considerable loss. In addition the subscribers of the telephone company had to suffer all these years from retardation and from the difficulty in transmission through those underground cables. Of course that experience led to the present perfected system, but the extended mileage of the class of cables first put down represented an enormous outlay, and it seems too bad that it is necessary to throw them overboard at this time. The company also put down what was known as the Brooks cable, in a three-inch iron pipe filled with resinous oil. It extended from the business part of the city to Twenty-second street, and never gave satisfaction from the outset. I believe it is still working in some sections, but not in a satisfactory manner.

You are all familiar with the difficulties that we encountered in the early days in trying to make arc light circuits work underground. It is a cause for congratulation that the service is now so satisfactory, and that a proper cable, or a number of them, have been found to do that class of work. We get along very comfortably and satisfactorily in performing a very large service, both commercially and for the purpose of lighting the city. It would seem from the figures that Mr. Degenhardt mentions, that there are something over 350 miles of electric light conductors working successfully underground. I should like to refer to Mr. Degenhardt's paper as it relates to the matter of insulation of arc lighting cables; in the specifications he states that the insulation must be 500 megohms. Did I understand you right?

MR. DEGENHARDT: I said the insulation resistance.

MR. SUNNY: Five hundred megohms?

MR. DEGENHARDT: Yes, per mile.

MR. SUNNY: Has it ever been possible to attain that?

MR. DEGENHARDT: I would say in that connection what I should have said in the paper. That insulation resistance is found when they are tested on the reels. I do not think when laid and measured from the lamps that they show 500 megohms.

PROF. BARRETT: That is the test in the conduit, without carrying the lamps.

MR. DEGENHARDT: That is equivalent to a reel test.

MR. SUNNY: How long did that insulation keep up?

PROF. BARRETT: That is a pretty hard matter to tell, because after the lamps were joined to it the insulation would be reduced under all circumstances. I believe you will find several of them that stand up to day if you test your lamps.

MR. SUNNY: That is the reason I asked the question. I never have been able to get a test that showed anything like such marvelous insulation as that after the cable had been put down originally. The telephone cables, according to my experience, measured as high as 350 or 400 megohms to the mile when they were put in the conduit in the first place, and they gradually dropped at the end of about two or three years to about five megohms, and the insulation resistance generally remained at that point. It did not go below that figure unless the cable was defective. In arc light service if we get one megohm to the mile we are perfectly contented

PROF. BARRETT: That is with all the connections?

MR. SUNNY: That is with all connections, and with lamps on the circuit, of course. With the lamps out and the branches and everything cut off, except the main line, we would probably get ten or fifteen megohms if the cable has been in service for a longer period than six or twelve months; but anything higher than that would be unique in my experience.

MR. WILMERDING: I tested a circuit about 8,000 feet long, the other day, without any switch boxes or any connections on it at all; it was a new circuit and had just been put in. It tested with a reflecting galvanometer 10,000 megohms. Then we connected about five or six switch boxes, but they were not connected to any loops. The insulation was then twelve megohms. So it went down considerably, simply on the connection of those switch boxes.

MR. GREER: There is a cable, I believe, in Hoosac Tunnel, that is not exactly underground, but it is under water, in a trough. Perhaps Mr. Degenhardt can give us some information in regard to that.

MR. DEGENHARDT: I haven't any information as to the insulation resistance of that cable, but I would say this: In my experience the causes which result in the reduction of the insulation resistance from 2,000 megohms to 200 megohms are so numerous that it is hardly necessary to go into them. The moment that a cable is exposed to atmospheric action and moisture is allowed to enter along the copper, there is a perceptible drop in insulation. Perhaps a man in uncovering the end of the cable has put his moist hand on it; that is a very common cause of annoyance. The result is that tests made on the street are not the tests that we obtain in the laboratory, or in the factory on a reel. It has been usually accepted—at least my experience has so shown me—that if we can get five megohms we are getting all that is actually necessary. When we consider what five megohms are in operation, we find it is practically infinity. The ordinary galvanometer in use does not show anything above one or two megohms, perhaps, and the result is that 500 megohms are not necessary practically for the reason that they are without the apparatus to make that test with. I do not say that the specifications are not meant to be carried out, nor were they formulated with any such idea, nor did I make the suggestion because I thought I could not make a test on the reels, which is really the test of the cables. When you are talking about testing cables you are not supposed to be connecting the lamps and switches and different devices along the line. It is not to be supposed that any one can connect on the cable all this class of apparatus, which materially reduces the insulation resistance, and call it a cable test. Consequently with tests of the cable jointed in the ducts, with the ends sealed and all precautions taken to insure dryness, I expect to find 500 megohms, and I do not see any reason why we should not. It is true that if proper care has not been observed in making joints you are bound to get a drop in the insulation. It follows naturally that the moment you expose as delicate a piece of work as a cable you must perforce get a drop in your insulation unless you restore all the conditions of the original cable. I do not see how it is possible to expose the copper to the condensing operation, which naturally takes place by exposure, and not get a drop in the insulation.

C. A. BROWN: I have been interested in listening to the remarks on the subject of underground electrical construction, and I do not know that I have anything particularly to add. I can indorse what Mr. Degenhardt has just said about the necessity of taking into consideration the terminals of the cable in considering the insulation. The drop in the insulation of telephone cables, referred to by Mr. Sunny, I think can be found at the terminals in almost every instance unless there is injury to the cable itself. If the cable, after it has fallen from 500 megohms to 5 megohms of insulation resistance, is restored to its original condition by drying at the terminal, and getting perfectly dry ends of the cable, it should test again the original 500 megohms or more.

I have also been impressed in listening to the remarks made this evening, by what can be accomplished by an honest effort in any direction. Here in Chicago we were aided by some peculiarly favorable circumstances. The area ways under the sidewalks were perhaps the most favorable circumstances connected with underground construction. That of course is something that the New York streets do not have; it is practically a ready-made conduit for underground wires. But contrasting the efforts made by Prof. Barrett, which have resulted in such success, not only in relation to city work, electric light, fire alarm and police, but also to the general burying of conductors in Chicago, I would call attention to the fact that it is only two years ago, I believe, that a committee of New York gentlemen visited Chicago, and could not find any underground electrical conductors in successful operation. I also know of instances, in which to bear out their assertion that underground electrical work for electric light construction was impracticable, they deliberately would engage in the business, and deliberately put down cables which they knew would not work, for the purpose of making a failure. I think that the reaction which inevitably results from such dishonesty—I think that is the proper term to use—is just; and I think that you can attribute the high-handed action of the city authorities of New York particularly to that very dishonesty. Of course there are a great many problems to be solved in underground electrical work, aside from those of insulation of conductors, and pulling them into the conduits. There is distribution, which is variously accomplished, and I would like to hear something about the system adopted by the Chicago Telephone company. I think Mr. Nate can inform us about that. He has the very simplest, cheapest, and at the same time most successful method of distribution that I know of.

MR. NATE: I am hardly prepared to go into the details of that matter this evening. So far as the statistics which Mr. Degenhardt has given us are concerned, and Mr. Sunny's comments, I can verify them, from a continued experience in that direction. And I want to add only one thing, and that is, with reference to the question of insulation. Our specifications say that we shall have 100 megohms resistance per mile after the cable is made, laid, spliced and connected to the terminals. That insulation is called for from one to two years thereafter, and we are getting it in both instances. I know also to a certainty that moisture and careless handling of cables have caused faults. We have a system of distribution boxes which we are using now for the preparation of wires in the conduits. We have endeavored to use glass; we have tried porcelain and other materials for an insulator between conductors, but these failed, and we have substituted cement, which we have hardened thoroughly, coated with asphalt and burned again. This gives us the desired result, but the least carelessness in making this diaphragm may frequently cause high static capacity and low insulation. We have had this difficulty, and of course have had to undo a large amount of our work to remedy the trouble.

PRESIDENT F. G. BEACH: The president is not an expert in underground work. I have been making it a study, and am still making it a study so as to convince those persons who are advocating underground work that it is entirely impracticable. [Laughter.] I am trying not to know anything about it. The subject is forced upon us [Central Union Telephone company] very frequently in different places in our territory, comprising smaller exchanges. We have no very large exchanges. Columbus, Ohio, is the largest, with 1,400 subscribers, and we have but three exchanges of over a thousand subscribers. We have seventy-five or eighty exchanges, ranging from one hundred subscribers up to six or eight hundred. A short time since the underground subject was forced upon us in an Ohio city. We had a very tedious argument with the city authorities, and finally succeeded in convincing them that it was impracticable—at that point.

MR. LOVEJOY: I am connected with the engineering department of the Thomson-Houston company, but our experience in underground construction in Boston is extremely limited. We get along without any underground work there, and satisfactorily. Of course I refer to Boston particularly as that is our headquarters. The telephone cables of course are successfully run underground, I believe, to some extent, but as far as electric lighting is concerned, I think there is but little, if any, underground cable. The wires are all overhead. Our experience has covered New York, as we are largely interested in some of the installations there, but we are all familiar with the troubles and experiences which they have had during the past year.

I was interested somewhat, and have gone into the subway work in New York City, and have attempted to follow the construction of subways, and the method of laying or pulling in cables, which is certainly a very interesting subject. I understand the rule of the Board of Control of New York City, in regard to insulation, is fifteen megohms per mile per 100 volts. They attempt to maintain this, and insist upon the electric companies making from time to time—I believe every month—a test of the insulation. If it is found to be low, lower than the standard, they insist upon what is called an ex-converter test. That pertains more particularly to the alternating system, which is largely used there. That necessitates on the part of the electric company the disconnection of their converters so that the cable alone may be measured, and so that it may be ascertained whether there is any depreciation in the

insulation of the cable itself. The electric companies of New York [illegible] time issued specifications for a cable they would require, and I have in mind now one [illegible] which, it seems to me, called for an insulation of 1500 megohms per mile. It struck me as being excessive, but that is surely the figure that was given in the specifications on which some of the cable makers agreed to manufacture. What success they have achieved in that direction, and whether or not their cables maintain that, is a question which has not yet been determined.

I have just come from New York and the systems are all working there very satisfactorily with the cables which we have down, but an endless amount of attention is requisite on the part of the best experts, in making the joints and maintaining the insulation required. As a company we have done no special work except in certain localities, and this is more familiar to the people in that locality than to us as a company. Of course we are waiting and looking forward to the time when a system which will be satisfactory to all will be found, but so far as I am able to see, the time has not yet arrived. We might take the work in New York City as an example of the subway, but from the discussion which has been so interesting to me to-night, I think we shall have to look to Chicago for our experience in underground construction, for no doubt you have more here than elsewhere.

MR. DEGENHARDT: Isn't it possible in asking for an insulation resistance of 500 megohms, that companies might want to bring their average up? They drop down to two megohms and they want to bring the average up on the cables a little higher?

I wanted to ask Mr. Sunny, if in these tests on the telephone cable it is not true that the test was made on each wire, and that the result does not refer to the average test of the cables, showing only two or three megohms? Is it not true that some of those wires would run as high as 1700 and others would drop down to, say, fifty? And if that is true, does it not show conclusively that the drop was due to careless handling of the wires? Say in the telephone cable you run from fifty wires to 204, and in testing a cable of that character you test each wire? If some run up as high as 1700 megohms and others drop down to fifty megohms, or less, it would convince me that the men were not as careful in putting up some wires as they had been in those which showed a high insulation.

MR. SUNNY: My recollection is that the test was in the case of a 100 wire cable, and we took diameters numbered from one to ten That would represent the condition of the cable all the way through from outside to inside. It is my recollection also that the highest insulation would probably be five or six megohms, and the lowest would be perhaps 100,000 ohms. Those tests were made chiefly on lead-covered aerial cables, and we were not always successful in raising the insulation resistance of the cable to a high standard by cutting out the splices and making new ones for the reason that the moisture had gone into the cable so far, that it would call for the destruction of a large part in order to get the insulation up. Mr. Nate may remember those details more accurately than I do.

MR. NATE: I do not recall the test of those cables very perfectly, excepting that the tests were made on a set of ten wires at a time; and it is also my recollection that there was a difference in the tests received from various conductors. I would state, however, that the present specifications as framed and adopted by the telephone company call for a test to be made on each conductor, with all other conductors grounded; and that owing to the formation of those specifications, and the conditions, the tests are uniform. So much attention is paid to the construction of the cable, and so much care is taken in handling it, that unless there is carelessness we have comparatively favorable results in most cases. The amount of insulation that is called for on these conductors is one-eighth of an inch, and in addition the wires are tested as I have already described. You will see, therefore, that it is almost impossible for us to have trouble, except as a result of carelessness.

THE PRESIDENT: Mr. Day of England is present, and if he can give us any information with reference to underground work we shall be pleased to hear from him.

MR. DAY: I feel much honored in being called upon to speak to you on this subject to-night, but my practice has been rather confined to a different branch of electrical work. But I may say this; that in some of the large cities in England and in Scotland, Glasgow more especially, where the telephone wires have to a very large extent been placed underground, the arrangements are made for a minimum insulation resistance of ninety-eight per mile, I think it is. I am speaking principally from memory. The cable resistance when tested, before the joints are made in connection with the different branches, circuits, lights, switches and so on, is about 1400 or 1500 megohms. I do not think it is higher than that. Glasgow, of which I am speaking more especially, happens to be a very damp place, and it is almost impossible to keep anything dry there. A little more care therefore must be taken in order to reach the insulation resistance required by the standard, which is higher, as I understand from the remarks made here to-night, than has been the experience in this city. I don't know whether they have a more perfect system of making joints.

MR. KEMPT: There seems to be a phase of this discussion that has not been touched upon. This elaborate discussion will go out to the electrical world, and every small hamlet throughout the country will be imbued with the same enthusiasm over the underground system as we have here to-night. I think in this discussion a comparison of the cost ought to be mentioned for good reasons. So if any gentleman is prepared to give us some figures, showing the difference in cost between aerial and underground construction, I should like to hear them.

THE PRESIDENT: I do not understand that the discussion to-night has had anything to do with the question of practicability; that is, of the practicability of underground systems for certain purposes, but it has had rather to do with the successful working of underground conductors. If the subject of the practicability of adopting the underground system for telephonic work was under discussion, there would very properly be much to say, as to where the reasonable limit was reached in that direction. Underground work has not yet reached the territory of the Central Union company, and we hope it will not soon. As I said a few moments ago, the subject was recently forced upon us in an Ohio city. It is a town of about 21,000 or 22,000 population. It covers an area, I think, about half as large as Chicago, or nearly so. In Cleveland, about forty miles away, there is quite an extensive underground system being put in As a result, quite an enthusiasm is created in the smaller city. It undertakes to put on metropolitan airs, and thinks that everything must go underground. One sitting of our discussion on this subject lasted, I think, about two days, and it is hardly necessary to elaborate the argument. I think anybody familiar with the business can see the points very readily. In Chicago in a single block there are 125 or 130 telephones, paying at the rate of $125 each. Now in the same area in the town to which I have referred the greatest number of telephones we had in any one block was eighteen, with a rate of $54 each.

I understand the cost of underground work to a certain extent is based on the lineal foot, the cost being practically the same, whether you are going to put down 100 conductors, or 6 000 conductors. In order to have a perfectly practical underground system, you must have a perfect system of distributing boxes, and have your wires ready to lead into every house in every street you go along, whether you have a subscriber there or not Otherwise you must tear up the street again every time you get a new subscriber.

MR. SUNNY: I do not think that the impression ought to go out from Mr. Degenhardt's paper, or from the discussion of that paper, that underground work is a complete and unqualified success. I do not think we have a perfect underground system of telephone wires, electric light wires or telegraph wires, but I think we have been making a little progress right along from year to year, ever since 1883. I made some figures some years ago with regard to the cost of operating arc lights through underground conductors as compared with the cost of furnishing the same service through overhead wires. As I remember it, counting the cost of the conduit, the interest on the original investment or rental if the conduit were rented, depreciation of the conduit, the care of the conduit, cleaning out manholes, and the repairs and maintenance of cables, the underground circuit cost one-cent per lamp hour more than the aerial circuit. That would be for ordinary street lighting in the city, twelve cents a night more for underground service than for overhead service. I think now that we are working in the right lines, both in the telephone, telegraph and electric lighting, and that five years more will bring us nearer to a perfected system. But to-day I do not feel free in recommending any system that we have got in Chicago for use in any other place. We feel surer of it than we did a year ago, but we are not absolutely sure—so sure we could recommend its adoption elsewhere, although it is reasonably certain to give satisfaction, at least the same satisfaction that we are getting in Chicago.

PROF. BARRETT: The point raised by Mr. Sunny is that we have not a perfect system. I don't know that you have a perfect overhead system. You never had one. You get better service to-day from the telephone in the city of Chicago than ever before. Any man that uses the telephone knows that to be the case. The prices which our friend Sunny gives, only touch the edge of it. It is not a fair explanation of the situation, and I am not sufficiently familiar with it to give it as it is. I do not think it is right to have it stand in that shape. It is a fact, with the underground system of Chicago to-day, that you deliver more of your product at the lamp than you did with the overhead system.

Now then, the question of insulation is another thing; you can get all the insulation you want and a good deal more. I recollect a short time ago, that a cable was abandoned here because the insulation was so high that they could not use it. Gentlemen in the room know that to be a fact. They had to reduce the insulation so that the cable would work. Do not suppose that I claim that the underground service of Chicago is perfect. As I said before I don't know of anything that is perfect, but I do know that the service is safe, feasible and practicable. I do know that the people of this country want to get rid of the high pressure wires overhead; I do know that the electricians want to do it. I also know that the capitalists don't want to have it done. We are all interested in capital. I have a little in that direction myself, in an overhead system, not in Chicago, however.

MR. SUNNY: Why don't you go underground?

PROF. BARRETT: We haven't got far enough along. [Laughter.] I do know just as sure as fate you are going underground in these large cities I fully understand the objection raised in regard to small cities with small service, but the people that give you rights in these streets don't care what it costs you to go underground; it is no business of theirs, and there is not an electrician on top of this earth who will not admit it as a practicable thing, and all it requires is a little experience. There has never been an inducement held out by the electricians in this country for first-class underground service. The electric light people get together from time to time and they tear the underground service all to pieces. I recollect that three gentlemen who were delegated by an Eastern city to come here to examine the underground service called at my office. I offered to give them all the attention possible, and they went back and reported that they had not seen a bit of underground work in Chicago, which was true. The next year one of them came back here. I said to him, "Do you want to make a report on underground work this time?" He said, "Yes." I said, "I am going to see that you see the underground service this time." I went out and opened a manhole where I had a ladder and put him into it.

The proper place for the consideration of an underground scheme for the country is in the electric light convention and the telephone convention. The telephone people appear to be perfectly satisfied with what they have. If the electric light people were to offer some inducements to the inventors of this country for a perfect system of underground conduit, I will guarantee that they will produce it. I don't have any trouble in my service. People say, "Well, you have only got to go to the end of the block." That is true; but if I had to go further I would find a way to get there. So did these gentlemen. They did not find any trouble getting anywhere they wanted to, excepting overhead.

MR. DEGENHARDT: I want to say a word in defense of the paper. Everything goes by comparison in this world, as far as I have explored it, and certainly the operation of the underground electrical apparatus to-day is a success when you take a look seven years back in 1883, when the first practical demonstrations were made in this city by commercial companies. Certainly the stride made between 1883 and 1890 is wonderful to my mind, and the work is successful. I do not see what else you can call it. The failures of 1883 are not the failures of 1890. We do not encounter any of that trouble to-day. We do not put a cable down and expect work of it that we know it can't do. We put in cables suited to the necessities of the case, and those cables are evidently working, because they keep on putting in more; they keep on improving in all directions. When a telephone company now says to you that it wants a cable which will show a static capacity of so much, and an electrostatic capacity of so much, it gets it, and it gets performances such as it never secured in 1883 from its cable. To-day you require a cable say of 1,200 megohms; when in 1883 a cable was put in, megohms were never considered; it was only a question of putting in a cable. Now, certainly we are doing better to day after seven years, and Mr. Sunny himself says that eight years from to day we will have made a wonderful stride. Certainly that is an indication of success. I say again, everything goes by comparison, and comparing 1890 with 1883, the date of the inception of the underground work, the result is a demonstration itself of an unqualified success, in my opinion.

MR. SUNNY: Prof. Barrett says that the telephone service to-day is better than it was when they were working through overhead wires if I understood him. I beg to take issue with him on that point. The transmission certainly is very much inferior to what it was when there were nothing but overhead wires. A great many in this room will probably remember when we used to have a little telephone exchange at the Exposition in the fall. The telephones were left off the hooks in the Exposition building so that people all over the city to the furthest extreme of the North, West and South Sides could hear the music through the telephone The band was across the main hall from the point where the telephones were fastened upon the wall. Now, it is almost impossible to hear a man clearly telephoning from the South Side to the North Side, even when he gets head and shoulders into the transmitter. That is the trouble that is injuring the whole telephone service in Chicago, and makes it almost impossible to talk intelligently or satisfactorily outside of one central station. When you get two central stations it is very difficult to talk, and it takes an expert to make any kind of headway at all. Now, I cannot admit that a telephone system that works in that way through underground conductors is a complete success. I know that the plans that are being made by the telephone companies to change the form of cable that they are using will lead to better service, and where those cables are used in other parts of the country the service is more satisfactory. The system will be the same as that used between New York and Philadelphia, New York and Boston, that is metallic circuits, and it will do away with a good deal of the interference with conversation.

In the electric lighting business I claim that the underground work is not a complete success for the reason that the lights are apt to go out once a week from some underground defect. The insulation is liable to run down so low on short notice as to require the shutting down of the circuit for repairs. Now, there are a great many places all over this country where the extinguishment of the arc light for one minute in the whole year, during the time that it is performing services is unknown. They furnish an absolutely reliable service, so that gas has been taken out of the hotels and large rooms, and arc lights are used. This is on the pole line service That is not so in large cities where there is a labyrinth of wires; that results in crosses and break-downs which make the service unreliable.

With regard to expense, the statement that I made of the additional cost as compared with the overhead wires is absolutely correct, and is based on figures that were very carefully made. Those are figures, however, that were made a year or perhaps eighteen months ago. I think, however, those figures are still true, because the accounts that were kept run about the same, month in and month out. It takes about the same number of men to look after the ducts, the same number of men to keep up cable repairs, and the depreciation is about the same.

MR. STILES: It is rather unfortunate that every little country town thinks it should have just what they have in Chicago. Chicago is considered a model, and there are a great many men in city councils in these small towns who think when an improvement of this kind is going on it makes no difference what the expense is, they should have it. I believe that the underground wires are successful, but I think it has cost a great deal of money to arrive at the point where we now are. I have spent considerable money experimenting, and I am very anxious to let other people spend all the money they want to experimenting, because it is going to help business and make us better posted. I apprehend that in a great many of our small cities, like the one referred to by our president, if the impression goes out that the underground system is a tremendous success, it would be quite difficult in putting in telephones or telegraph or lights to get such an ordinance through the councils of those towns as would be liberal enough to encourage a company to do business. Any one who has had any experience in that line knows the ideas that the city

councils of some of these small towns have. Now, I apprehend that this question might be discussed perhaps in a financial light here to the advantage of this society, and I think it would be a good idea to postpone the further discussion of this question until some other evening. Perhaps some one would be prepared to make some statements in that direction that would be beneficial to all of us.

I do not believe if all the requirements that are made in the city of Chicago to-day had been made by the towns which do require them now, that the electric light business, or the telephone or telegraph business would have been where it is to-day. I believe, as Prof. Barrett told us, that if the electric light companies and the telephone companies would offer sufficient inducements for inventors with a view to the efficiency and cheapness of the underground systems that the underground business would be far in advance of what it is now.

MR. DAY: If I am permitted I would like to supplement my remarks just now made by something that has occurred to my recollection since. I have no doubt that every member of the Chicago Electric Club will remember a discussion which took place in the *North American Review* some five or six months ago, in which two articles appeared, one by my friend, Sir William Thomson, and the other by George Westinghouse, Jr., with regard to underground and aerial conductors. It will no doubt be recollected that the conclusion arrived at by these two eminent electricians was that the aerial system was the best, and Sir William Thomson went so far as to say, "Cables in the air, may they long remain there." I am not for a moment intending to advocate that opinion. It is simply the opinion of an eminent authority.

I was asked just now to say what had been done in Europe in regard to the underground conduit system. I can say from a very recent experience, a very prolonged experience, that very little indeed has been done in Europe in that respect. No doubt many members of this club have visited European cities, and you will find that it is almost the universal practice that all conductors are placed in the air. We have not got the magnificent broad straight streets as a rule, that you have in this country. In the city of Edinburgh and in part of Birmingham, and in the city of Glasgow, and perhaps some other cosmopolitan cities, we have broad and straight streets, but still not nearly so broad, and the span over the roofs of the buildings does not give anything like so great a stretch of cables as may be found in other, places where the pole system is adopted. The pole system undoubtedly remains in Europe.

But I wish to say this in particular, that in Europe and in England especially, we are very far behind what you have done in this country in regard to these matters, and one of the inducements for my coming to this country was to acquaint myself with the immense progress that had been made in that direction. And from what I have seen in this city since I have been here, a very short time, and from what I have learned to-night I am satisfied that you are solving the great problem between the overhead and pole system or roof system, and the underground system, and I feel perfectly persuaded in my own mind that although on the score of costs there may be a great deal at the present time in favor of the aerial system, yet I cannot bring myself to believe that we shall not succeed in a very short time in finding a perfect and cheap system of insulation which will lead to the adoption of a duct system of some kind all the world over.

MR. SUNNY: There is an old saying the substance of which is that a well told lie is often better than the truth. When this underground system first started in Chicago the statement was made, as the professor will remember, that every wire in Europe was underground.

PROF. BARRETT: My authority for that was a gentleman who had been traveling in Europe. I never was there.

MR. SUNNY: Well, that statement was the basis of driving your wires underground in Chicago.

A MEMBER: Mr. President, I would like to ask the professor what year it was that he first laid the underground cable.

PROF. BARRETT: In 1876. I want to correct a statement I made in regard to the telephone service. I mean to say that we had a better telephone service since we put our wires underground than we ever had before. The time you had reference to, Mr. Sunny, when you got your music through the telephone, was when we had but one or two exchanges, as I recollect it.

MR. SUNNY: No, we had about the same number of exchanges that we have now.

MR. DAY: I believe that you will find, that the earliest underground cable laid in the United Kingdom, was not in England and Scotland, but in Ireland, under the river between the two sides of the city of Dublin. It is not a very broad river, no more than 900 feet wide at the place I refer to. I refer to that simply as an historical fact. It broke down very soon after it was laid.

Electric Lighting in Japan.

"Five years ago," says the Jiji Shimpo, "the electric light began to be used in Japan. In the spring of 1886 the Electric Light company of Tokio was formed, and received a commission to fit up apparatus in the printing office of the *Official Gazette* and in the officers' college of the War Department. The Cotton Spinning company of Osaka quickly followed suit, and by degrees people began to believe in the advantages of the light. The Tokio Electric Light company soon opened a second and yet a third office, and after it had been commissioned to provide the palace with lights, other companies were formed in Kyoto, Magoya and Kobe. The cotton spinning mills in different localities vied with one another to employ the light, while in Tokio the field was entered by two additional companies, the Shinagawa Dento-Kaisha and the Nippon Dento-Kaisha, and there is talk of yet another being added under the name of the Teikoku Dento-Kaisha. Outside Tokio we have the Hokkaido company, the Hakodate company, the Thizuoke company, the Nagano company, the Kumamoto company, the Nagasaki company, the Yokohama company, the Hakata company and the Hiroshima company, all of which have received official sanction. Moreover, projects are on foot for the formation of other companies in Kanagawa, Otsu, Mito and Tendai. If things go on at this rate the progress of electric lighting in Japan will soon be something astonishing." The total capacity of eight stations in operation is 22,300 lights

The Art of Electrolytic Separation and Refining of Metals.[1]

BY DR. G. GORE.

More than thirteen hundred years ago Zosimus mentioned the earliest known fact respecting the electrolytic separation of metals, viz: That by immersing a piece of iron in a cupreous solution it acquired a coating of copper. Ever since that time the same fact has been commonly observed by workers in copper mines, that their tools of iron or steel became coated with a film of copper by contact with the water percolating through the mines; the water holding in solution blue vitriol derived from oxidation of mineral sulphides of copper contained in the rocks. Paracelsus in the years 1493 to 1541, and even Stisser, the professor of chemistry in Helmstadt, as late as 1690, believed that by this process the iron was changed into copper.

The discovery of chemical electricity by Volta and the invention of the voltaic battery as an instrument for producing it, did not occur until about the year 1799. Wollaston soon afterward observed that "if a piece of silver in connection with a more positive metal be put into a solution of copper, the silver is coated over with copper, which coating will stand the operation of burnishing." (*Philosophical Transactions* of the Royal Society, 1801). About the same time Mr. Cruickshank passed an electric current from his voltaic battery through a solution of sulphate of copper, and found that the copper attached itself to the wire connected with the zinc end of the battery, and stated that the metal was "revived completely" (Wilkinson's "Elements of Galvanism," Vol. II., 1804, p. 54). In 1805 Brugnatelli also observed that when the current entered the liquid by means of a piece of copper, the copper was dissolved and then deposited upon the negative pole.

In 1831 Faraday discovered magneto electricity, or the production of electric currents by means of mechanical power acting through the medium of magnets, a discovery which enabled all the subsequent inventions and improvements in dynamo-electric machines to be made, and the refining of metals by electrolysis to become commercially possible on a large scale. When he made this discovery the electric current he obtained was so very feeble that he was barely able to detect it, and he remarked: "I have rather, however, been desirous of discovering new facts and new relations dependent on magneto electric induction than of exalting the force of those already obtained, being assured that the latter would find their full development hereafter" ("Experimental Researches," para. 158). This prediction has since been abundantly verified.

In 1836 De la Rue observed that the copper deposited by the voltaic current in a Daniell's battery cell gradually became thicker, and might be stripped off in the form of a separate sheet of metal from the surface upon which it had been deposited. About the year 1839 Jacobi, of St. Petersburg, and soon after Jordan, Spencer and others made and published their experiments on electrotyping in copper, and thus made the process of depositing that metal familiar to the public.

From that time until the present copper has been constantly deposited on a commercial scale as a coating upon various articles of iron, etc., in order to protect them; the electrolytic process has also gradually extended, and been employed to form ornaments and other articles, until at length copper of more than one inch in thickness has been deposited, and copper statues weighing several tons have been formed by the process. Electro deposited copper has also been frequently analyzed and found to be extremely pure—so much so that it has been employed in the royal mint to alloy with gold in making the standard coins of this realm. Its deposition on a large scale and great degree of purity, thus foreshadowed the electrolytic refining process.

The first actual commercial application of electrolysis to the refining of copper is to be found in a patent (No. 2,838) granted to James B. Elkington (son of the late G. R. Elkington, the original patentee of commercial electro-silvering and gilding), Nov. 3, 1865, entitled "Manufacture of Copper from Copper Ore." In this process plates of crude copper are used as anodes, suspended in "troughs charged with a nearly saturated solution of sulphate of copper," the cathodes or negative plates being formed "of pure copper, rolled very thin." As the crude copper dissolves, pure copper is deposited upon the negative sheets. The patentee proposed to use a series of depositing troughs each containing a set of properly connected anodes and cathodes, the electrolysis being effected by a current obtained from a magneto-electric machine. The insoluble residue which falls from the anodes to the bottom of the liquid frequently contains "silver, some gold, and also tin and antimony."

In a second patent (No. 3,120) taken out by the same patentee Oct. 27, 1869, for the "manufacture of copper and separating other metals therefrom," impure copper, and especially that which contains much silver, "is cast with a T-shaped head of wrought copper," to enable it to be conveniently suspended as a dissolving plate in the depositing vessel.

"These plates are placed in fire clay jars, ranged longitudinally in troughs on a slightly inclined, pitched, and otherwise prepared wooden floor, in the dissolving house. Each jar has a hole in the bottom, closed by a wooden plug, and two holes in the sides, one low down and the other on the opposite side near the top, each jar being connected with the next lower one by a pipe or tube passing from the higher hole of the one to the lower hole of the other jar. The liquid circuit thus established between the solutions effects mixture of the layers of different density, maintaining all the liquids in the series of jars practically alike at top and bottom, notwithstanding the disturbing influence of the electro-deposition, which constantly tends to produce inequalities of density.

"The solution made use of is water saturated with sulphate of copper, a store of which is kept in a tank at the upper part of the depositing room, whence it is admitted into the uppermost jars, and runs from jar to jar till all are filled. A solution may also be used obtained by boiling the deposit formed in the culvert or long flue by which the smoke from the copper furnaces is led to the high chimney.

"The tubes connecting the jars have clips attached to their India rubber portions, acting as stop-cocks. When needful the clips are removed, so as to cause the solution to mix, the dense layer from the bottom of one jar displacing the lighter portion from the top of another, until the density throughout becomes equalized. The outflow is received in a tank at the lower end of the room, from which it is pumped back to the upper reservoir. The plugged holes at the bottom of the jars enable the latter to be emptied on to the inclined floor, the liquid then flowing into the lower tank. The T-shaped heads attached to the plates enable them to be suspended in the jar from horizontal copper bars having forks upon them. Interposed between the copper plates to be dissolved are suitably suspended receiving plates for the deposit of the electrolytic copper. The receiving plates of one jar are connected by a conducting strip of copper with the cast plates of the next jar, and so on throughout. The series being coupled up into a circuit, the terminals are connected with one or more magneto electric machines. The silver originally contained in the copper of the plates set for solution separates as a sediment, and ultimately accumulates as a deposit in the tank below after the repeated workings and emptyings of the jars.

"Ores rich in silver are preferred as the source of cast copper for this treatment, since the silver is obtained as a by product without increasing the cost of obtaining pure copper from the impure metal."

These two patents of James Elkington contain the essential parts of the process of purifying copper by means of electrolysis, viz., employing slabs or thick plates of the crude metal as anodes; a series of depositing vessels with the solution flowing slowly through the whole of them, in order to keep it uniform in composition; the use of electric currents generated by means of mechanical energy, and the collection of the valuable impurities in the form of a sediment at the bottom of the vessels. The only other essential circumstance remaining is that of occasional purification of the electrolyte by evaporating it, and crystalizing out of it the sulphate of iron and other soluble salts which gradually accumulate.

The process was developed and carried out on a large scale at Pembrey, near Swansea. The works at Pembrey formerly belonged to Elkington, Mason & company, but have since passed into the possession of the Elliott Metal company, Selly Oak, near Birmingham, and at the present time this refinery is one of the largest and most perfect existing.

Meanwhile *i. e.*, during the gradual extension of electro-deposition of copper, the originally minute, but nevertheless, extremely important fact and phenomenon, of the production of an electric current by mechanical energy acting through the medium of magnetism, was developing slowly. This phenomenon when first discovered by Faraday in 1831 was so small as scarcely to be perceptible, and was first observed by him as "a sudden and very slight effect at the galvanometer" (Faraday's "Experimental Researches." Vol I., p. 3) No sooner had Faraday published this seemingly unimportant effect than various experimentalists endeavored to obtain it upon a large scale. Prof. Forbes of Edinburgh, Nobili, Ritchie, and others, as well as Faraday himself, quickly succeeded in obtaining electric sparks by means of the magneto-electric current In 1832 H. Pixii, invented and exhibited at Paris the first magneto electric machines and decomposed water by means of the current from it; this was followed in 1833 by Saxton's improved machine, and by that of Clarke in 1836, and on August 1, 1842, was granted to J. S. Woolrich the first patent, No. 9,431 for the magneto electro machine for commercial purposes. Woolrich's machine was for a long time used by Messrs. Prime, of Birmingham, for electro-silverplating.

Since that time the improvements in producing magneto-electricity have been numerous. In 1857 Werner Siemens invented his shuttle wound armature; in 1860 Pacinotti developed his ring armature machine for yielding a continuous current, which formed the basis of Gramme's and other direct-current machines. In 1866 H. Wilde further increased the power of the apparatus by using a soft iron electro-magnet instead of an ordinary steel one to produce the currents; in 1867 Siemens, Wheatstone and Ladd each separately observed the fact of self excitation by mechanical power and developed the self-exciting machine; and in 1871 M. Gramme produced the first practical continuous-current machine for commercial purposes. Alterations and improvements have since that time succeeded each other so rapidly that there exists now quite a large variety of machines for converting mechanical energy into electric current. The magnitude, weight and speed of the machines have also increased, until there are some which require several hundred horse power to drive them; others which weigh as much as forty five tons each, and some with armatures revolving at a speed of nine thousand revolutions a minute. The efficiency of the machine has also been increased until as much as 96 per cent. of mechanical energy imparted to the armature is converted into electric power. With a single dynamo as much as thirty tons of copper are now deposited per week. Even now the limit has not been attained, or even conceived, to the magnitude and uses of the machine, and dynamos will probably yet be constructed equal in amount of energy to the largest steam

[1] Historical sketch from advance sheets of Dr. G. Gore's new book on "The Art of Electrolytic Separation and Refining of Metals," published by the Electrician Printing and Publishing company, London.

engines, and their power be applied to a great variety of purposes, mechanical, thermal, and chemical.[2]

At the present time the process of electrolytic separation and refining of metals is extending rapidly; it is carried on at Pembrey, Widnes, Swansea, Tyldesley (Lancashire), St. Helens (Lancashire), Milton (near Stoke-upon-Trent), Paris, Marseilles, St. Denis, Angoeleme, Biache (Pas de Calais), Froges (near Grenoble), Hamburg, Stolberg, Berlin, Moabit near Berlin), Oker (in the Hartz), Eisleben, Burbach near Siegen), Frankfort-on-the-Main, Schaffhausen, Stattbergerhutte (near Cologne), the Koenigshutte (in Silesir), Witkowitz (in Moravia), Stephanshutte (in Upper Hungary), Brixlegg (in the Tyrol), Ponte St. Martino (in Piedmont), Casarza (near Genoa), Pittsburg, Pa., Milwaukee, Wis., Bridgeport, Conn., Omaha, Neb., Ansonia, Conn., St. Louis, Mo., Newark, N. J., Cleveland, O., Lockport, N. Y., Santiago (Chili), Chihuahua (Mexico), etc At Messrs. Balbach's works, Newark, N. J., sixty tons of copper are deposited and refined per week. "Messrs. Bolton at Widnes, and Messrs. Vivian, as well as Messrs. Lambert at Swansea, are each depositing from forty to fifty tons per week, by currents from 5,000 to 10,000 amperes." The "daily quantity refined at Oker is two and a half tons; and the total amount in Germany and Austria is about six tons daily." Messrs. Elliott & Co. of Pembrey (near Swansea), deposit nearly the largest amount, forty-five to sixty tons per week, in this country. I am informed from a direct source that the Bridgeport Copper company of Bridgeport, Conn., electrolytically refine "1,000,000 pounds of copper per month," or about 108 tons per week, "by means of three dynamos."

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 8.—The progress thus far made in electric traction on a commercial basis has been confined almost entirely to cities of the second and third class. With the single exception of Boston no large city of any importance has adopted the electric system on an extensive scale. True, Minneapolis and St. Paul combined have been busy in this line and many other cities of equal importance have been introducing the new method of propulsion, but Boston has stood alone among large Eastern cities. To-day the manufacturers of electrical apparatus for street railways are rejoicing over the prospect of several large contracts for cities equal to and even larger than Boston. Philadelphia, for instance, is looking into the subject and it now looks as if electric traction would be adopted by the Quaker city within a month. The subject is being agitated with unusual interest and the overhead system is pretty sure to be selected for rapid transit in that city. Already the city of Providence has fallen into line and will use the overhead system. Upon the authority of an official who knows the inside of the business, Philadelphia is just upon the verge of adopting a complete system of overhead electric traction. The railroad committee of councils of the latter city called a meeting of the joint sub-commitees last Wednesday to consider the ordinances authorizing the use of the overhead electric system by the Germantown Passenger Railway company, the Lehigh Avenue Railway company, the Twenty-second and Allegheny avenue Railway company, and the Holmesburg, Tacony and Frankford Electric Railway company. Arguments for and against the system by the representatives of the different railway companies, electricians, property owners and others made the session in the secret council chamber of special significance. Chairman Green called the meeting to order and asked for the opinions of those interested in the project. The principal objections raised to the overhead system were the "unsightly poles" and the "danger of overhead wires." On the other hand property owners in Germantown and along the proposed lines were almost unanimous in their opinions that the appreciation in the value of real estate would be great, if such a system of transit were adopted. Marshall Kinney, who represents over 1,000 residents in West Philadelphia who are in favor of the overhead system said, "I haven't heard a dissenting voice to the project and don't think there is one." The matter is now in the hands of the executive committee of the Rapid Transit Commission and by the call of the mayor yesterday after ascertaining the exact position of the work at the present time, arrangements were made to have a final report and adoption by January 1, 1891.

An important patent suit has been instituted in the United States Circuit Court of the Southern District of New York by the Brush Electric company and the Consolidated Electric Storage company of New York, against the Anglo American Electric Light Manufacturing company for alleged infringement of the Brush storage battery patent, owned by the former companies.

The much abused conduit system of electric traction is again battling for existence, and improvements which will insure its success are said to have been accomplished. A well known conduit company in New York has been experimenting, with entirely satisfactory results according to its report.

Popping manholes on lower Broadway vary the motonony of the lives of the policemen in that section of the city, and at the same time afford subjects of gossip and newspaper articles for the opponents of the underground system.

The body of a man with a broken skull found floating in the Broad Channel, Jamaica Bay, recently, is believed to have been that of William Hieronimus, an electrician, who has been missing for two weeks. W. H. T.

[2] Dynamos of "12,000 electric horse power each," weighing "300 tons," and having armatures "45 feet over all," are being constructed.

Kansas City, Mo.

KANSAS CITY, Nov. 8.—The Northeast Electric Railway company is supplying its cars with electric heaters. The heater is a flat slab of iron set on short legs and placed under the seat. Each car is being supplied with four of these heaters. The new method seems to be entirely satisfactory. A grating covers the heaters, preventing damage to the clothing of passengers.

The Consolidated Electric Light & Power company of Kansas City, Kan., has brought suit against J. M. Killmer, S. J. Jones, James Fisher, W. C. Capley, F. A. McDowell and C. Schoeller, councilmen of the city of Rosedale. The company alleges that on October 4 last the councilmen named cut the company's wires, broke the iron arms from which electric light wires were suspended, broke the lamps and otherwise injured their property in Rosedale. The cutting of the wires, it is alleged, rendered useless the line in Rosedale, Armourdale and Central Avenue. It is charged that these entire lines were thrown out of order and made useless. The company demands $10,000 damages.

The telephone service between Independence and Kansas City for the past few months has been impaired by the electric railroad at Kansas City. The telephone company has rearranged its circuits and made other changes in its system.

The Western Union Telegraph company will not move its general office up town, as was reported some time ago, but it will occupy the entire Thatcher building, The operators' quarters will continue to be upstairs, but more space will be given them. The offices in the second story will also be occupied by the company.

The Joplin Thomson-Houston Mining company filed articles of incorporation with the county recorder this week. The capital stock is $200,000. This is held by C. S. Rusling of Chicago, formerly the Thomson-Houston agent at this point; Ira Hubbell, H. M. Holden, Ira C. Hubbell, D. J. Haff, C. E. Hart of Joplin; and C. A. Ross, B. E. Sunny and Henry Wadsworth of Chicago. The first meeting of the directors of the new company, which is to operate in the Joplin district, will be held next week.

John Winter of Trenton, Mo., was in the city last week in the interest of a company in that place, which will soon commence to put in an electric street railway.

At this week's council meeting in Kansas City, Kan., councilman Troup introduced an ordinance granting to the West Side Railway company the right to construct and operate for a term of twenty years a double track electric railway from Fifth and Minnesota avenue on Fifth to State avenue, on State to Third street. The road is to be completed May 1, 1891. This company already has a franchise to operate an electric railway from Third to Minnesota avenue to the northern part of the city and along the northern portion to the western limits. The ordinance was referred. Work is to be started on the line within ten days. P.

Minneapolis, Minn.

MINNEAPOLIS, Nov. 8.—The St. Paul city council held a very important session last evening, which was attended by Thomas Lowry and many prominent citizens, and which dealt with the electric railway problem in all its aspects. Mr. Lowry entered into a detailed explanation of the progress of construction in that city, and presented a communication showing that the following new lines had been completed: University avenue line, Lexington avenue line, Como avenue line, Mississippi street line, Maria avenue line, on Fifth street, from Wacouta to Broadway; on Broadway from Fifth to Grove; Mississippi, from Grove to Thirteenth; Tenth, from Broadway to Locust; Eighth, from Wabasha to Robert; Robert, from Seventh to Eighth; Concord, from Bancroft to Arthur; State, from Concord to South Robert, and on the latter to Annapolis; Smith avenue extending from Ohio to Winifred, and Smith avenue to Annapolis. He rehearsed the now well-known causes of delay which the company had encountered, and stated that when the council had a year ago forced him to agree to complete the whole system before Nov. 1, the understanding existed that an extension of time should be granted in the event of failure from unavoidable causes. Mr. Lowry's address to the council was a succinct description of the work now in progress, which he stated would cost the company not less than $2,000,000. The question of granting an extension was discussed by the council, and an ordinance was finally passed giving the company until March 1, 1891, to complete the work now in progress. The result was not attained, however, without important concessions, among which was an agreement that the company should put in operation a system of transfer checks on the East Seventh street cable line and the Oakland avenue and West Seventh Street electric lines. Mr. Lowry stated that he would put the transfer check system in operation all over the city but for the fact that it was impracticable where "bob tail" horse cars were used. Several prominent citizens of St. Paul, who had, upon Mr. Lowry's invitation, inspected the work, spoke in behalf of the extension, and the prevailing sentiment was vastly more friendly toward the company than would naturally be considered possible when the occurrences of a year ago are recalled. The council was very decidedly averse to injuring the credit of the company by permitting the penalty of $200,000 to hang over it, which would have been the case if no formal extension had been granted.

The telephone company had a communication on file setting forth that owing to unavoidable delays in receiving materials they were unable to comply with all the conditions of the agreement by which they secured their conduit franchise. The matter was referred to the committee on streets, and it is believed friendly action will be taken.

The matter of burying the Western Union wires was brought up again, but no new action was taken. The council was apparently anxious to meet Supt. McMichael personally, and for this reason laid the matter over until the next session.

The Minneapolis Street Railway company now has its system of transfer checks in operation on all lines in the city, agreeably to the terms of the ordinance granting its franchise. New motors are being put on the various completed lines daily, and trail cars are used with most of them, giving a magnificent service. The pleasant weather is affording the company just the opportunity it wants to push work, and the progress of construction will be much farther advanced than was expected when winter interrupts it.

The Robinsdale Electric Railway company this week surprised North Minneapolis by commencing work on its new line at the city limits and Thirty-second avenue. A large crew of graders is at work, and with a week of pleasant weather the roadbed will be ready for the track. The intention of the company with regard to the completion of the line and its operation this winter cannot be learned, but residents of the suburb of Robinsdale are said to have assurances that it will be finished this fall.

The Spirit Island dam project has been revived in a manner that seems to mean business, and Gov. C. A. Pillsbury is authority for the statement that the dam will be built. The plan is to utilize the vast undeveloped water-power at that point of St. Anthony Falls to generate electricity for light and power throughout both of the Twin cities. Gov. Pillsbury says that $1,000,000 will be expended in developing this power. It will be remembered that Henry Villard last spring personally investigated the Meeker Island water power with the same end in view. All that is known of the Spirit Island project is that wealthy and influential citizens are in it, and Gov. Pillsbury says that no specific details will be given to the public for some little time.

Judge Otis of St. Paul, has denied the plaintiff's motion for a new trial in the suit of Howard Fleming against the St. Paul City Railroad company. It was an action to enforce a mechanic's lien growing out of the change of plan from the cable to the electric system.

The Gerry Lumber company is now negotiating for an electric light plant which will be used to light both its lumber mill and the village of Eagle River, Wis., in which the mill is situated. N. O. F.

Little Rock, Ark.

LITTLE ROCK, Nov. 8.—The sale of the City Electric Street Railway company, called the "Dummy Line," which took place last week, means that mules and "dummy" engines must give way to rapid transit on the local system of street railways.

The owners of the Capitol Street Railway have bought the Dummy Line, and the right of way from the western limits of the city, to Cunningham's Lake, including the farm and lake known as the Cunningham place, a short distance from town, west of the present terminus of the line.

The price was about $60,000, paid principally in securities of the Capital Street Railway company.

Horace G. Allis, president of the First National Bank and of the Capitol company said that they will operate the

line with electric power, the work on the Capitol line having been delayed some weeks awaiting the consummation of this deal.

Edison generators and overhead system and Westinghouse motors will be used. The engines to be used have been ordered from the E. P. Allis company, Milwaukee. They are two 300 horse power and one 400-horse power compound condensing engines.

The engine builders have contracted to deliver the engines and boilers by Feb. 10, and the electric companies agree to install the electrical portion of the plant by the time the engines and boilers are delivered.

The work of macadamizing and repairing the tracks cannot, of course, be undertaken with economy until the mules are taken off.

With the purchase of the Dummy Line the Capitol company is already in possession of a system of street railway, nineteen miles in length, and with the contemplated extension of the Dummy line, the Little Rock system of street railways will embrace twenty-two miles. K. C.

Louisville, Ky.

LOUISVILLE, Nov. 8.—In spite of the fact that the installation of certain classes of electrical appliances has been interfered with by a rush of orders at the four or five large factories supplying that sort of apparatus, trade in other branches has been unusually lively. The consolidated railways expected to have their cars running along Fourth street by July 1, and then by Sept. 1. It was also expected that electric cars on Market, Shelby, Eighteenth, Brook, Seventh, and the Parkland line would be running by the latter date. The ground wires are all put down along the tracks of those lines, and the poles and supports are up, but it is now a matter of conjecture when the lines will be running. The motors for the Fourth street line, for which the contract was awarded over six months ago, are expected within a couple of weeks. The line, leading as it does direct to the amphitheater, Auditorium, where the most popular theatrical attractions are seen, will prove a boon to the amusement-loving public, as well as those along the line, as the present street car service is unsatisfactory.

At last the city is to have electric lights to supplant the gas now used in certain portions. Mayor Jacob advertised for bids for lighting certain streets for one year, according to specifications as follows: The lighting to be done by arc lamps, not less than 150 in number, to be distributed at points within the territory bounded by Shelby, Fifteenth, Broadway and Water streets, at certain points indicated, but to be relocated from time to time, according to the public requirements; the lamps to be suspended in most part over the centers of the streets. But such a number as it may be deemed expedient by the mayor, are to be suspended from mast arms or to be placed on poles. Lamps over the center of the streets are not to be less than twenty-five feet above the ground, and those on poles are not to be less than twenty feet nor more than twenty-five feet, as may be directed by the superintendent of electric lights.

The Gooch Electric Light company has been incorporated by a number of local capitalists, including W. T. Grant, J. J. Harbison, Graham Macfarlane, Abner Harris and Dexter Belknap. Its capital stock is $100,000, $80,000 paid up. The company succeeds to the assets and business of the Gooch Electrical company.

The Thomson-Houston company is enlarging its local office on Main street, between Fourth and Fifth, and it will be one of the handsomest of the city when the work is complete.

At Frank Fehr's new City Brewing building, the Edison company, through its local agents, will put in ten arc and 360 incandescent lights. The company has also contracted for 500 incandescent lights for the Central Electric Light station at Bowling Green, Ky. The same company has just put in a 5-horse power motor for the Kentucky Jeans company, a 3-horse power motor for the Falls City Shirt company, and a 1-horse power motor for J. M. Reister, jeweler, to run appliances in his shop.

The Gaynor Electric company has just taken a contract to put in eighty incandescent lights for the Tarascon Woolen mills.

The two big depots and a number of immense office buildings nearly completed, will require large electric light equipments. The big Union depot at Seventh street, being built by Huntington, will require 20 arc and 183 incandescent lights, while the big L. & N. passenger station at Tenth and Broadway, which will also be a union station, will require 20 arc and 1,000 incandescent lights. The Louisville Trust company's building, nearly ready, will require 630 incandescent lights.

A correspondent from Lexington, Ky., announces that the spirit of opposition to the electric railway at first manifested there is rapidly passing away, and the company is enjoying the confidence of the community. The new rapid transit system is greatly preferred to the slow mule method.

At New Albany, Ind., it is said that the Electric Light company will soon be able to furnish the citizens with incandescent lights almost as cheap as gas, as the gas rate per thousand is very high in that city. New machinery was ordered a few days ago, and as soon as received the number of lights in the city may be doubled at any time. The company has been asked by the mayor to make a proposition for lighting all the streets by electricity. No action has yet been taken, but gas for the public streets will probably be discarded.

The Covington, Cincinnati & Rosedale Electric Railway company has been incorporated. This is the initial step in the building of an electric railway to pass from Cincinnati through Covington, a mile and a half through the southern suburbs of Covington, in the Licking Valley. The road is intended to build up that territory which is now looked to as a big suburban site. Bids have been advertised for. Hon. Harvey Meyers is one of those interested.

The New Albany Structural Iron Works have ordered in an electric light plant in order to run night and day. The Sheet Iron mill, the De Pauw Glass Works and the woolen mills also use electric light.

A local electrician announces that a suburban electric line fifteen miles long is proposed. It will run from East St. Louis to Belleville, Ill. The franchise to operate an electric railway over the turnpike has already been secured. Seventy-five-horse power motors will be required to run the trains. It is proposed to operate the same kind of cars, if practicable, over the proposed belt line that will connect Louisville, Jeffersonville and New Albany as soon as the new bridge is completed. L.

THE ELECTRIC LIGHT.

The erection of an electric light plant is suggested at Neunan, Ga.

Alexandria, La., is preparing to introduce electric lighting on an extensive scale.

The city of Troy, Ala., will probably erect an electric light station and furnish its own lights.

It has been decided to rebuild the plant of the Charleston, S. C., electric light and power plant.

The Thomson-Houston Electric company will probably erect an electric light and power station at Orlando, Fla.

The Citizens' Electric Light company has purchased the Baton Rouge, La., Electric Light company's plant for $30,000.

An electric light plant will be installed at Ashville, Ala., by a company of local capitalists now forming for that purpose.

Colonel W. A. Sheldon of the Schuyler Electric company last week started the arc light plant at Monroe, Mich. Its capacity is 150 lights.

The managers of the Aurora cotton mills at Burlington, N. C., contemplate the introduction of an incandescent plant in those extensive mills.

Dawson, Ga., will introduce electric lighting, and the Edison General Electric company has been awarded the contract for furnishing the apparatus.

G. W Carder of Arkadelphia, Ark., is ready to receive propositions for an electric light plant. He has not yet decided how many lights he will install.

Among the improvements contemplated by the Planters' Oil and Manufacturing company at West Point, Ga., is the introduction of an electric light plant.

At Palestine, Tex., the Edison Illuminating company has found such a demand for incandescent lamps that a large increase in the capacity of the station is demanded.

An extensive electrical plant will be installed by A. J. Corriveau at the Sherbrooke, Ont., seminary and college. The cathedral and bishop's house will be illuminated from this plant.

The Thomson-Houston Electric company contemplates installing an electric light plant at Bartow, Fla. A stock company is being formed by J. W. Brady, J. O. C. Blount and other local capitalists.

One of the first improvements determined upon by the Western Carolina Land & Improvement company, which was organized at Anderson, S. C., to build a new town, was the erection of an electric light and power plant.

The Griffin, Ga., Water company, recently organized, has been incorporated by W. A. Robinson, J. T Robinson and E. R. Hulbert, to erect an electric light plant and construct waterworks. The authorized capital stock is $75,000.

THE ELECTRIC MOTOR.

An electric railroad will be built at South Houston, Tex.

The Jackson, Miss., Land and Improvement company contemplates building an electric road three miles long

The North Chattanooga Railway company of Chattanooga, Tenn., is said to be negotiating for the changing of its line to an electrical railroad.

J. Deutschman has been elected president, and F. W. Openhauser secretary of the Texarkana, Ark., Gas and Electric Railway company. The capital stock is $500,000.

The progress of the work of the Electric Rapid Transsit company at Los Angeles, has been stopped by injunctions secured by residents along the proposed route, who object to pole lines.

The street railway company at Rochester, N. Y., is hurrying the work of equipping its lines with electrical apparatus, keeping a large number of men engaged day and night. Electric lights are hung over the roadway at night, making it as easy for the workmen as in the day.

The property and franchises of the Central Street Railway company, Sacramento, Cal., have been transferred to San Jose capitalists who will introduce an overhead electric system. The present road is four miles long and other lines will be added and extended, and all equipped with electrical apparatus.

The Birmingham, Ala., Railway and Electric company, which controls and owns the Bessemer & Birmingham, Ensley and Birmingham Union railways, has been bonded at $1,500,000, with the Central Trust company of New York as trustee. The purpose of the mortgage is to secure funds to change the motive power to electricity.

A number of Pacific Coast capitalists have organized a company with a capital of $250,000 for the establishment of an electric railroad between Oakland, Cal., and San Leandro, Haywards and San Lorenzo. A franchise has been obtained and work will be commenced at an early day. The main line will be eleven miles in length, with a branch two miles long.

The commission appointed to appraise the value of land required for the construction of the electric railroad between Charlotte and Manitou Beach, summer resorts of Rochester, N. Y., has made its report, and the work of construction will proceed at once. The line will be equipped and in readiness for the summer travel. The proposed route is along the beach to Charlotte, where connection is made with the electric road up the boulevard to Rochester, bringing the beach within fifty minutes' ride of the center of the city.

The directors of the Joplin, Mo., Electric Railway company have decided to extend its line from the eastern suburbs of Joplin to Webb City, where it will connect with the line of street railway now in operation in that city and Carterville and to Blendeville, the new mining camp, one mile south of the city limits. This will give a continuous line of at least ten miles of road. In addition to this the directors are negotiating with the Electric Light & Water Power company to supply electrical power for propelling the cars three miles further south to Grand Falls, and six miles west to Galena, Kan.

Mayor Hazard of Los Angeles, Cal., recently vetoed a franchise granted B. O. Carr and F. B. McDonald of San Francisco to construct an electric road. The franchise is a valuable grant as 23 miles of streets are included. The mayor's objections were based on the fact that the franchise required only six miles of road completed in three years. The city council, however, passed the ordinance over the mayor's veto. A franchise to build an electric road has been granted John Bryson and W. C. Clark. It is understood that an electric road is to be built from the terminus of the Los Angeles & Pico Heights road, by way of the Rodeo de las Aguas and the Soldiers' Home, to the sea at Santa Monica.

THE TELEGRAPH.

Fire destroyed the telegraph office at Owensboro, Ky., and damaged the telephone exchange considerably last week. The fire originated in an adjoining block and swept away s large portion of the business district of the city.

The Supreme Court at Little Rock, Ark., recently gave an opinion in a case against the Western Union Telegraph company involving the liability of the telegraph company for errors in transmitting unrepeated messages. The court held that the telegraph company was liable for an error in transmitting an unrepeated message, and that the measure of damages was the actual damages proved as having occurred by reason of the error.

Miscellaneous Notes.

A company has been formed at Newport, Ky., with a capital stock of $250,000, to establish an aluminum plant. The process which the company has adopted was invented by Charles Hartsfeld.

An electrical conduit manufactured of concrete in accordance with the spiral centering method of Alexander Crawford Chenowith has been laid in Ashburton and Palisade avenues in Yonkers, N. Y., for telephone wires. The police and fire department of New York is laying one of same kind at High Bridge, New York City.

A dispatch from Paris says: Great interest is taken in naval circles on the possibilities of the application of electricity to naval uses. The government has taken the matter up and proposes to institute a series of lectures for the benefit of naval officers on the theory and use of electricity. These lectures will be given by recognized experts, and will extend over a period of four months. Particular attention will be paid to the various systems of electric lighting, which four working electricians from each naval port will carefully study under the direction of the government.

The electrical display at the Mechanics' Fair, San Francisco, was worthy of considerable attention. Prizes were awarded the California Electric Light company, Brush system, for its electric lighting apparatus and meters; the Edison company for incandescent system arc lamps, for incandescent circuit switches and other devices for incandescent systems; Paraffine Paint company for insulating

material, Pacific Electrical Storage company (Accumulator system) for storage battery system, and the National Electrical Development company for transformer system.

A conference of representatives of the Bell Telephone company, the Rochester Railway company, the Western Union and Postal Telegraph companies, and the Rochester Electric Light company, with the members of the executive board of the city of Rochester, N. Y., last week, regarding the poles in that city. It was decided that all the companies should use the same poles.

Personal Mention.

Dr. W. A. Allen, Davenport, Ia., was in Chicago this week.

J. W. Marsh, general manager of the Standard Underground Cable company of Pittsburg, Pa., was in Chicago this week.

H. R. Hixson, assistant manager and purchasing agent of the Great Western Supply company, has severed his connection with the company. Mr. Hixson will in all probability remain in Chicago as he has already been the recipient of several tempting offers.

E. V. Cherry, president of the Standard Electrical Works of Cincinnati, has been elected to the important office of member of the State Board of Equalization of Ohio. Mr. Cherry is a man of excellent business judgment, and is in every way well qualified to discharge the duties of the position. He has received the congratulations of a large number of friends throughout the country, especially those in the electrical fraternity.

Business Mention.

The prosperity of the San Francisco branch of the Edison company is evidenced by the fact that it has been obliged to secure additional space for store rooms.

Milliken & Co., manufacturers of the Milliken patent iron electric railway pole are building an extension to their New York factory 80x120 feet. The firm has received orders for over 6,000 poles in the last three months.

The Thomson-Houston Electric company of Boston has recently issued a handsome pocket map of Massachusetts and Boston for the purpose of calling attention to its system of electric power transmission.

The Commercial Electric company of Detroit, Mich., has issued a neat catalogue containing wire price lists and many useful tables. Okonite, Grimshaw, Clark, Habirshaw and underwriters are included.

The Central Electric company of Chicago, has just issued a remarkably effective circular to advertise the merits of okonite wire. The circular resembles in appearance a legal document, as it is ornamented with tape and seal. Attached to the document is a piece of okonite wire apparently as good as new. A letter addressed to the Central Electric company, by G. S. Cook & Co. of Minneapolis, is reproduced on the circular and tells the story. The firm writes: "This piece of okonite wire was placed in our Lumber Exchange Building in this city five years ago and has been used continuously ever since as part of the electric lighting circuit of the building. The wire was originally stapled to the fire proofing and plastered over and so far as we can see is as good as ever."

In the work of inventing and perfecting articles necessary to the development of the electrical industry, the Markle Engineering company of Detroit, Mich., was among the earliest pioneers. The long experience of the company, incident to construction work during the early period and subsequent development of the business, afford it a knowledge of requirements, which enables the company to produce uniformly high class articles. These new devices are appreciated by the trade, and by all those having a fair understanding of the art. The Markle Engineering company in addition to the novel "Pantechnetheca" fixture described in this issue, are exploiting a number of other specialties of merit. Among these may be mentioned the Stoddard cut-out, the U. S. fixture cut-out, wooden cleats, and the Stoddard street hood and bracket.

The Writing Telegraph company of New York, announces that it is now doing business and achieving rapid success. It is claimed by pamphlets recently published by the company that there can be but one opinion among commercial men about the value of an invention which facilitates business and secures absolute immunity from error in the transmission of messages and communications from one place to another. The written communication at the receiving end of the line is a duplicate of the message sent, and can be nothing but an exact counterpart. Business men are readily appreciating the value of this invention and taking an increasing interest in its development. The parent company being now in full commercial sway, subordinate companies are to be organized in the leading cities of the country. W. E. Gump, the managing director, has been specially successful in establishing what promises to become a large and profitable business.

The business being done by the Electrical Supply company of Chicago is rapidly increasing. Those who have seen the phenomenal growth of the company since the time the Chicago branch was established, will be surprised to see the large establishment and office on Randolph street, as well as the immense storehouses which the company has been obliged to secure outside. The success which the Electrical Supply company has obtained is the result of its push and business energy, while the new specialties which have been secured for the West by this enterprising house are proving a great success and confirming the business foresight which adopted them. Owing to the large and well established force which this company constantly employs, the interests of purchasers are looked after in the best possible manner, and the rush of orders amply testifies to the appreciation in which such care for their welfare is held by the customers themselves.

In the last issue of the WESTERN ELECTRICIAN mention was made of the fact that the Great Western Supply company of Chicago was transferring its business to an Illinois corporation of the same name. Within the last few days a number of changes have been made in the personnel of the company. Manager George Cutter has resigned to accept, it is stated, a position with the Brush Electric company. Assistant Manager and Purchasing Agent H. R. Hixson has also resigned. H. P. Lucas, formerly of Holmes, Booth & Haydens, and late with the Northwest Thomson-Houston company of St. Paul, Minn., has been appointed manager of the company to succeed Mr. Cutter. T. C. Turlay of Leavenworth, Kan., will be treasurer of the newly organized concern. H. P. Lucas, the newly appointed manager, is a gentleman well known and highly esteemed by the fraternity in general, and under his management a great increase in the already large business of this company may be expected.

The Evans Friction Cone company of Boston, Mass., has received contracts for introducing its friction system in the following plants: Lebanon (N. H.) Electric Light & Power company, one 650-light alternator; W. S. Griffith & Co., Philadelphia, Pa., two 200 light Mather dynamos; Washington (Pa.) Electric Light company, one 500-light alternator; Hopedale (Mass.) Electric Car company, two 30 horse power generators; National Transit company, Oil City, Pa., one 140-light dynamo; Rhodes Manufacturing company, Philadelphia, Pa., two 30-light dynamos; A. M. Church company, Troy, N. Y., one 20-arc light and one 50-light incandescent; Clinton (Mass.) Gas Light company two 45-arc light, two 650-light alternators and one 30 horse power generator; Worcester (Mass.) Polytechnic Institute one 500-light alternator and one 250-light continuous current machine; Edison General Electric company, Broad street, New York, one 180-light dynamo; Belfast (Me.) Electric Light company, one 500-light alternator and one 300-light alternator; P. H. Glatfelter, Spring Forge, Pa., one 400-light incandescent and one 20 full arc; Seamless Rubber company, New Haven, Conn., one 100-light dynamo. With these plants the Evans system is used to operate machines of 4,060 horse power.

W. A. Stadelman, who has been connected with Chadbourne, Hazelton & Co. of Philadelphia, has recently severed his active interest in that concern and has reorganized the Equitable Electric Railway Construction company of New York, of which he was chief engineer, and will devote his entire energies to the new concern. The new company will be known as the Equitable Engineering & Construction company, and a new charter has been applied for which will give the company the right not only to equip electric railways, but to buy and sell, or lease or operate them. The old company will go out of business by liquidation and the new company will take its place. Handsome new offices in the Drexel building have been taken, and the new company has already several large contracts, one for an electric railway in the South and one for a complete central station, alternating current lighting plant, including engines, boilers, buildings, etc., to be erected near Philadelphia. The capital stock of the new company is $50,000 and the officers are as follows: J. A. McKee of the Tradesmen's National bank, president; H. J. M. Cardeza of Cardeza, Gilliams & Co., secretary and treasurer; W. A. Stadelman, manager and chief engineer. Directors: J. A. McKee, J. L. Stadelman, L. Gilliams, F. D. Lalanne, W. A. Stadelman.

Electrical Patents.

Issued Nov. 4, 1890.

439,622. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The essential features of this system, so far as the conductors are concerned, lies in the use of suspended working conductors, arranged along the track. These conductors are bare, and may be made in the form of flexible cables, wires or rods, and with which the traveling electric vehicle makes contact.

439,724. Electric Heater. Charles W. Drew and Edward R. Francis, Minneapolis, Minn.

439,737. Standard Galvanic Cell. Edward Weston, Newark, N. J.

439,746. Trolley Line Switch for Overhead Electric Conductors. William L. R. Emmett, East Rockaway, N. Y.

439,775. Electric Motor and Generator. Alfred Gartner, Newark, N. J.

The claim reads as follows:

"In an electric motor, the combination of an insulating sliding and regulating bar, two metallic springs on the lower end of said bar and arranged opposite each other, a pin connecting said springs, two stationary insulating bars arranged alternately opposite the sliding bar, and a series of springs secured to said stationary bars, each of said springs being connected with the coils of the magnets, said combination of parts being adapted to increase or diminish the magnetic force."

439,796. Insulating Composition. Turner D. Bottome, Hoosick, N. Y.

439,838. Electric Actuating Device for Pendulum Clocks. John H. Dyson, Mazomanie, Wis.

439,840. Electric Log. William P. Granville, Stroud Green, County of Middlesex, England.

439,850. Secondary Battery Plate. Albert E. Woolf, New York, N. Y.

439,859. Magazine Fuse Box for Electric Circuits. William Fr. Bossert, Ilion, N. Y.

439,867. Electric Railway. Mark W. Dewey, Syracuse, N. Y.

The last claim follows:

"15. In an electric railway, a source of irregular or alternating currents, a line working conductor extending therefrom, a slotted conduit containing the conductor, a series of coils distributed apart along the way and connected with the conductor in series, an iron core for each of said coils and having exposed poles extending along the way, a vehicle, an electric motor to propel said vehicle, electric connections between said motor and working conductor, and an iron body carried by the vehicle and arranged to make contact with said poles to maintain one or more closed magnetic circuits at or near the vehicle during its movement to cause the generation of counter electromotive force in one or more of the said coils at or near the vehicle, and between the connections."

439,904. Electric Arc Lamp. Harold C. Shubert, Chicago, Ill.

The object of the invention is to produce a lamp in which the electric arc shall be maintained by means of a positive feed automatically controlled by the current passing through and feeding the lamp, and at the same time the objectionable blinking and jumping of the arc shall be prevented.

439,906. Automatic Car Register. William B. Sprague and Charles W. Kellogg, Chicago, Ill.

439,916. Device for Applying a Coating to Electric Conductors.

439,929. Method of, and Apparatus for Connecting Dynamos. Charles T. Child, Brooklyn, N. Y.

439,939. Rheostat. Edwin R. Gilbert, Hartford, Conn.

439,941. Street or Station Indicator. Louis Goldstone, San Francisco, Cal.

439,959. Telegraph Key. William A. S. Kohrn, San Francisco, Cal.

439,974. Electrical Generator. Frederick L. McGahan, Indianapolis, Ind.

440,013. Electric Indicator. Leston O. Chatfield, Benton Harbor, Mich.

The object of the invention is to provide a means and system of electric connections and attachments whereby the device may be either used as a fire alarm or method of signaling.

440,016. Automatic Regulator for Dynamos and Motors. Fremont J. Cleaver and George Fassold, Pittsburg, Pa.

The invention consists in the combination, with the field magnets of a dynamo, of an armature formed of a hollow cylinder of non-magnetic material wound with a conductor, a commutator cylinder connected with the conductor of the armature, an armature core placed within the hollow cylinder and supported by a shaft extending through the tubular armature shaft, and a pair of brushes connected with the shaft of the armature core, so as to be moved thereby.

440,023. Electrode for Secondary Batteries. Justus B. Entz, New York and William A. Phillips, Schenectady, N. Y.

Specifically stated, the invention relates to those batteries in which the oxide of copper forms a part, whether in the capacity of a depolarizing agent, as in primary batteries, or as the active material in the positive electrode of a secondary battery.

440,024. Method of Making Electrodes for Secondary Batteries. Justus B. Entz, New York, and William A. Phillips, Brooklyn.

440,042. Insulator for Electric Conductors. William Kessler, Lafayette, Ind.

The object of the invention is to simplify the manner of attaching wires to insulators and to provide an insulator adapted to receive and securely retain a wire without necessitating the usual tying,

440,070. Magnetic Separator for Grain. Ewald von Syo, Augsburg, Germany.

440,071. Electric Heater. Charles H. Talmage, Kansas City, Mo.

The first claim is given:

"An electric heater, consisting of a transformer having a primary coil and a closed secondary circuit of sheet metal cylinders surrounding the primary coil, whereby a current of electricity of moderately high electromotive force can be transformed into a heating current."

440,091. Holder for Telephone Receivers. Frank T. Tinning and William K. S. Tinning, Toronto, Canada.

440,096. Telephone. Sigmund Bergmann, New York, N. Y.

440,106. Adjustable Trolley and Guard for Electric Wires. Lewis S. Hoyt, Boston, Mass.

The invention comprises a journal frame provided with a slotted socket to permit a semi-diameter revolution or less around the supporting trolley pole, right and left pairs of inclosing disks, the outer of which are provided with lugs to form a parallel support against said journal frame, and the spiral springs therein, which comprise the guard.

440,115. Electrical Burglar Alarm. Francis Pierce, Philadelphia, Pa.

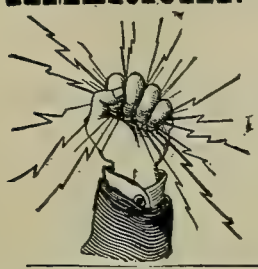
One of the objects of this invention is to furnish means at the central office for testing the condition of the circuit, and also for detecting from which station an alarm proceeds, without having recourse to a local battery at the place protected.

440,118. Automatic Toll System for Telephone Pay Stations. Howard C. Root, Brooklyn, N. Y.

The invention relates to that class of automatic toll boxes for telephone pay stations in which the customer calls up the exchange or central office from the pay station in the ordinary way, and asks to have the line connected with a certain subscriber, and puts into a receiving box at the pay station a coin or other token of the proper value as the toll for the services asked for, and the operator at the exchange is enabled to detect the value of the coin or token which has been put in by the customer at the pay station.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

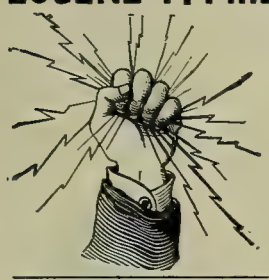
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

—MANUFACTURERS OF—

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS

4 LASALLE AVE CHICAGO.

MAKE ANYTHING IN BRASS.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

Sealed Proposals.

SEALED PROPOSALS will be received by the Common Council of the city of Big Rapids, Michigan, at the City Recorder's office until Monday evening, Dec. 1st next, for lighting said city with twenty-six (26) to thirty-five (35) 2000 candle power electric lights, from January 1st, 1891 to January 1st, 1892. Said bid to state price for lights running from dusk until 12 o'clock, and also price to run from dusk until daylight. Each bid to be accompanied by a bond in the sum of $1000 as a guarantee that the parties tendering such bid will enter into a contract for operating such lights if their bid is accepted. The Common Council reserves the right to reject any and all bids.

S. G. WEBSTER, Recorder.

Big Rapids, Mich., Nov. 5, 1890.

—THE—

WRITING TELEGRAPH

instruments and system have been perfected, and also proven by the test of time.

The instruments are adapted for

EXCHANGES,
NEWS REPORTING,
PRIVATE LINES.

It is desired to form Sub-Companies in the different WESTERN STATES to introduce this system of communication, which has its many advantages.

For particulars address WRITING TELEGRAPH CO., P. O. Box 1322, New York, N. Y.

N. B.—The patents of the Writing Telegraph Co. for CANADA, AUSTRALIA and SOUTH AMERICA are for sale, or desirable arrangements will be made with proper parties to operate the instruments in said countries.

FOR SALE.

One 350 Light Thomson-Houston Incandescent Dynamo, Compound-Wound, Motor-type.

ADDRESS "DYNAMO."
Care of WESTERN ELECTRICIAN.

FOR SALE.

One 8½x10 Armington & Simms Automatic Engine.

One 20-Light Fuller-Wood Arc Light Dynamo and Lamps.

A. L. IDE & SONS,
SPRINGFIELD, ILL.

ELECTRIC LIGHTING,

FRANKFORT, INDIANA.

PROPOSALS are wanted until December 19, 1890, for lighting by electricity and gas, the Public streets, etc. of this city for a period of five years.

Address **S. A. COOK,**
City Clerk as above.

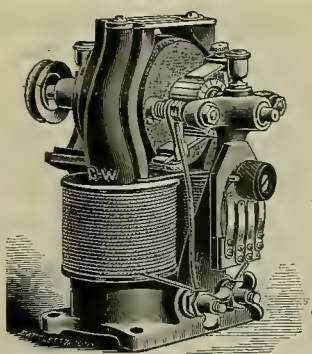
By Order of Committee. J. H. CHAMBERLAIN, J. W. HAMMOND, J. S. VANARSDAL.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.



THE CROCKER-WHEELER

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation
Forged Fields, Let into Base—Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies o be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

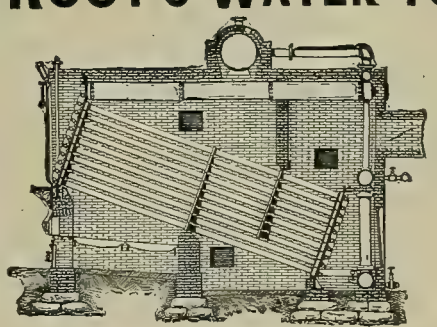
CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Prest.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

INSULATED WIRES AND CABLES,

OKONITE TRADE MARK

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL OKONITE COMPANY, Limited, - - 13 Park Row, NEW YORK.

BRANCHES Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

EDISON LAMPS REDUCED TO 44 CTS.

16 CANDLE POWER LAMPS.

Lots of 25 to 150 .....44 cents each.
Lots of 150 to 500.....42 cents each.
Lots of 500.....40 cents each.

Other sizes in proportion. All sizes in stock, with bases to fit any make of lamps or sockets.

Full Line OKONITE WIRES in Stock. Safest and best wire made.
Full Line of Edison Sockets and Appliances.

STANDARD ELECTRICAL WORKS, CINCINNATI, OHIO.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed. Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

GEORGE P. BARTON,

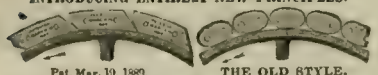
LAW OFFICE,

225 DEARBORN STREET,

CHICAGO, ILL.

Patent and Trademark Cases

INTRODUCING ENTIRELY NEW PRINCIPLES.



Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental

MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

EXPERIMENTAL, MODEL AND ELECTRICAL

Work, Intricate and Special Machinery and anything that can be done in a first class experimental machine shop is solicited.

E. D. STIFF,

67 and 69 South Canal Street, Chicago. Light Manufacturing under Contract.

FRANK T. BROWN, Late

PRINCIPAL EXAMINER ELECTRICITY,

U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

Stilwell's Patent Live Steam-Feed Water Purifier.

Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

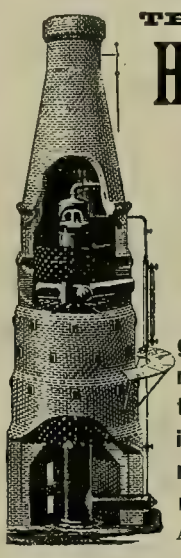
HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.



THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

Endorsed by all users as the BEST DYNAMO OILER IN THE MARKET

UNIQUE APPEARANCE. | *Can be instantly started or stopped at will of operator* | EASILY REGULATED. CONVENIENT TO FILL.

MANUFACTURED ONLY BY

THE WM. POWELL CO., CINCINNATI, O.

SEND FOR CIRCULARS AND PRICE LISTS.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO ERIE PA.

EDISON GENERAL ELECTRIC CO.,
FLEISCHNER BUILDING,
PORTLAND, ORE. **Pacific Northwest District.**

PORTLAND, OREGON, Oct. 30, 1890.

JAS. W. QUEEN & CO.,

GENTLEMEN:—In reply to your favor of the 22d inst., I would say that the portable testing set I bought of you recently has given every satisfaction, and for an instrument of its class surpasses anything I have ever seen for accuracy and reliability.

I would heartily recommend it to electricians. Yours very truly,

R. FLEMING, Assistant District Engineer.

The set referred to was manufactured by

QUEEN & CO., - Philadelphia.

ELECTRIC MERCHANDISE CO.

Standard Devices for all Systems.

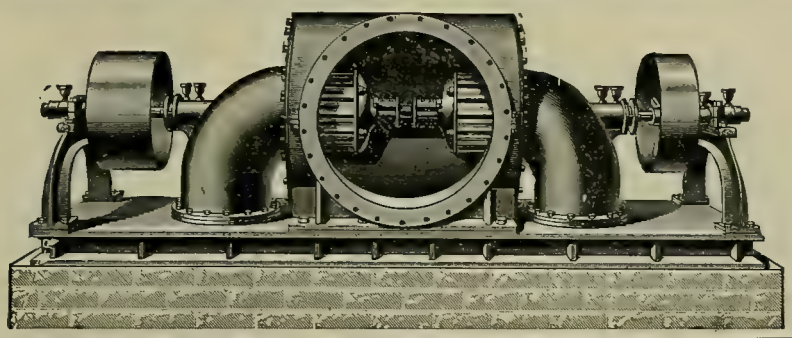
11 Adams St., CHICAGO.

CATALOGUES FURNISHED.

W. R. MASON, General Manager.

ELECTRIC RAILWAY SUPPLIES.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use. we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

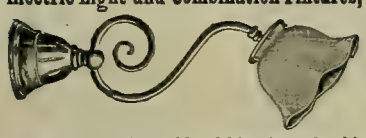
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO. 1221-1223 Union Ave. KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

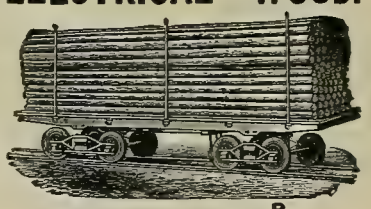
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.

Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

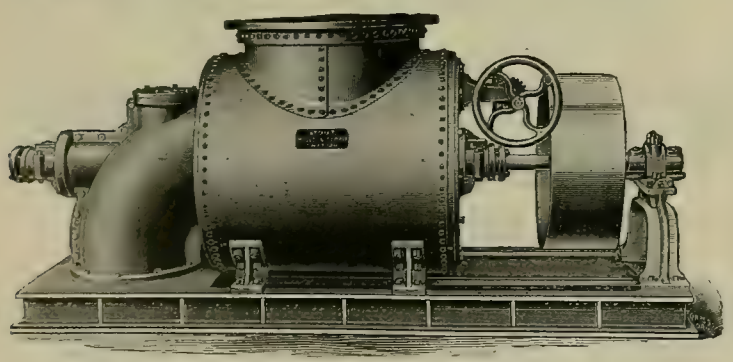
Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators.
Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

Electrical Testing Apparatus manufactured to order, repaired or calibrated.

WESTERN ELECTRIC COMPANY, - - NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,
SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,
Oral, Electric, Pneumatic, and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.
W. R. OSTRANDER & CO.,
21, 23 and 25 Ann St. New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.
15 Dey Street, NEW YORK.

INSULATED WIRE.
ELECTRICAL SUPPLIES
OF EVERY DESCRIPTION.
SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

ADVANTAGES OF THE EVANS SYSTEM OF DRIVING DYNAMOS.

ECONOMY IN ROOM.

No loss of room by reason of long lines of belting. All the space is made available. More than double the number of dynamos can be put in the same space than by ordinary belting. In the erection of new stations, or the increase of old, an immense saving is realized.

EFFICIENCY.

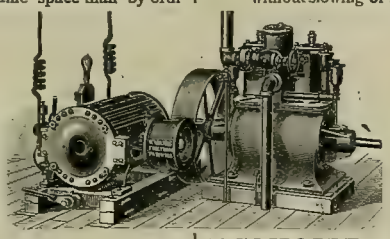
There is no slip. Consequently there is less loss of power in transmission, and a steady light is obtained. There is also less pressure on the bearings than by ordinary belting for the same amount of power.

SAVING IN BELTS.

Belts cost less than one-tenth of ordinary belts, and last over twice as long. The saving in belts alone nearly pays the royalty.

SIMPLICITY AND COMPACTNESS.

The dynamo pulley is placed in immediate contact with the driving pulley. No expensive clutches or complicated belt holders are necessary. The Evans Friction is a perfect clutch in itself.



PERFECT CONTROL.

Each and every dynamo can be stopped or started independently of every other without slowing or stopping the engine or other motive power.

FOR POWER GENERATORS.

Where the load is intermittent and subject to sudden changes, as in street railway work, the Evans Friction adapts itself promptly and effectively to the work without the "flop" or unsteady motion of ordinary belting.

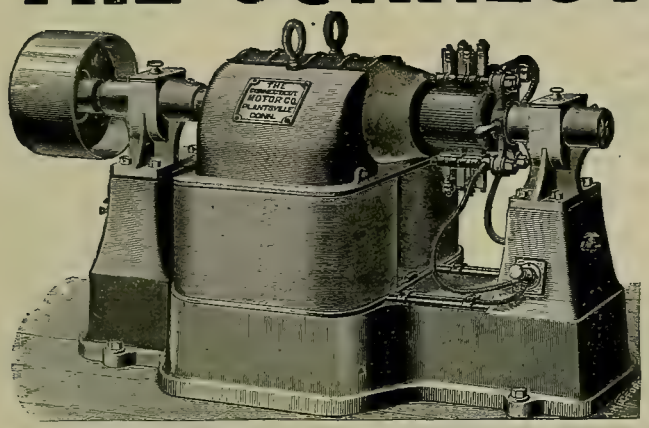
CLEANLINESS.

The Evans System does away with long flying belts which carry a large amount of dust, and not only is the room cleaner but the bearings are freer from grit.

For SIMPLICITY, COMPACTNESS, ECONOMY, EFFICIENCY and CLEANLINESS, the EVANS SYSTEM surpasses anything yet devised for driving dynamos.

Send for Catalogue "D" to ***The EVANS FRICTION CONE CO., 85 Water St., Boston.***

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W. Sixth St.
HARTFORD, 14 State St. NEW HAVEN, 65 Orange St.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

Manufactured by

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

W. D. SARGENT, President. JOHN A. BARRETT, Vice-President and Cons. Electrician.
E. H. CUTLER, Treasurer and Manager. FRANK A. PERRET, Electrician.

THE ELEKTRON MFG. CO.,

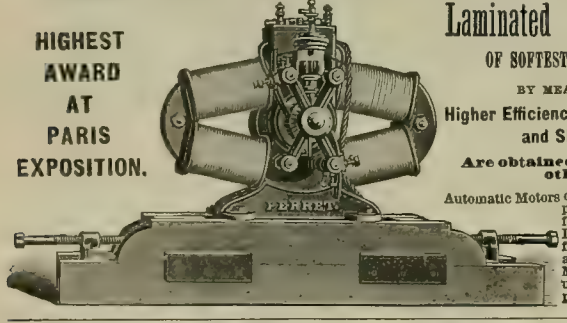
79 and 81 Washington St., Brooklyn, N. Y.,

— MANUFACTURERS OF THE —

PERRET ELECTRIC MOTORS AND DYNAMOS,

Automatically Regulated, Unexcelled in Simplicity and Durability. The only Machines having

HIGHEST AWARD AT PARIS EXPOSITION.



Laminated Field Magnets

OF SOFTEST CHARCOAL IRON,

BY MEANS OF WHICH

Higher Efficiency, Closer Regulation, and Slower Speed

Are obtained than is possible otherwise.

Automatic Motors of all sizes and for all purposes, Automatic Dynamos for Incandescent Electric Lighting. Isolated Plants for Stores, Factories, etc., a specialty. Moisture-proof Motors and Dynamos for use in Mines and damp places.

MILLIKEN PATENT

ELECTRIC RAILWAY POLE.

Manufactured by

MILLIKEN & CO.,

No. 55 Liberty St. New York. | No. 59 Dearborn St. Chicago.

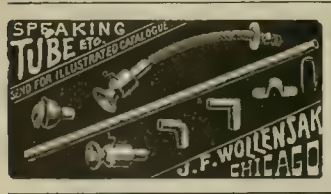
ADOPTED BY

New York, Jersey City, Paterson, Buffalo, Pittsburgh, Hamilton, O., and many others.

Recommended by best Engineers.

Over 6000 Ordered in Last 6 Months.

Western Department, 59 Dearborn Street.



Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.

— WE MAKE —

Electric Supplies Under Contract.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

OKONITE TRADE MARK

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.

Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,

MANUFACTURING ELECTRICIAN,

Office, 63 Broadway, New York.

Factory, 118-120 Park Avenue, Brooklyn, N. Y.

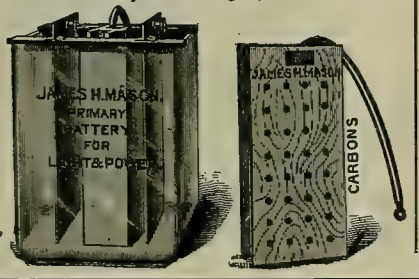
COMPLETE PLANTS FOR SMALL STORES.

Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



BERNSTEIN ELECTRIC CO.

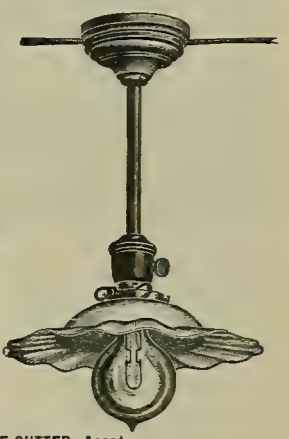
INCANDESCENT LAMPS

—FOR—

ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

CHICAGO OFFICE. 190 Fifth Ave., GEORGE CUTTER, Agent.

BARNES' NEW SENSITIVE DRILL

Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

DICTIONARY

—OF—

ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

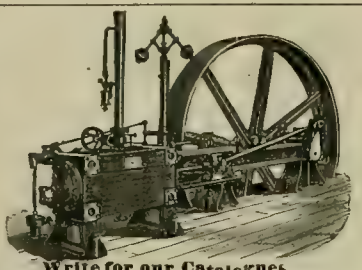
ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



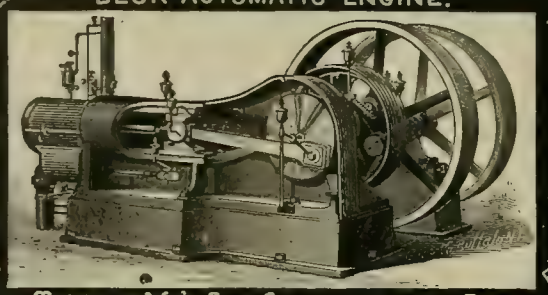
Write for our Catalogues

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.
ECONOMY UNEXCELLED
REGULATIONS PERFECT
HOT BEARINGS UNKNOWN
PRICES MODERATE

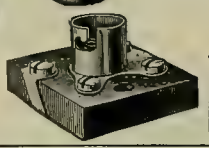


TAYLOR MFG CO. CHAMBERSBURG, PA.
COMPLETE STEAM PLANTS A SPECIALTY

E-D-I S-O-N
Miniature Incandescent
ELECTRIC LAMPS.

1-2 to 36 Candle Power.
For use with Batteries or Dynamos.
3 to 40 Volts.

We will Send Free, Catalogue E,
Which shows prices of, and experiments with Edison Lamps, and gives directions



How to Make a Cheap Battery,
And how to operate them. Any intelligent boy can operate these batteries and lamps.

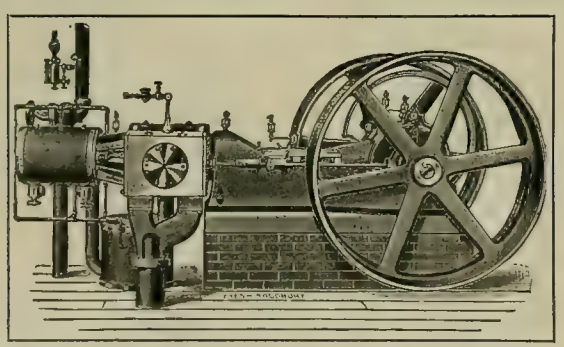
EDISON LAMP COMPANY, Harrison, N. J.

Chicago Electric Club

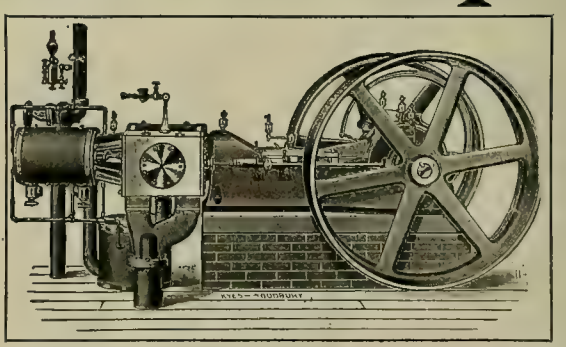
Will hold its next regular meeting at the Club Rooms, Monday Night, November 17.

ARMATURES COMMUTATORS
TRUED OR RENEWED
REPAIRED and REWOUND
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

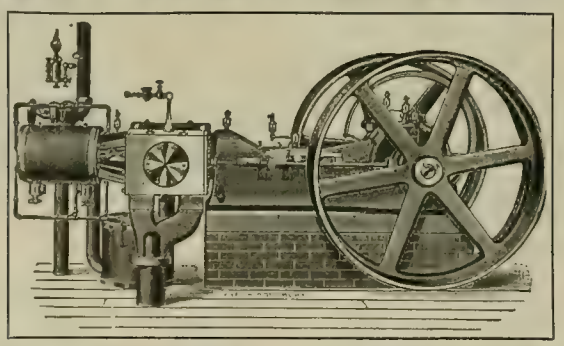
None so Good, None to Equal.



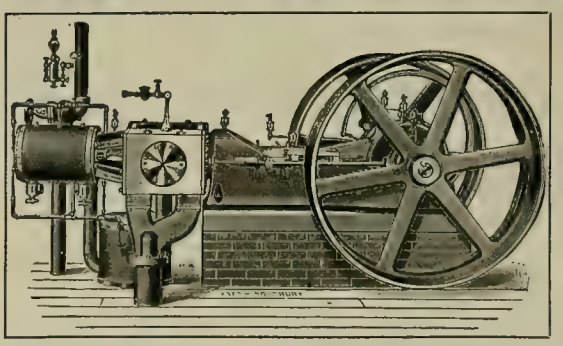
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



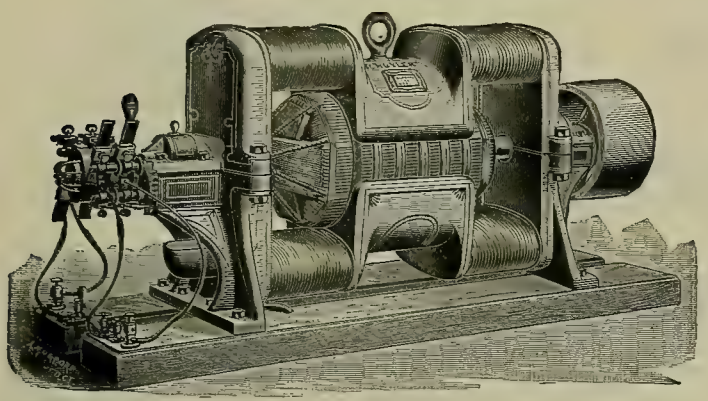
WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. **Compound and Valveless.**

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

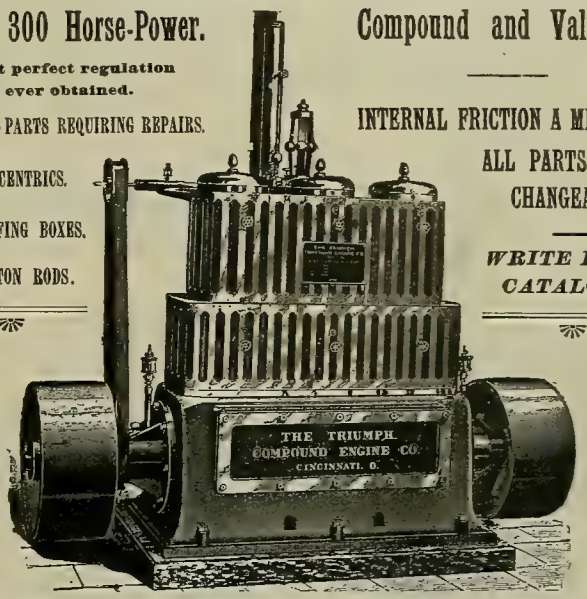
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

Trade Mark Registered.

For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

The LECLANCHE BATTERY CO., NEW YORK.

THE

THOMSON-HOUSTON ELECTRIC CO.'S

RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

Companies desiring Centre Pole Construction should see the Indianapolis Plant, illustrated below. Also Washington, D. C., Rochester and Brooklyn, N. Y.

Citizens' Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

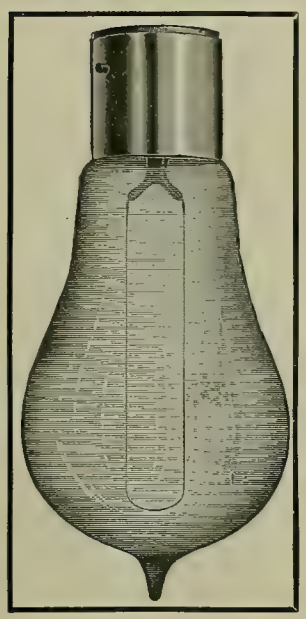
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 408 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

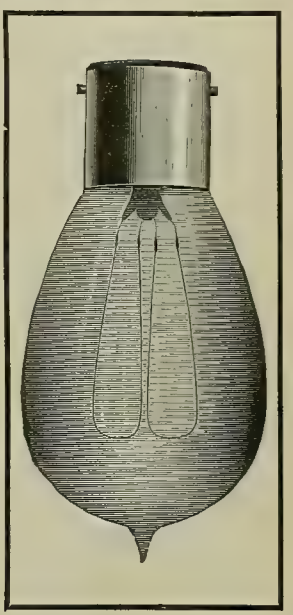
—— THE ——

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

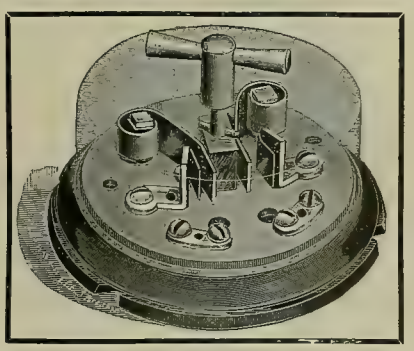
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

—— WE CALL SPECIAL ATTENTION TO ——

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

— FOR —

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.

"Would say that we have between twelve and fourteen miles of two and three braid Shield Brand in use here, running through trees, and bad ones at that, and it has given perfect satisfaction thus far, after being in use two years."

W. A. RICHMOND, Supt. Electrical Dept.,
CONCORD GAS LIGHT CO., CONCORD, N. H.

"Answering your inquiry about the sample of Shield Brand No. 4, I handed you last summer, the circuit from which the sample was taken had been up nearly a year, including a severe winter. The current on same varied from 3 to 18 amperes; the pressure 2,100 volts, constant potential. In my opinion the wire showed up well, and the insulation was worth the higher price paid for it."

ALEX. DOW, Expert Electrician,
BRUSH ELECTRIC CO.

"Shield Brand has given us entire satisfaction wherever used, and is, in our opinion, one of the best Water-Proof Wires on the market at present."

GEO. A. MAYO, Electrical Engineer,
Rockford Elect. Mfg. Co.

"It is a first-class Moisture-Proof Wire, and I would have no hesitation in using it for the most trying overhead circuits."

CARL KAMMEYER, Superintendent,
National Elect. Mfg. Co.

LARGE STOCK OF ALL SIZES CONSTANTLY ON HAND.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTIING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.

WOOD ARC DYNAMO.

MAIN OFFICE:

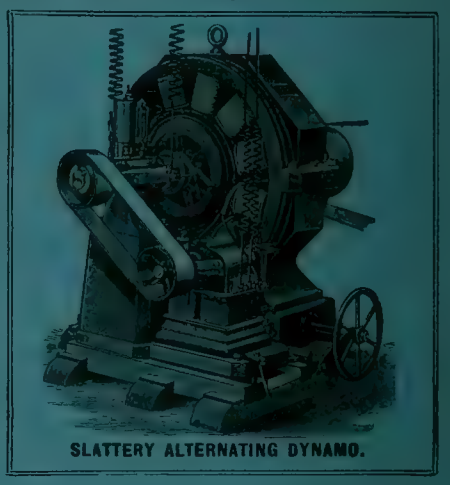
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

PHŒNIX GLASS CO

OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES **SHADES**

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, NOVEMBER 22, 1890. No. 21

"AJAX SWITCHES"

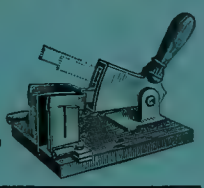
In all Sizes, for any Potential, Single, Double and Treble Pole

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,

74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE.

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. { PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin'

ELECTRIC RAILWAYS? If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4⅞-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,

By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.* Concealed Wiring in all Locations

Aerial Use, Subterranean Use, Submarine Use.

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, { 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

ELECTRIC MERCHANDISE CO.

Standard Devices for all Systems.

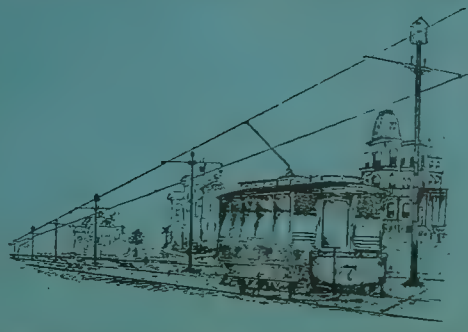
11 Adams St., CHICAGO.

CATALOGUES FURNISHED.

W. R. MASON, General Manager.

ELECTRIC RAILWAY SUPPLIES

MILLIKEN PATENT ELECTRIC RAILWAY POLE.



Manufactured by

MILLIKEN & CO.,

No. 55 Liberty St., New York. | No. 59 Dearborn St., Chicago.

ADOPTED BY

New York, Jersey City, Paterson, Buffalo, Pittsburgh, Hamilton, O., and many others.

Recommended by best Engineers.

Over 6000 Ordered in Last 6 Months.

Western Department, 59 Dearborn Street.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave., Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.

THE ONWARD MARCH!

Some Facts in Electric Lighting.

No. of Companies using Thomson-Houston Arc Apparatus, Jan. 1, '90	516	
No. of Companies using Thomson-Houston Arc Apparatus, July 1, '90	587	
Increase 6 months, ending July 1, '90		71
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, Jan. 1, '90	68,203	
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, July 1, '90	79,387	
Increase 6 months, ending July 1, '90		11,184
No. of Co.'s using Thomson-Houston Incandescent Apparatus, Jan. 1, '90	337	
No. of Co.'s using Thomson-Houston Incandescent Apparatus, July 1, '90	436	
Increase 6 months, ending July 1, '90		99
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, Jan. 1, '90	281,555	
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, July 1, '90	408,515	
Increase 6 months, ending July 1, '90		126,960

There are also in the United States Isolated Plants using in the aggregate
20,000 Thomson-Houston Arc Lamps,
and over 100,000 Thomson-Houston Incandescent Lamps.

ELECTRIC RAILWAYS.

Roads in Operation, July 1, 1890	80
Number of Motor Cars	1,069
Roads under Construction, July 1, 1890	43
Number of Motor Cars	408

Grand Total.

Number of Roads 123 Number of Motor Cars 1,477
Total Length of Track (in miles) 897

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co. xxviii
Abendroth & Root Mfg. Co. .. —
Alexander, Barney & Chapin. ix, xii
Allis, E. P. & Co. xxii
American Electrical Works. . xv
Ansonia Brass & Copper Co. . i
Automatic Switch Co. vii
Baggot, E. xvi
Bain, Foree. xvi
Ball Engine Co. xii
Barnes, W. F. & Jno. xxi
Barton, Geo. P. ..... —
Baxter Electric Motor Co. xxviii
Bernstein Electric Co. ..... —
Bleckert & Nelson. xvii
Brown, Frank T. xvi
Brush Electric Co. xxvii
Bubier Publishing Co. iv
Bunnell & Co., J. H. ..... —
Butler Hard Rubber Co. xx
C. B. & Q. R. R. xvi
C. & C. Electric Motor Co. ... ix
C. & N. W. R. R. Co. xvi
Central Electric Co. xi
Chicago Electric Club. xxii
Cleverly Electrical Works. ... iv
C. M. & St. P. R. R. Co. ..... —
Colburn & Co., I. W. xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co. ..... —
Consolidated Electric Storage Co. ..... —
Continental Dynamo Co. iv
Cowles Electric Smelting and Aluminum Co. xvi
Crocker-Wheeler Motor Co. ... xv
Crosby Electric Co. iv
Curtis Regulator Co. ..... —
Day's Kerite Insulation. i
Dayton Globe Iron Works Co. xviii
Eastern Electric Cable Co. xv
Eddy, Henry C. xvi
Edison Mfg. Co. xxi
Edison General Electric Co.,— Lighting Dept. viii
Edison General Electric Co.,— Lamp Dept. ..... —
Electric Construction & Sup. Co iv
Electric Merchandise Co. i
Electrician Publishing Comp'y xvi
Electrical Supply Co. xxvi
Elektron Mfg. Co. xix
Empire City Electric Co. xviii
Empire China Works. xvi
English, Morse & Co. xvii
Eureka Tempered Copper Co. . xvii
Evans Friction Cone Co. xix
Fibrone Mfg. Co. xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works. xx
Fort Wayne Electric Co. xxviii
Globe Carbon Co. xviii
Great Western Electric Sup. Co. v
Greeley & Co., E. S. xiv
Harmount, G. A. vii
Hawkeye Electric Mfg. Co. .... —
Hazelton Tripod Boiler Co. ... xvi
Heisler Electric Light Co. ..... —
Hill Clutch Works. xx
Holmes, Booth & Haydens. xvii
Holmes & Co., C. H. xvii
Holtzer-Cabot Electric Co. i
Humphrey, H. H. xiv
Ide, A. L. & Son. xv
Illinois Electric Material Co. ... xiv
India Rubber & Gutta Percha Insulating Co. i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L. ..... —
Jewell Belting Co. xv
Jones Bros. Electric Co. xxii
Knapp Electrical Works. xxv
Laminar Fibre Goods Co. xvii
Law Telephone Co. xv
Leclanche Battery Co. xxiii
McLaughlin, James. xvi
Magnolia Anti-Friction Metal Co i
Mason, James H. xxi
Milliken & Co. i
Monitor Electric Co. vii
Munsell & Co., Eug. xv
Munson Belting Co., Chas. xiv
National Carbon Co. iv
National Electric Mfg. Co. x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T. xxii
N. Y. Belting & Packing Co. ... —
Okonite Co. xv
Ostrander & Co., W. R. xviii
Page Belting Co. ..... —
Paiste, H. T. xiv
Peckham Street-Car Wheel & Axle Co. vii
Partrick & Carter xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co. ..... —
Pond Engineering Co. xxi
Powell Co., Wm. ..... —
Pumpelly Storage Battery Co. xviii
Queen & Co. xv
Roeblings' Sons Co., Jno. A. ... xix
Sawyer-Man Electric Co. xiii
Schieren & Co., Chas. A. xiv
Schmiedbarenguss Furnace Co. . xvi
Schoverling, A. xx
Schuyler Electric Co. xxiii
Shultz Belting Co. xxi
Southern Electrical Supply Co. xxi
Sperry Electric Co. xviii
Standard Electrical Works ... xvi
Standard Paint Co. xiv
Standard Underground Cable Co. i
Standard Carbon Co. xx
Stanley & Hall. xiv
Star Electrix Co. vii
Stephenson & Co., Jno. ix
Stiff, E. D. & Co. xvi
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xviii
Taussig, S. xvi
Taylor Mfg. Co. xxii
Thomson-Houston Electric Co. Lighting department. ii
Thomson-Houston Electric Co., Railway department. xxiv
Triumph Compound Engine Co xxiii
Turner Brass Works. xv
Union Hardware Co. xiv
United Electric Traction Co. ... xxiii
United States Electric Lighting Co. xiii
Van Nuis C. S. i
Wanted. ..... xiv, xv
Western Electric Co. xviii
Western Power Construction Co. xxii
Westinghouse Electric Co. xiii
Weston Electrical Instrument Co. xiv
Wollensak, J. F. iv
Woodbridge & Turner. xvii
Wrigley, Thos. xii
Writing Telegraph Co. xv

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co
Pumpelly Storage Battery & Elec Motor Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Schmiedbarenguss Furnace Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
McLaughlin, Jas.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bubier Publishing Co.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.'
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.

Belting—continued.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
McLaughlin, Jas.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
White, R. T.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways.
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electric Merchandise Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.

Lamps, Incandescent—Con td
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Elektron Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Queen & Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.
Writing Telegraph Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Stilwell & Bierce Mfg. Co.

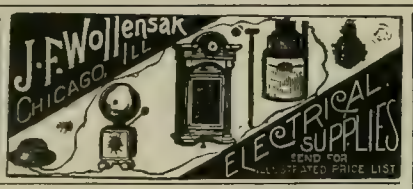
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

HAVE YOU SEEN IT?

— NEAT. — — CLEAN. —

Always Ready for Use.

Especially for Grenet Medical and Bichromate Plunge Batteries.

Box making 1-pint solution. **Price 15c.** Postpaid.

LIBERAL DISCOUNT TO THE TRADE.

BUBIER PUBLISHING CO., Lynn, Mass.

GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

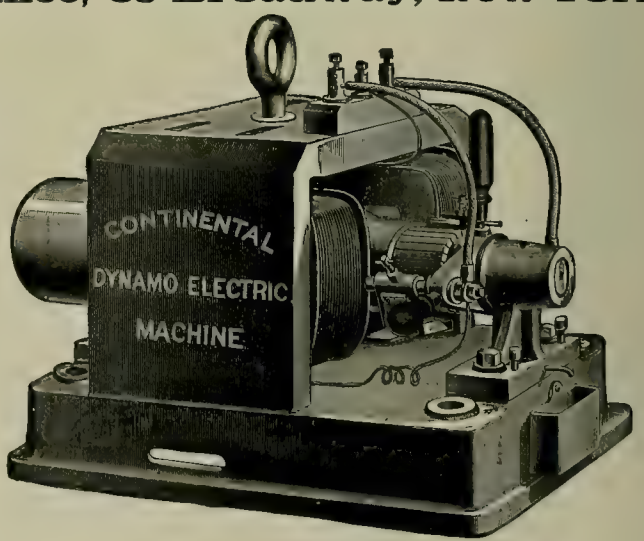
87 and 89 South Fifth Avenue, - - NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192 FIFTH AVE., CHICAGO.

Makers of the Choicest Electrical Supplies.

ELECTRIC SHADES

IN LARGE VARIETY.

OPAL SHADES,
ETCHED SHADES,
OPALESCENT SHADES,
COLORED SHADES,
AND
CUTTER'S COMBINATION TIN SHADES.

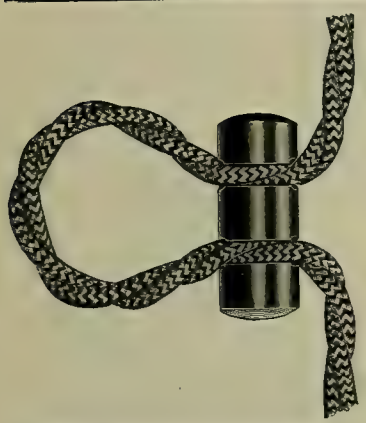
FINE LINE OF

ELECTRIC AND COMBINATION

FIXTURES

—TO SUIT—

ALL ARTISTIC TASTES.



IMPROVED LAMP-CORD ADJUSTER.

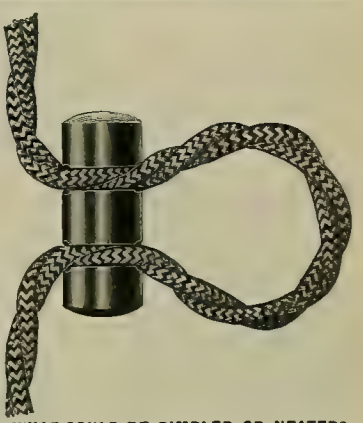
WE HAVE THE MOST RELIABLE

SAFETY DEVICES,

MAIN CUT-OUTS,
BRANCH CUT-OUTS,
WOOD ROSETTES,
HORSESHOE CUT-OUTS,
PORCELAIN ROSETTES,
FUSIBLE PLUGS.

—TRY US ON—

TESTED FUSE WIRE.



WHAT COULD BE SIMPLER OR NEATER?

The Wire that gives
The Highest Line Insulation,

SIMPLEX

The Wire that Pays Best
In the Long Run.

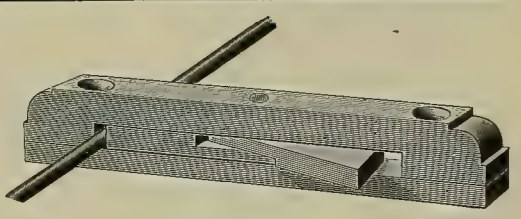
Why not use the Best?
We sell it entirely on its merits.

INSULATORS

Of All Patterns and Sizes in Quantity.

TAPE,
FIBRE,
HARD RUBBER.

GOOD FIGURES ON INSULATORS.



SELF-BINDING CLEAT.

You draw the Wires Taut,
This keeps them so.

DO YOUR CEILINGS BLACKEN?

WHY DON'T YOU USE THE ONLY PRACTICAL CURE:

Cutter's E. L. Insulator,

It keeps your ceilings clean, looks well, and gives high insulation.

INCANDESCENT
LAMP CORD,

—ALL SIZES—

COTTON OR SILK.

SOCKET BUSHINGS
—AND—
RUBBER TUBING.

ALL OF OUR

Specialties

WEAR WELL.

A SINGLE TRIAL WILL PROVE IT TO YOU.

For the Choicest Goods at the Lowest Prices, Remember Our Address.

IMMENSE STOCK!!
BOTTOM PRICES!!

Electrical Supplies

OF ALL KINDS.

NORTHWEST
THOMSON-HOUSTON
ELECTRIC CO.,

403 & 405 SIBLEY ST., - ST. PAUL.

OUR POLICY:

First Class Goods, Small Margins and Quick Delivery.

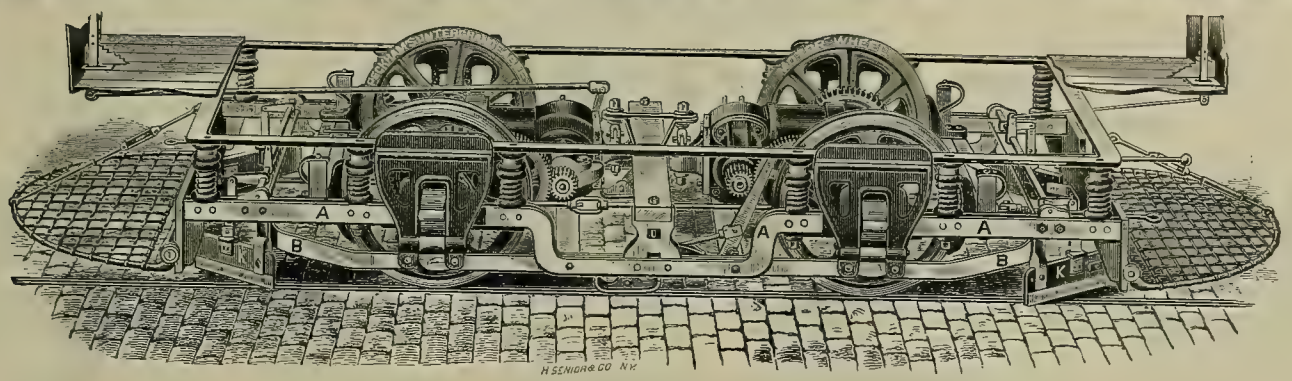
LARGE STOCK OF

Grimshaw White Core,
Holmes, Booth & Hayden's "K. K."
Underwriters' Line Wire & Magnet Wires.

FULL LINE OF PORCELAIN GOODS.

"ELECTRIC BLOCK", 403 & 405 SIBLEY STREET, ST. PAUL, MINN.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

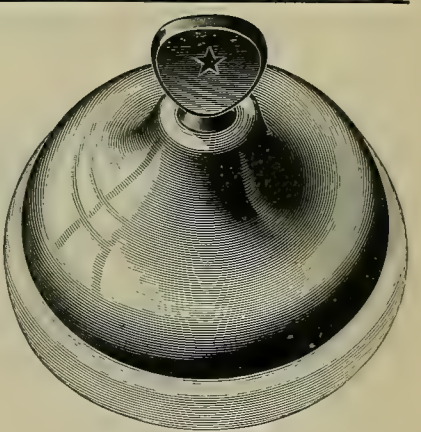
For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

ELECTRIX!

5 Amp. S. P. Switch.

"Nothing Succeeds like Success," and judging from the way orders come piling in for the ELECTRIX Switches, and other specialties, success expresses it but mildly. We are away behind on orders now, but have doubled our capacity in the past week and will catch up soon.—Ask your Dealer for our goods or write to us.



10 Amp. S. P. Switch.

STAR ELECTRIX CO., 1320 WALLACE ST., PHILADELPIA, PA.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,
BALTIMORE, MD., U. S. A.
Sole Manufacturers of the
WHITTINGHAM
AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

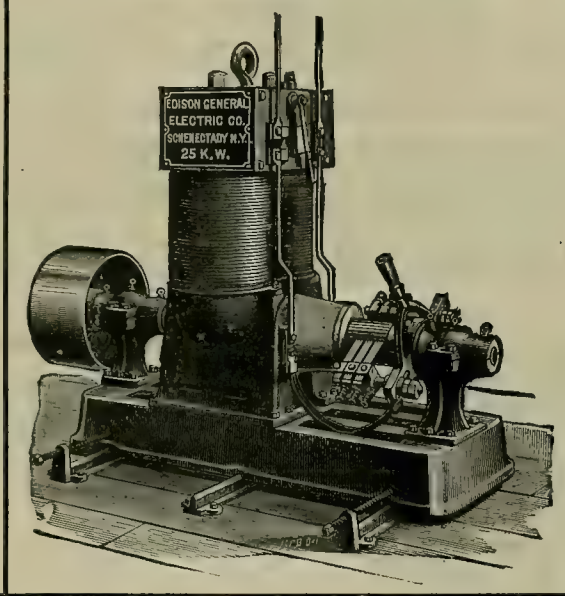
Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

EDISON ELECTRIC MOTORS.

NOTICE.

REDUCTION IN PRICES!



H. P.	LIST PRICE.	PRICE TO PURCHASER.
		45 per cent. off list price.
¼	$ 68.79 (no rheostat.)	$ 37.84
½	106.85 (no rheostat.)	58.76
1	194.23 (including rheostat.)	106.83
2½	321.85 " "	177.02
5	506.85 " "	278.77

SUBJECT TO CHANGE WITHOUT NOTICE.

Prices of larger sizes of motors furnished on application.

Write for Circulars and Quotations to Nearest District Office, or any Electrical Supply House.

EDISON GENERAL ELECTRIC COMPANY.

MAIN DISTRICT OFFICES:

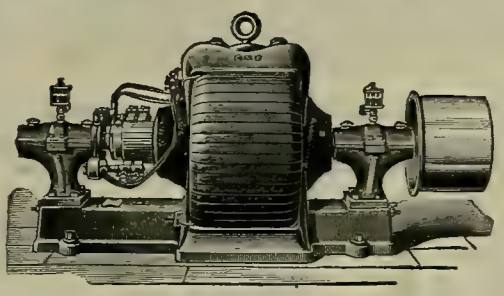
Canadian District, Bank of Commerce Bldg, Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad Street, New York.
New England District, 38 Pearl Street, Boston, Mass.
Pacific Coast District, 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg, Portland, Ore.
Rocky Mountain District. Masonic Building, Denver, Colo.
Southern District, Cotton Exchange Bldg, New Orleans, La.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

NEW YORK.

STREET CARS

FOR

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.

THE PRODUCTS OF THE

FIBRONE MANUFACTURING CO.,

For Electrical Purposes,

MADE OUT OF

Plasticon, Fibrone,

AS WELL AS

Alexite and Herculite

WILL HEREAFTER BE SOLD SOLELY BY

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING,

20 Cortlandt St., New York.

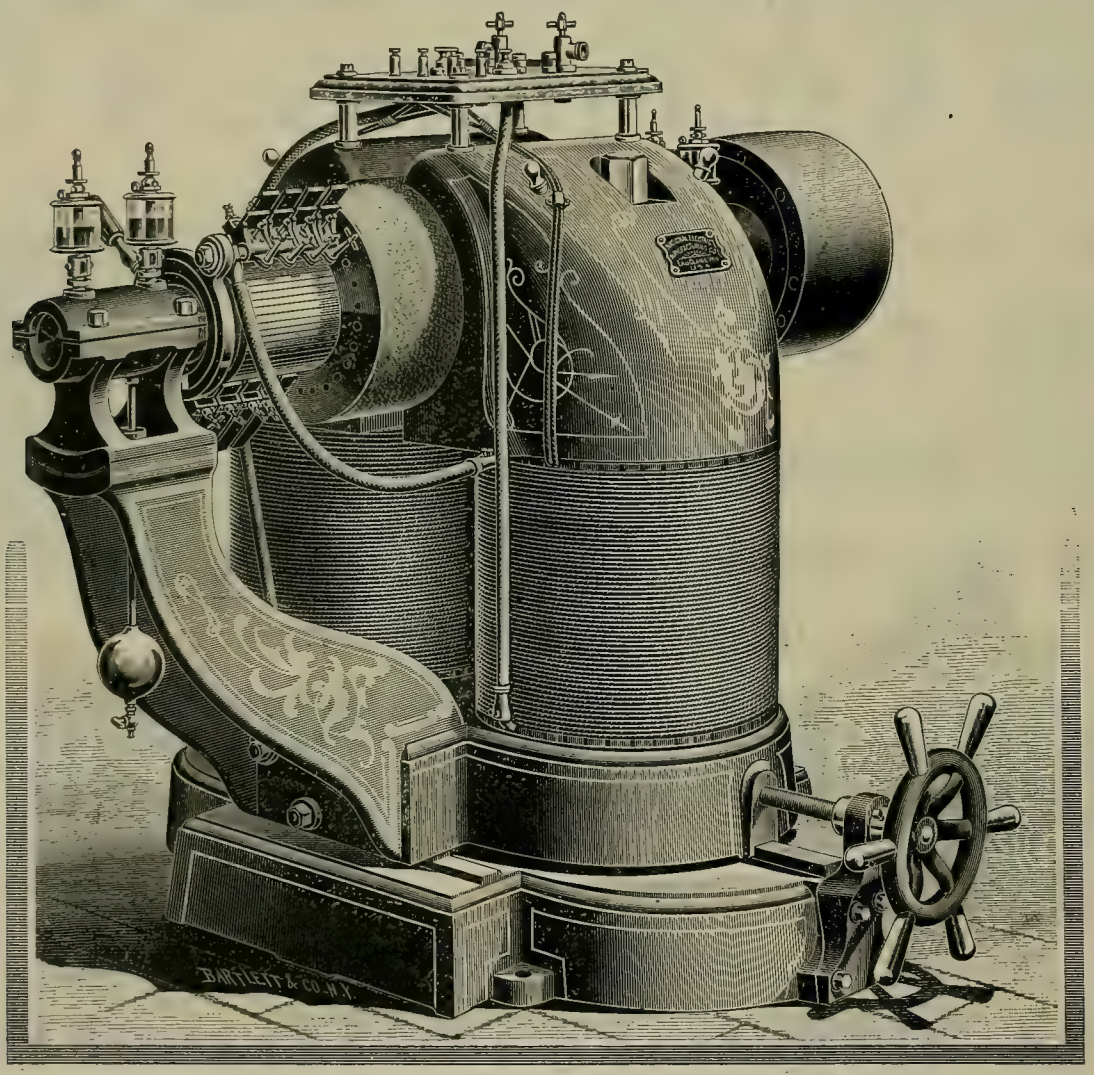
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMO—CAPACITY 500-16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Ag'ts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.

CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building. St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

Do You Know Why It Is That the "A. B. C." Incandescent LAMP Is Superior to Others? A Trial Will Show You the Reason. We Can Prove It.

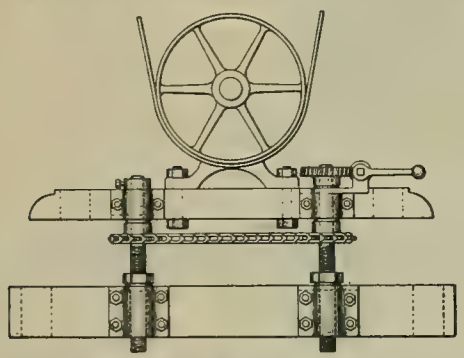
TRADE A.B.C. MARK

ALEXANDER, BARNEY & CHAPIN,

GENERAL ELECTRICAL SUPPLIES,

TELEPHONE BUILDING,
20 Cortlandt Street,
NEW YORK.

VERTICALLY-ADJUSTABLE DYNAMO SUPPORT.

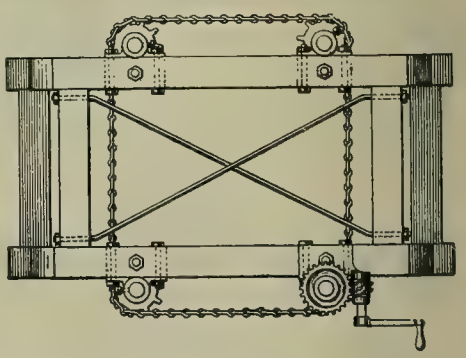


Patented August 12, 1890. For full description see article in WESTERN ELECTRICIAN of September 20, 1890, or Patent Specifications 434,011.

The Best and Cheapest Adjustable Support

In Stations where Dynamos must be placed either above or below the power. In use exclusively in the Chicago City Lighting Stations. Will license users to manufacture the apparatus on royalty, or will sell the patent outright.

CORRESPONDENCE INVITED.

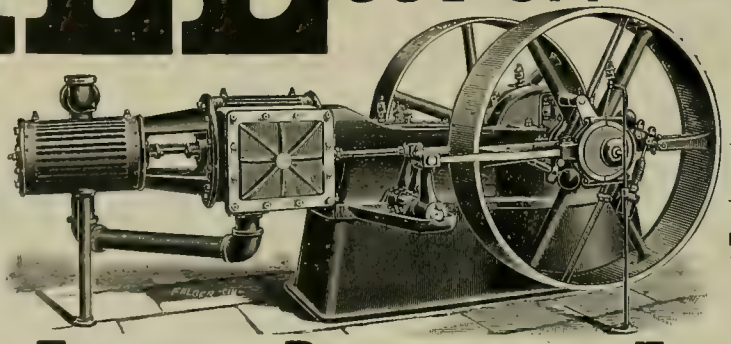


Manufactured and for Sale by

THOMAS WRIGLEY, 85 Fifth Avenue, CHICAGO.

BALL AUTOMATIC CUT OFF ENGINE

Standard.
Cross Compound.
Triple Expansion.
Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER.
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Building, CHICAGO, ILL

WILLIAM T. BONNER,
618 New York Life Insurance Building,
OMAHA, NEB.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

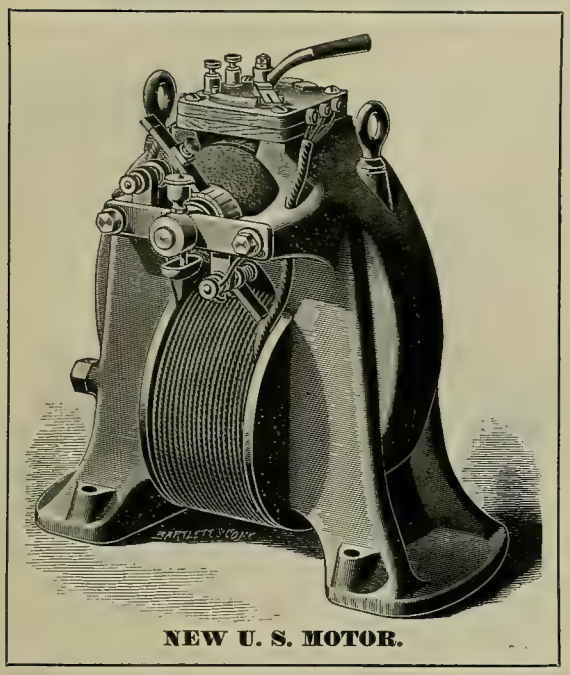
The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

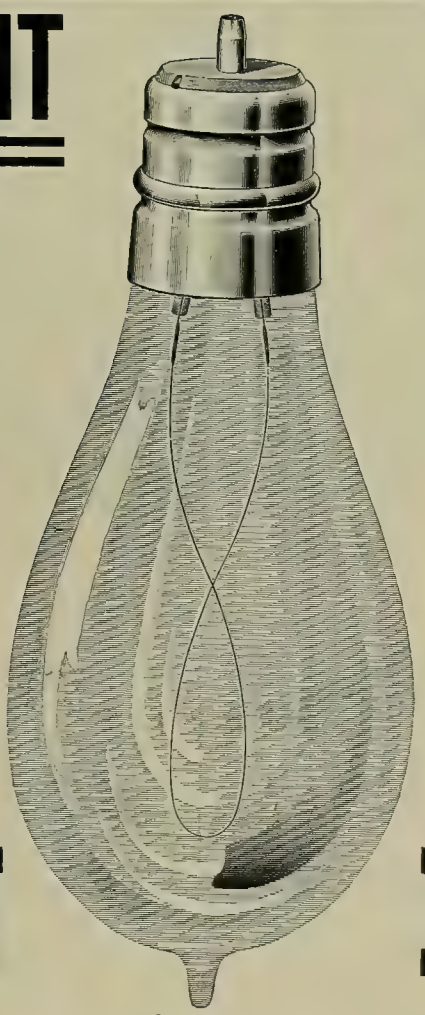
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.

INCANDESCENT LAMPS.



To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS

THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, NEW YORK.

620 Atlantic Avenue, BOSTON, MASS.

217 La Salle Street, CHICAGO, ILL.

INCANDESCENT and ARC LIGHTING and MOTORS.
Isolated Lighting a Specialty.
H. H. HUMPHREY,
1034 New York Life Building.
Contracting and Consulting Electrical Engineer. OMAHA, NEB.

WATERHOUSE ARC APPARATUS
FOR SALE OR EXCHANGE.
Complete Outfit. - Rare Opportunity.
ADDRESS,
NEWARK ELECTRIC LIGHT and POWER CO.,
Newark, N. J.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,
PATENTEES AND SOLE MANUFACTURERS,
Also New York, Boston, Philadelphia.
46 SOUTH CANAL ST., CHICAGO. ILL

THE E. S. GREELEY & CO.,
GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.
ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.
Illustrated Circular of Lamps and Lamp Novelties upon Application.
MINIATURE INCANDESCENT LAMPS.

THE WESTON STANDARD
Voltmeters and Ammeters.
These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.
Send for Illustrated Catalogue.
ADDRESS
WESTON ELECTRICAL INSTRUMENT CO.,
114 & 116 William Street, Newark, N. J.

DUST-PROOF BELLS.
None Genuine Without the Washer.
STANLEY & HALL,
(Formerly HAZAZER & STANLEY,)
32 and 34 Frankfort St.,
NEW YORK.

THE THING for Electric Railways. **"CANVAS JACKET"** FEEDER WIRES.
INDESTRUCTIBLE PATENT WOVEN INSULATION.

POLES. POLES.
ELECTRIC LIGHT SUPPLIES ELECTRIC RAILWAY.
Send for descriptive circulars,

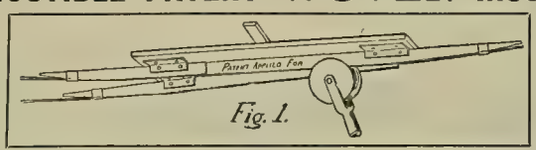


Fig. 1.

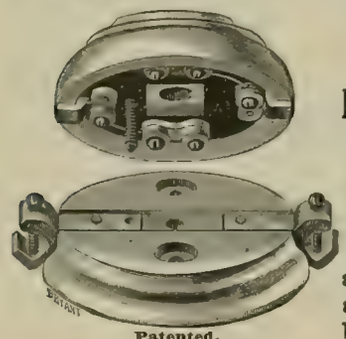
MURRAY OVERHEAD TROLLEY SWITCH.
CUSTOMERS REPORT:
"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."
THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE **INTERIOR CONDUIT & INSULATION CO.**
ARE ESPECIALLY APPLICABLE TO
ELECTRIC RAILWAY REQUIREMENTS.
A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.
INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.
UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.
For Catalogue, Price List and General Information, Address
INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.
Edw. H. Johnson, President.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.
Charles Munson Belting Co
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.
TRADE MARK.
PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.
28,30,32,34 & 36. S. CANAL ST.
Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.


Patented.

DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.
A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.
H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.
Kept in Stock and for Sale by all Prominent Supply Houses.

GET THE BEST!
P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY
The Standard Paint Co.,
NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, NOVEMBER 22, 1890. No. 21

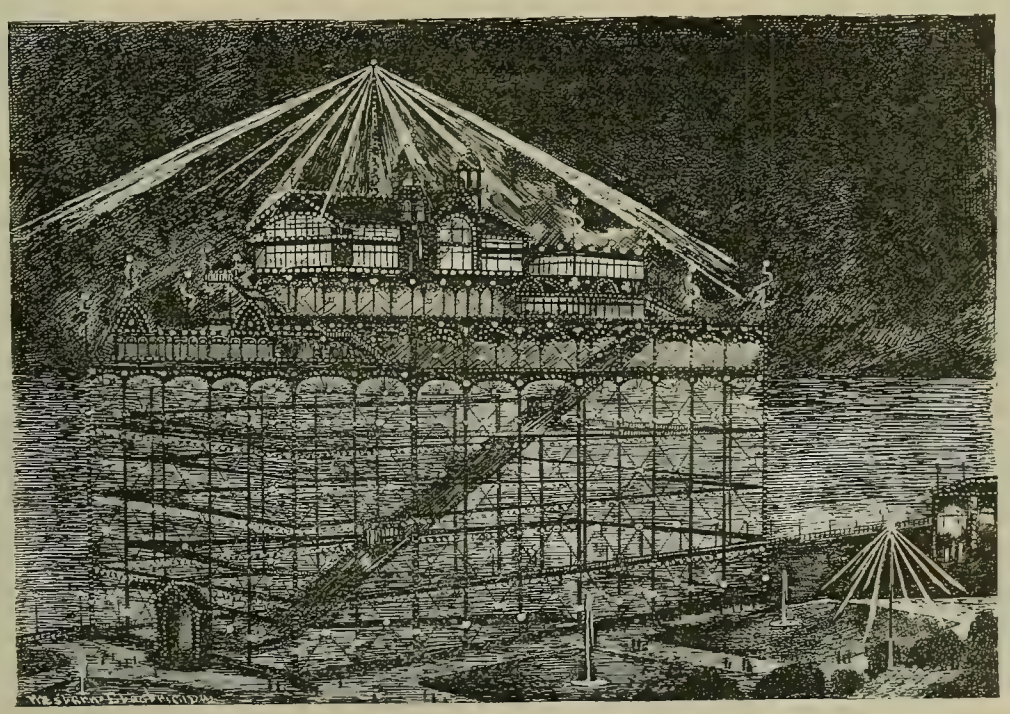
The Columbian Belvedere.

The inventive genius of American architects has been engaged during the last year in the formation of plans and designs for novel features in connection with the Columbian Exposition at Chicago in 1893. Many unique and attractive enterprises have been prepared. Probably the most elaborate project contemplated in this line is the erection of an immense steel edifice, a view of which is shown in the accompanying illustration. It is expected this structure will occupy the same relation to the World's Fair of 1893 as the Eiffel tower to the Paris Exposition, for while no attempt will be made to imitate the French engineer's plans, the structure now under consideration will be more than a huge tower. It will combine many novel features, and as it will be located in a prominent position on the Lake Front, it promises to be one of the chief attractions at the Columbian Exposition. The observatory on the top of the structure will be about 500 feet high and will command an excellent view of the city. Passengers will be carried to the top of this observatory in electric cars and elevators operated by electricity will be provided. There will also be a winding carriage drive, forming a boulevard three miles in length and thirty-five feet wide. The boulevard, electric railways and elevators will all command an excellent view of the spacious court in the center of the structure which will be arranged with all the skill of the landscape gardener. Flower beds, shrubbery and shady walks in this inclosure will add much to the attractiveness of the place. Again at the top there will be a boulevard "so wide," as the projectors describe it, "that there can be no crowding of carriages, pedestrians or loungers." There will be plenty of room for all. One of the great annoyances at the Eiffel tower was the failure of the management to provide ample facilities for transportation, visitors being obliged to wait for hours before ascending the tower. Music in an elaborately arranged and spacious concert hall will be one of the chief attractions. The restaurant feature of the project will be something unique as well as complete. There will be three of these restaurants in one end of the top building. One will be conducted on the German plan, one on the French plan, and one on the American plan; that is, at each one of these restaurants a certain style of cooking will prevail.

Electricity will play an important part in this immense undertaking. In addition to the inclined railroad and the elevator operated by electric motors there will be many other novel electric features. As will be seen from the sketch of the building electric lights will be profusely distributed and used for decorative effects as well as illuminating the spacious halls. The boulevards will be brilliantly lighted by arc lamps at night, also the grounds in the court and about the building; there will be an electric fountain and many novelties.

Preliminary steps have been taken toward the formation of a stock company to construct the building and already, it is said, over a million dollars have been pledged to the enterprise. Many prominent capitalists are interested, including some of the directors of the exposition.

The structure was designed by A. Cudell and the plans were prepared by him. A. Gottlieb, consulting engineer of the exposition, will probably have charge of the work.



THE COLUMBIAN BELVEDERE.

Electricity on Warships.

Commodore George Dewey, chief of the Bureau of Equipments of the United States Navy, in his annual report to Secretary Tracy, makes the following comment on the introduction of electricity in the naval service: "The lighting of ships of war by electricity, which was inaugurated by this government, has now become so essential that no warship is considered complete which is not so lighted. Special attention has been given during the year to the subject of means of interior communication on shipboard, and a telephone system is soon to be added experimentally to other devices in use on board one of the new cruisers. Night signaling by electricity has also been and is still actively under consideration. A most notable feature in connection with the extensive telegraphic time service, which has become an established and apparently an indispensable commercial factor centering at the Naval Observatory, has been a concerted attack upon the prevalent system by a large number of observatories located throughout the United States, the object being to break up the system in order that time, which is now furnished without cost from the Naval Observatory, may be distributed and charged for at these minor observatories as a means of contributing to their maintenance."

Electric Lighting in Australia.

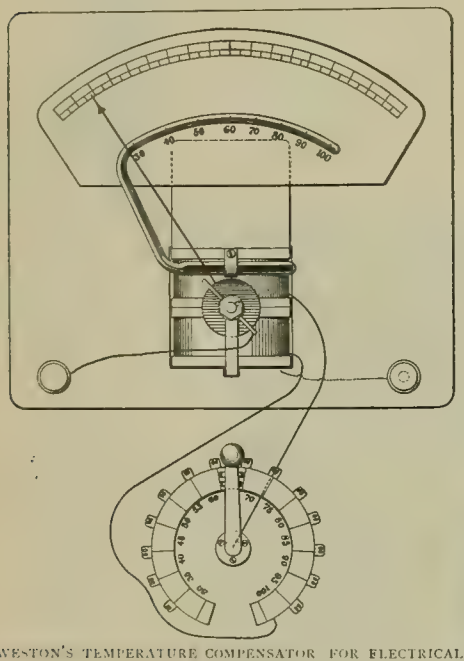
A handsomely appointed station is now in course of construction at Melbourne, Australia, for the New Australian Electric company. It will be the best equipped station in the country, it is claimed. At present only a portion of the station has been erected. When completed, it will consist of four machine and engine rooms, each 160 feet long by 62 feet wide, and containing engines of 12,000-horse power, and dynamos capable of supplying 200,000 10 c.p. lamps. Steam will be supplied from three rows of boilers. The smoke will be carried off by three stacks, each 180 feet high, and 10 feet diameter inside at the top. There are three engines in position at present. Each engine gives 330 effective horse power, when used non-condensing. Steam is supplied from two Babcock & Wilcox boilers, each of 250 net horse power, but capable of supplying all steam required for the three engines. Oil is obtained from three tanks, small pumps being placed in convenient positions, and sight feed lubricators are supplied on all the principal bearings which are of exceptionally large size. Driven by means of twelve cotton ropes from each engine are the 4,000 light alternators. These machines weigh 11 tons each. The field magnets are excited by means of three continuous current dynamos, driven by means of cotton ropes from pulleys fixed on the shafts of the alternators.

All the machines are fitted on sliding rail beds with screws to enable them to be moved back to take up slack in the ropes without stopping the engines. In addition to the machinery mentioned, foundations have been prepared for the reception of two horizontal engines, each of 130-horse power, with grooved flywheels for rope gearing. Each shaft will drive an alternator for 1,000 10-candle power lamps, and two Thomson-Houston dynamos, each for 30 arc lamps of 1,200-candle power.

Weston's Temperature Compensator for Electrical Measuring Instruments.

If the coils in electric measuring instruments, as ordinarly constructed, are made of copper wire, the variations in the resistance which they offer due to changes in temperature may be considerable. For instance, the resistance of copper increases at the rate of about two-tenths of one per cent. for every degree Fahrenheit in temperature. If, therefore, an elevation of five degrees in temperature occurs, the resistance of the coil will be raised about one per cent. Bearing this fact in mind the advantage obtained by the use of Mr. Weston's device will be appreciated. The essential parts of the regulator are a thermometer and a variable series of resistances as shown in the illustration. In order that changes in temperature may be readily observed, the thermometer, which is provided with an elongated bulb, is curved and fastened, as represented, against the exterior of the coil in the instrument. The bulb is held firmly in place by a small clamp or strap. The thermometer-tube is bent, as shown and arranged upon the scale plate parallel to the scale markings. By means of this thermometer the temperature of the coil is shown upon the same scale-plate as the regular indications of the instrument.

The series of the variable resistances is inter-



WESTON'S TEMPERATURE COMPENSATOR FOR ELECTRICAL MEASURING INSTRUMENTS.

posed as represented in the diagram, in the circuit of the coil of the instrument. The contact-plates of the resistance coils are marked to correspond to the thermometer-scale. Thus one contact-plate is marked "30" to correspond to the 30-degree mark of the thermometer, and another is marked "40" to correspond with the 40-degree mark, and so on. When the arm is placed on the first contact-plate to the left it will be evident that the current in the instrument then passes through all resistances. The operation of the regulator will now be easily understood.

Let it be supposed, for illustration, that at the start the arm is on the first contact-plate to the left. Now, suppose the heat of the coil augments so that the thermometer shows a temperature of 65 degrees. This means an increase of resistance in the coil due to the 65 degrees difference in temperature. In order to compensate for this the switch arm is moved around until its contact-spring rests as shown in the cut, on the plate marked 65 degrees. Seven resistances will thus be thrown out of the circuit, and as each resistance corresponds to the increase of resistance in the coil due to the elevation of 5 degrees of temperature, it follows that by throwing out seven of these resistances, we have exactly compensated for the increased resistance of the coil due to its augmented heat. In practical operation, therefore, it is simply necessary to note the indication of the thermometer and place the arm on the contact-plate mark correspondingly to that indication, in order to keep the resistance of the circuit in the instrument uniform. It will be understood, of course, that the scale of temperatures here given is purely arbitrary, and that the number of contact-plates may be increased or diminished in number as desired, to correspond, for example, to every 10 degrees change, or for one or even for a fraction of a degree of change.

Combination Fire Alarm and Call Bell.

The accompanying cuts illustrate a device combining a fire alarm and call bell for use in residences, apartment houses and hotels. In Fig. 1 the complete device is shown. When the

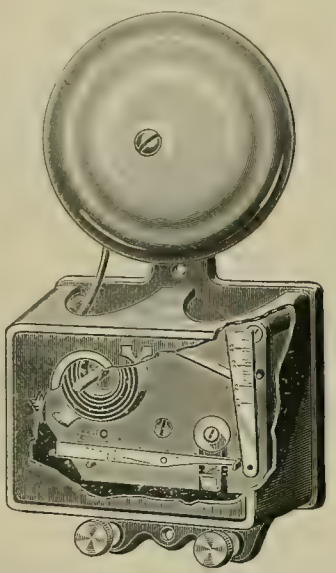


FIG. 1.

FIG. 2.

FIG. 3.

COMBINATION FIRE-ALARM AND CALL BELL.

temperature in the room rises above that indicated on the scale the alarm is sounded and continues until the circuit is opened. The device is very sensitive. The working of the mechanism is shown by the dotted lines. The clock alarm mechanism is back of the thermostat, and can be readily wound up. The call bell attachment can be introduced in connection with this device. Fig. 2 represents a closed circuit thermostat, and Fig. 3 shows an open circuit thermostat. The devices are manufactured by the J. W. Day Hardware Manufacturing company, Chicago.

Electric Transmission of Power at Red Cliff, Colo.

About twenty-five miles beyond Leadville, following the line of the Denver & Rio Grande railway, is the Eagle River Canon. At the very heart of the canon is Red Cliff, the principal station and county seat of Eagle county. At this place, the sides of the canon are very straight, and in many places almost perpendicular. Above Red Cliff, about 2,000 feet, is the town of Gilman, on the mountain tops, among the clouds, at an altitude of about 11,000 feet above the sea level. Here, perched on the sides of the sheer cliff, are several of the richest mines of gold and silver in Colorado.

Directly opposite Gilman, on the other side of the great canon is a mountain stream, called Fall River, which, rising in the mountains of the Holy Cross, comes roaring down the rocks and enters the Eagle River at the bottom of the canon.

The Fall River Electric company was organized to utilize this natural power, with a view of supplying the mines with power and light. The

ELECTRIC TRANSMISSION OF POWER AT RED CLIFF, COLO.

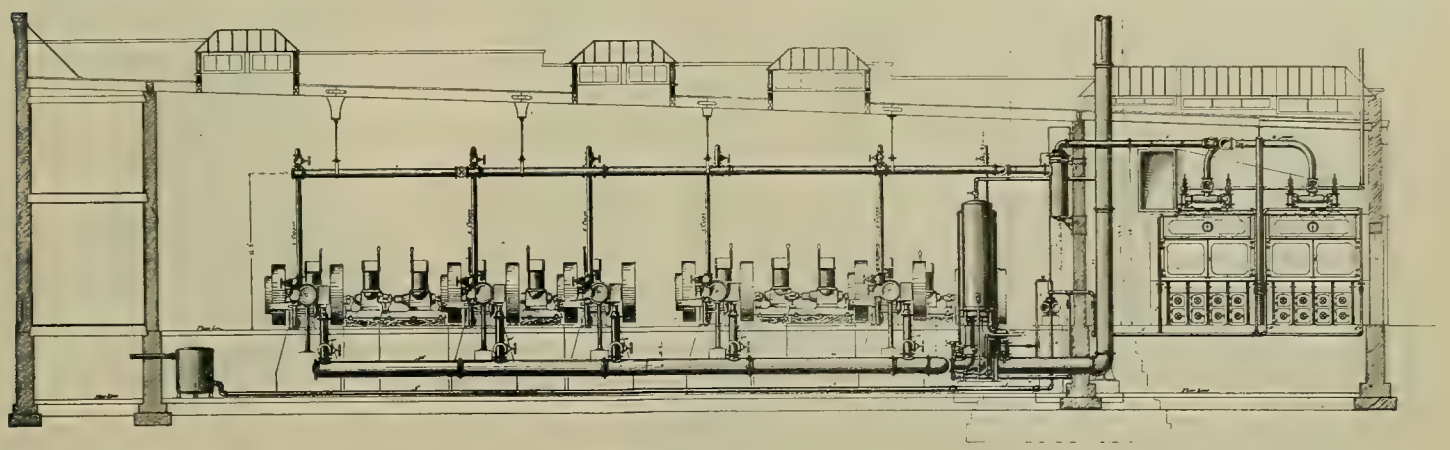
accompanying cut shows the pipe-line which brings the water into the rocky canon. The fall of the water is equivalent to 500 feet perpendicular, and it strikes with enormous force the buckets of the water-wheel as shown in the view.

The wheel drives the electric generators from which the electric current is conducted to the

The annual convention of the Ohio State Tramway association was held at Columbus, O., Nov. 19. A report of the meeting will be published in the next issue of the WESTERN ELECTRICIAN.

mines, up the steep sides of the rocky cliff. The power thus transmitted is used in the mines for hoisting, pumping water, running concentrators, and for furnishing light. This method of transmitting power is found to be much more economical than the use of steam. The cost of conveying coal up the side of the mountain on the backs of mules, makes the use of steam expensive.

It is also difficult frequently to secure water to be converted into steam in mines. By the use of electric motors the difficulty attending the use of fuel and water is done away with, and the cost of power is considerably reduced. The Hawkeye Electric Manufacturing company of Davenport, Ia., furnished the generators and electric motors.



CHICAGO EDISON COMPANY'S NEW STATION.

Chicago Edison Company's New Station.

The Chicago Edison company has erected a new station to supply incandescent lights in the aristocratic district on the South Side of Chicago. The new station is on Wabash avenue, near Twenty-seventh street, and will be known as Edison station, number 2. The building is constructed of brick, with an ornamental front, two stories high, and practically fire-proof throughout. It is 147 feet deep and 70 feet wide. In front are the offices, those of the superintendent and cashier being on the ground floor. The supply department is also on this floor. The meter room is on the floor above. There is also a large room on the second floor which will be fitted up for employes, where they will find all the electrical publications and practical works on electrical engineering. It is the intention of the company to afford its employes every opportunity to secure information that will prove valuable to them in their work.

The dynamo, engine and boiler rooms are in the rear of the offices and are separated from them by a brick wall. The floor of the dynamo room is made of asphalt and special precautions have been taken to guard against fire in the boiler room. The roof over this portion of the building is supported by 70 foot girders.

There is a basement ten feet wide under each side of the dynamo and boiler rooms, in which are arranged the steam pipes, water pipes and conductors.

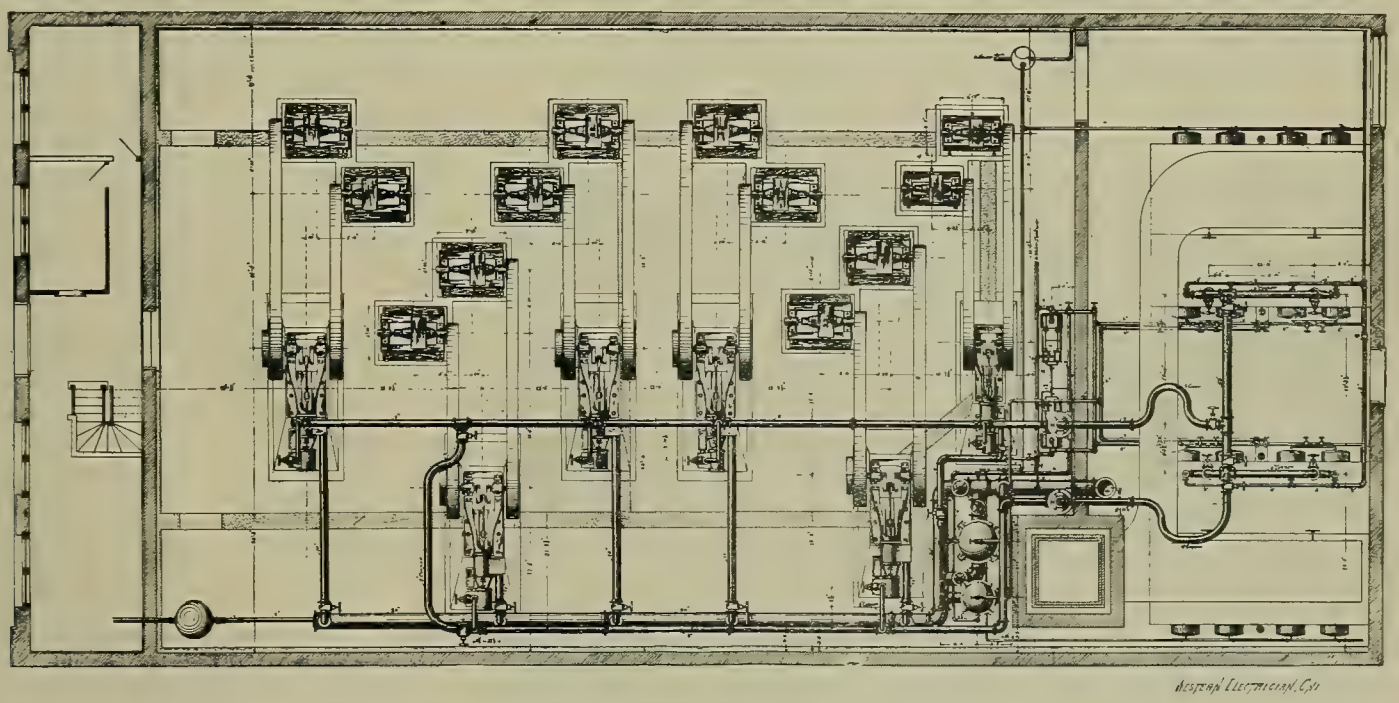
The steam plant at present consists of two Heine safety boilers, 375-horse power each. They were specially constructed by the Heine company according to specifications of the Edison company. These boilers were built for a working pressure of 160 pounds, but at present they will be run at 130 pounds' pressure. This is a departure from the regular practice in Edison stations and it is asserted that this will be the first plant to use as high pressure as 130 pounds. For this reason special care has been exercised in the construction of the steam plant. In order to preclude the possibility of a shut down a duplicate system of main steam piping has been introduced so that in case of failure of one set another may be brought into use. By this arrangement repairs may be made without shutting down the plant. A 400-horse power Berryman heater and two 7½x4½x10 duplex Worthington pumps have been introduced. It is the intention of the company to ultimately install a second heater of 1,000-horse power capacity and sufficient boiler capacity for 20,000 incandescent lights.

The initial engine plant consists of one 150-horse power and two 200-horse power McIntosh & Seymour compound condensing engines. They will be run non-condensing, however. Belted direct to the large engines are two 1,300 light dynamos of the Edison type, and to the small engine two 900 light machines. The plans provide for the installation of machinery of 15,000 lights' capacity, but should this be insufficient to supply the requirements of this district the capacity of the station can be increased by the substitution of larger engines and dynamos. This can be done without any trouble, owing to the absence of pillars in the dynamo and engine room.

The arrangement of the dynamos, engines, boilers and the disposition of the steam piping is shown in the accompanying illustrations.

As already stated, the station is located in a residence district and is the largest plant supplying incandescent lights outside the business district of the city. The territory to be supplied from this station is very large. Already twelve miles of tubing have been laid and before the plant is started it is expected four more miles will be completed. The residents of the district have shown their appreciation of the enterprise displayed by the Chicago Edison company and already wiring has been completed for 8,000 lamps. With the exception of 500 lamps in an apartment house all of these are in private residences. After January 1, when it is expected the plant will be started up, incandescent lighting will prevail in fashionable South Side mansions.

The entire work of construction of the station and the installation of the machinery has been under the personal direction of W. S. Church, superintendent of the Chicago Edison company. No expense has been spared in the construction, and everything will be done in the way of keeping it up to a high degree of excellence. Superintendent Church will have charge of the station.



CHICAGO EDISON COMPANY'S NEW STATION.

Crocker-Wheeler Motor on a Gatling Gun.

It is well known that the Gatling gun, as ordinarily used in the United States navy, requires considerable manipulation. Loading is effected by turning a crank attached to the breech mechanism of the piece. As this causes the barrels to rotate, they are discharged one at a time. Ten barrels are comprised in the piece, so that for each revolution ten shots are delivered.

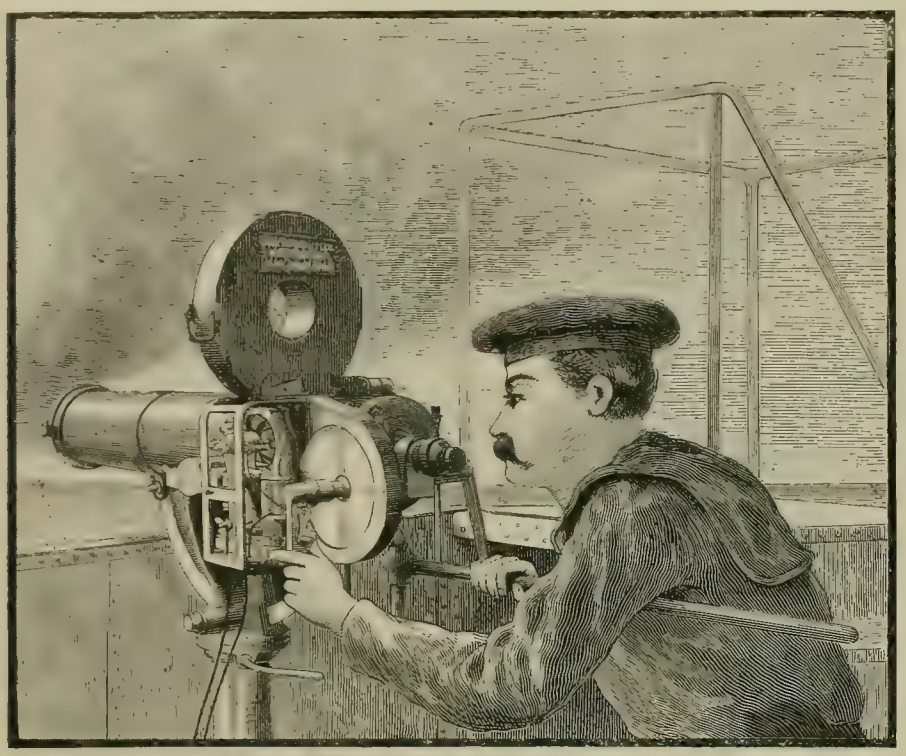


FIG. 1. CROCKER-WHEELER MOTOR ON A GATLING GUN.

While one man turns the crank, if a continual change of direction is needed, a second man holding the tail stock may be employed in directing and aiming the piece. While this character of manipulation is often required, and is that by which rapid-firing guns should perform the greatest execution, it has attendant difficulties. The turning of the crank inevitably causes the piece to oscillate and adds a second disturbing element to the vibration due to the recoil.

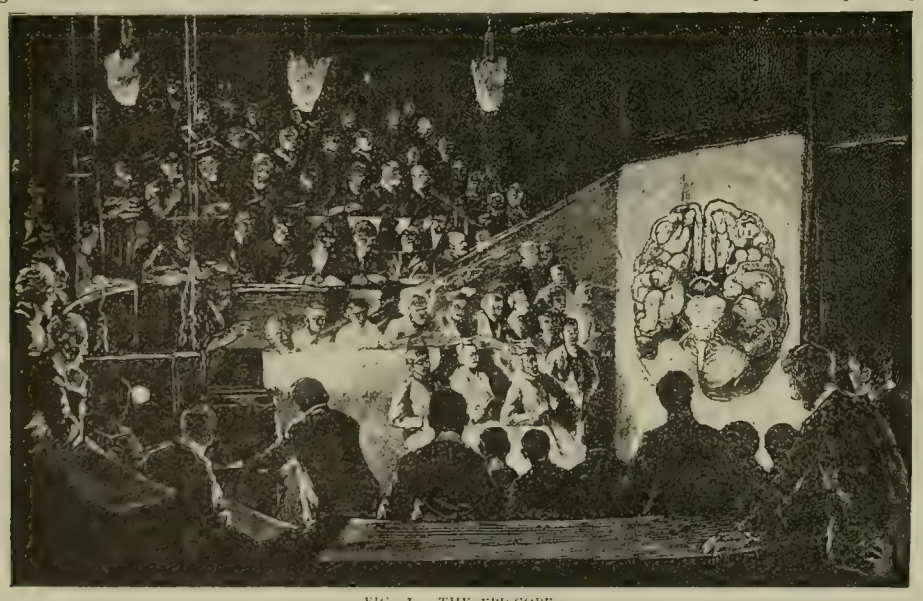


FIG. 1. THE EPISCOPE.

To overcome these difficulties was the object of the mechanism illustrated in the cut. This is a firing apparatus, which was devised by the Crocker-Wheeler Motor company of New York.

Several requirements had to be kept in mind in producing the design. The apparatus had to be attached to the barrel of the gun so as to move with it. It had to be out of the sighting line, and it was necessary to dispose of it so as not to interfere with elevation or depression of the gun. The motor finally had to be adapted for operation by the electric lighting plants as installed upon the ships of war. The engravings show clearly how the problem has been attacked.

Upon the left hand side of the breech of the gun an open frame of generally rectangular outline is secured. Within this frame the motor is placed. This motor is specially wound, and is adapted for an electromotive force of eighty volts, and a current of three to three and a half amperes. In other words, the motor absorbs about one-third of an electrical horse power. Its efficiency, it is stated, is over 80 per cent.

The arrangement of mechanism is as follows: The spindle of the armature which runs horizontally and at right angles to the axis of the gun, carries a pinion which engages a large gear wheel. This wheel is inclosed in the disk-like case which is seen next to the motor by the side of the breech. Its spindle is prolonged across the end of the gun barrel, and carries a worm at the end. This worm in turn gears into a worm wheel on the working spindle of the gun. By this means a double reduction in speed is secured and the gun is operated at about 150 revolutions per minute, giving 1,500 discharges. This rate is rather high for general practice and can be considerably reduced.

A small switch is provided for turning the current on and off. The artillerist, after starting the motor, is free to swing the piece in any direction. This he can do without interference from a second operator, and the gun is undisturbed by the shaking due to the turning of the crank.

Between the motor and the large gear wheel is a clutch by which the motor can be connected or disconnected from the breech mechanism. The crank by which the piece is worked by hand under the former conditions is arranged for rapid connection or disconnection. This provides against injury to the electric apparatus. If the device becomes disabled, or if its connections are severed, the clutch can be thrown open and the handle connected. The gun is then ready for operation by hand. This change takes only a few seconds. This application of electricity is of special interest as bringing the Gatling gun into the rank of automatically fired artillery. The cuts are reproduced from the *Scientific American*.

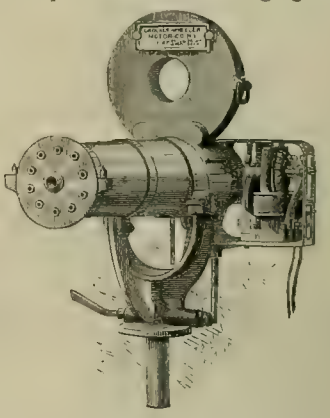


FIG. 2. CROCKER-WHEELER MOTOR ON GATLING GUN.

The Episcope.

The electric light has been frequently employed by lecturers in connection with a stereopticon for projecting pictures on a screen. The views are ordinarily merely the enlargement of pictures on glass. In the accompanying cuts is illustrated an ingenious contrivance for presenting on a large scale directly from the object the image of the surface of a solid mass. In other words, where the episcope is employed the image is projected directly from the object itself without a previous preparation of slides or other auxiliary appurtenances. The apparatus was designed by Prof. Stricker at the University of Vienna, and is used by him to illustrate his physiological lectures. The construction is very simple and consists of nothing but a tube in the shape of an elbow, Fig. 2. At the point O^1 is placed a powerful arc lamp, throwing its beams on the object $p\,q$. The image of the object is projected upon the screen Q^2, by the lense L. The success of the contrivance is due to the concentrated and powerful light from the electric lamp and its reflector.

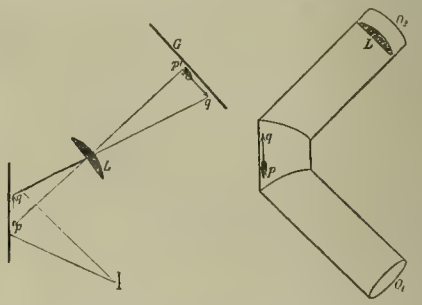
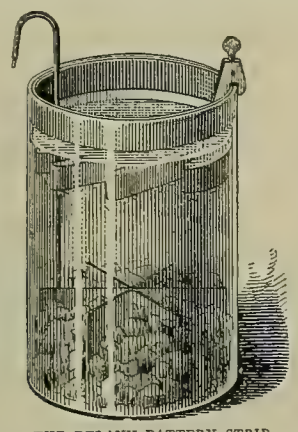


FIG. 2. THE EPISCOPE.

This apparatus which was named the episcope by Prof. Stricker is made large enough to receive an object weighing as much as, and of the same size as, a dog of twelve pounds. It is used for showing the pulsations of the heart and the functions of other vital organs. The smallest particles are readily distinguished. The apparatus is so arranged that the demonstrator may manipulate an object as may be desirable, his fingers appearing on the screen enlarged many hundred times. The operator is thus enabled to point to the particular part to which he especially wishes to attract the attention of the audience. In the cut is shown a view of the brain just removed from the skull. The cut is reproduced from *Ueber Land und Meer*.

The Delany Battery Strip.

The accompanying cut illustrates the application of a simple contrivance which was invented by P. B. Delany of South Orange, N. J., to prevent the creeping of salts in the gravity, Leclanche, and other primary batteries. The device is simply a strip made of rubber cloth and applied in the manner shown, to the inside of the rim of the battery jar. One side of the strip is covered with a sticky compound, and when the strip is properly applied it will never



THE DELANY BATTERY STRIP.

come off the jar. The strip offers a mechanical obstruction to the creeping salt which masses underneath it and is re-dissolved in the battery fluid each time that water is added to the solution to make up for evaporation. All waste and exhaustion of batteries by local action by this means, it is claimed, is prevented, and shelves are kept perfectly clean and dry. When the strip is properly applied no amount of washing or wetting will affect it.

National Electric Light Association.

The "Prospectus of the National Electric Light Association" containing the constitution of the organization, names of the present officers and members of committees and list of active and associate members, has just been published. There is appended a "Review of the Proceedings of the Twelfth Convention," all of which, it is stated, is published by order of the executive committee. Here is an abstract from the review which, it is thought, will be read with interest:

The strength of the association was put to a test at once by the demonstration made by Mr. Barrett of Chicago, regarding the paper on "Municipal Lighting" by Mr. Francisco. Central station managers throughout the country have been repeatedly put on the defensive and badly hurt by the broadly published statements attributed to Mr. Barrett and allowed to remain uncontradicted by him. Such statements may have served his purpose well in Chicago, to augment his political capital and assist him in securing appropriations to spend, but they were death-dealing instruments used skillfully to destroy investments in central stations all over the land. It is plain that central station men cannot afford to let matters stand in this attitude any longer. Mr. Francisco's paper placed Mr. Barrett on the defensive. He boldly accepted the issue. It is now in position to be fought out on clearly defined lines each party knowing full well the meaning to him of defeat. To Mr. Barrett defeat means loss of political prestige only. To those who have investments in central station plants, defeat means the depreciation of their investments to an extent that will make the aggregate loss much greater than the entire cost of the plant owned by the city of Chicago. If Mr. Barrett should succeed in issuing a statement that on its face appears to sustain his position, he will not thereby gain a victory unless that statement shall be proven true under stress of the most searching analysis and criticism to which it can be subjected. He has boldly affirmed that Mr. Francisco's figures are not correct, and has pledged his word of honor to this association that he will furnish to it a correct statement. He has failed to do so, although his self-selected time, within which he agreed to furnish the statement, has long since passed. This is an issue of vital importance to central station investments. Having brought the question to its present position, this association will not place such vast interests in jeopardy nor stultify itself by abandoning the case. It will pursue the investigation to the finish, not in a spirit of animosity toward Mr. Barrett, be it remembered, but with a clearly defined and well considered determination to foster and protect central station interests. In doing this, the association reasonably expects the support and co operation of every central station company in the United States.

The Southside Land and Improvement company, Richmond, Va., made a successful experiment with its electric railway, last week, and will immediately put all of its cars in operation.

Electric Railways for South America.

The street railway of Buenos Ayres, Argentine Republic, is to be converted into an electric road. The line is owned by a London syndicate which has secured the services of Lester E. Larned, of the Brush Electric Light company of Detroit, to supervise the equipment of the road. Mr. Larned will probably sail for England next week, and thence will take a steamer for Buenos Ayres. The street railway in the city is 8½ miles in length. The first equipment of the road will consist of fifty motor cars and fifty trailers. All the apparatus and supplies will be purchased, in all probability, in the United States.

The syndicate proposes to install a large number of electric power plants for use in mines which it controls in South America.

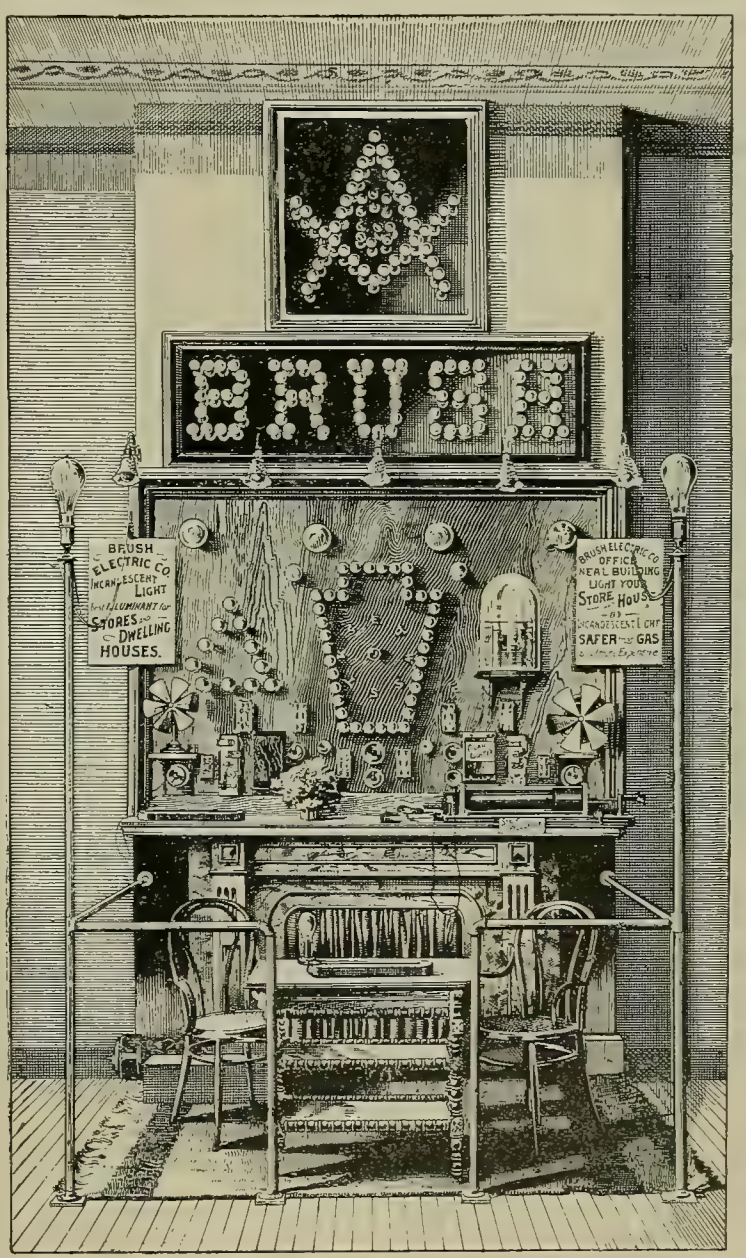
Chicago City Electric Light Plant.

The contract for furnishing electrical apparatus for the South Side station of the Chicago city electric light plant, was awarded to the Western Electric company of Chicago. The contract calls for seven 60-light dynamos and 180 double carbon arc lamps. There will be four low tension and three high tension dynamos. The apparatus will be installed immediately, and the plant be in readiness by Christmas day, when it is hoped electric light will be furnished the South Side streets. The posts for the electric lights have already been placed in position, and everything is ready for hanging the lamps.

Electrical Display at the Baltimore Masonic Temple.

The Masonic fraternity of Baltimore, Md., has just concluded a very successful bazaar in the Masonic Temple of that city. The temple had been very gaily decorated, a fine orchestra of musicians had been hired to entertain the guests during the evening, and in addition the management of the Brush Electric Light company of Baltimore had been prevailed upon to make an electrical exhibition in the hall.

The accompanying cut is an illustration of the display, which represented the characteristic features of the Westinghouse alternating current system. Besides the seventeen arc and about 200 incandescent lamps which the Brush company burned in the hall, the exhibit consisted of a stage regulator, a Shallenberger meter, an electric cigar lighter, which attracted especial attention, and on the table in front were two coils illustrating the Westinghouse converter system. Two lamps at the top of the rail in the front of the exhibit held a 250-candle power alternating incandescent lamp each. In the corner on the left hand side of the display were shown several small batteries and an induction coil. The attendant administered shocks to visitors, who desired them, and thus a good deal of amusement was created. The lettering, the compass, the keystone and other Masonic emblems were represented by incandescent lamps of various colored globes and the effect of the entire exhibit was very beautiful Over 50,000 people inspected the display, which was the first of its kind ever seen in Baltimore.



ELECTRICAL DISPLAY AT THE BALTIMORE MASONIC TEMPLE.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building. - - CHICAGO

Telephone 1740.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

The Columbian Belvedere. Illustrated 273
Electricity on War Ships 273
Electric Lighting in Australia 273
Weston's Temperature Compensator for Electrical Measuring Instruments. Illustrated 274
Combination Fire Alarm and Call Bell. Illustrated 274
Electric Transmission of Power at Red Cliff, Colo. Illustrated. 274, 275
Chicago Edison Company's New Station. Illustrated 275
Crocker-Wheeler Motor on a Gatling Gun. Illustrated 276
The Episcope. Illustrated 276
The Delany Battery Strip. Illustrated 277
National Electric Light Association 277
Electric Railways for South America 277
Chicago City Electric Light Plant 277
Electric Display at the Baltimore Masonic Temple. Illustrated .. 277
Editorial 278
Electricity in the Cheyenne Shops, Union Pacific Railway. Illustrated 279
Submarine Telegraphy 279, 280
The Ferranti Mains 280
Combined Heater and Filter. Illustrated 280
Telegraph Statistics 280
Electric Street Railways. By Theo. P. Bailey (Chicago Electric Club) 280, 281
Paris Telephone System 281
Operation of an Electrolytic Refinery. By Dr. G. Gore 282, 283

DEPARTMENTS.

Correspondence 283, 284, 285
The Electric Light 285
The Electric Motor 285
The Telephone 285
The Telegraph 285
Electrical Patents 286

CHICAGOANS who are familiar with the amount of vacant space on the Lake Front and have also a knowledge of the great advancement made of late years in the manufacture of electrical appliances, will wonder why it was ever planned by the World's Fair directory to locate the Electrical Appliance Building in a space which would necessarily be so limited. There was a time, and not many years ago either, when an electrical exhibit meant a room filled with glass showcases in which were displayed numerous delicate instruments. Space for such a display was then measured in feet and one large room was, perhaps, all that was required. In 1893 a different state of affairs will exist. Even at the present time we find electrical appliances of a size that astonish those familiar with the art. At the Centennial we found the electrical department covering a comparatively small area. Later on at the Philadelphia electrical exhibition when the dynamo was still more or less a novelty to many, a large building was found to be necessary to protect the entire display. When the immense strides which have taken place since such expositions were held, are taken into consideration, one is led to believe that the gentlemen who are planning for 1893 are sadly ignorant of the wants of the electrical fraternity. Put the electrical exhibit on the Lake Front along, perhaps, with numerous others and what room will there be for the display of the heavy machinery? The directory seems to forget that one of the greatest features of an electrical exhibition at the World's Fair will be the electric railway and mining machinery. What room will there be on the little strip of land in front of the Leland and Auditorium hotels, for a number of power houses, tracks, tramways, overhead construction, conduit systems and numerous other appurtenances necessary to make a creditable electrical display? Does the directory suppose, too, that there will be no awakening of adjacent property holders when the realization comes that the grandest and perhaps the most attractive portion of the display will embody electrical power houses and not necessarily only an architecturally beautiful building? The remark made by Commissioner Mercer in a recent interview will doubtless voice the sentiments of those who are not prejudiced lake front enthusiasts: "There is no objection to an electric light display on the Lake Front," said the commissioner, "but the electrical appliance building should not be there, and we will never consent to it." It is earnestly hoped that the directory will look well into this matter and not make at the start a move that may handicap a department which promises to be the most attractive of the exposition.

IN another column is given an abstract from a review of the proceedings of the Twelfth Convention, issued by the executive committee of the National Electric Light association. We do not know who prepared the synopsis, but it must be conceded that it is a most remarkable publication. The portion quoted elsewhere relates to the spirited discussion which took place at the last convention between M. J. Francisco and Prof. J. P. Barrett, city electrician of Chicago. It will be remembered that the former in a paper read at the meeting called in question the figures of the latter showing the cost of the municipal arc light service in Chicago. Subsequently, at one of the sessions of the convention, Prof. Barrett stated emphatically that his figures were correct and he criticised severely Mr. Francisco's insinuations that the facts had been wilfully misrepresented. The upshot of the whole matter was the decision by the convention to allow Prof. Barrett to prepare a statement setting forth his views, to accompany Mr. Francisco's when published. By this action the committee apparently determined to occupy neutral ground. It seems extremely singular, therefore, that in the synopsis, just published, a most decided stand is taken on the very question on which the convention refused to commit itself. Prof. Barrett is unsparingly criticized, and insinuations similar to those uttered by Mr. Francisco are expressed. It is not our intention here to discuss the question of municipal lighting, but simply to call attention to the fact that in an official communication the association discriminates very decidedly between two members of the organization. Every one, we think, will look forward with interest to a statement by Prof. Barrett presenting his side of the case.

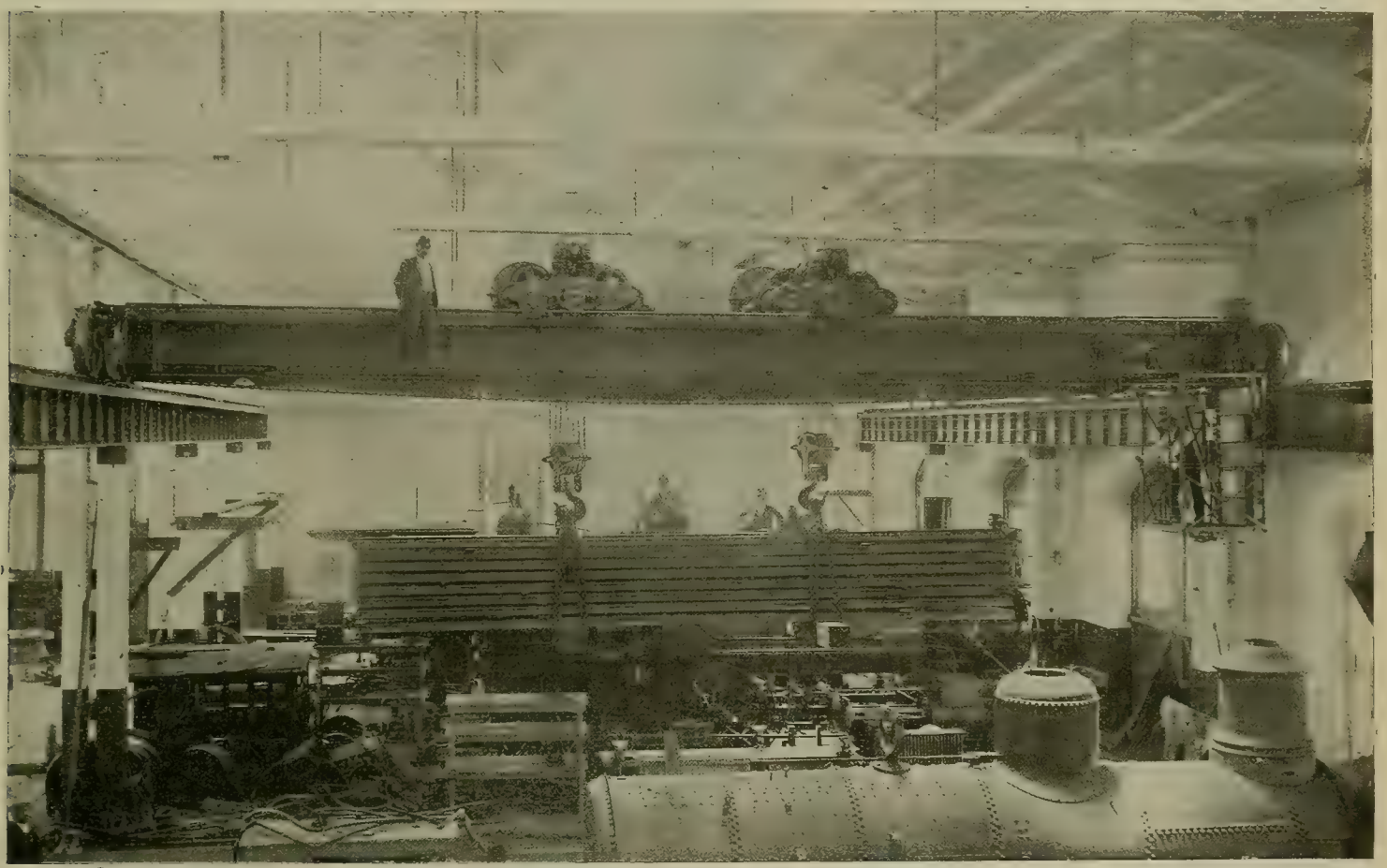
A SHORT time ago the WESTERN ELECTRICIAN published a letter from Gardner Sims, chairman of the World's Fair committee on electricity. Mr. Sims is thoroughly enthusiastic on the work which the committee has to do, and in his letter he suggested that as far as possible steam be dispensed with throughout the great exposition, and that electric motors obtaining current from a huge central station be used instead. It is generally understood that Mr. Sims has a candidate for the office of electrician-in-chief for the World's Fair in the person of W. J. Hammer of New York. No one can question that Mr. Hammer possesses the ability to make the electrical section of the World's Fair successful. He has a wide experience in connection with expositions and his successful organization of the Edison exhibit at the Paris Exposition is recognized by the electrical fraternity everywhere. It must be said, however, that the appointment of Mr. Hammer would not be entirely satisfactory to the fraternity in the West, for the simple reason that he is not a resident of Chicago or the West. It is the feeling in Chicago, most certainly, that the appointment should go to a resident of Chicago, and it is not unlikely that the wishes of the local fraternity will be respected by the authorities of the fair.

"ELECTRIC RAILWAYS," was the title of the paper by Theo. P. Bailey read at the last meeting of the Chicago Electric club. The electric railway is a favorite subject at the present time with a large number of writers, but it is a pertinent fact that many of the articles which appear emanate from men entirely unqualified by experience to discuss the topic. Mr. Bailey's paper is doubly interesting on account of the author's extended experience in this particular branch of electric work. Mr. Bailey has grown up, so to speak, with the electric railway, and the success which has attended his efforts in the exploiture of the system is sufficient indication in itself that the writer would necessarily be well informed on the details of the electric street railway business. As a matter of course the subject is treated more from a commercial than a scientific standpoint. "There are," says Mr. Bailey, "at the present time 246 electric street railway plants either in operation or ready to be put in operation within a short time." Now the question is not whether it is a practical or a commercial success, but rather, "How soon can you furnish the equipment for our road, and what will it cost?" When we take into consideration the short time which has elapsed since the electric road was unheard of and glance over the few statistics given by Mr. Bailey, one can but be amazed. "Two thousand and twenty-four miles of track and 3,830 motor cars, requiring in the neighborhood of 6,400 motors with a probable aggregate capacity of 174,435 horse power, employing an electrical generating capacity at the station of about 94,880 horse power; * * nine hundred and fifty-nine street railways in the United States and Canada. Of this number 589 are operated by horses; 49 by cable; 246 by electricity; 75 by steam." Such figures as these need not be commented upon. In addition to the above are given a number of interesting and comparative figures relative to the amount of capital invested in street railway properties and the cost of operating roads by different motive powers. As to equipment Mr. Bailey, apparently, looks for no radical changes at present. The development will be more in the line of details. The tendency at this time is, he thinks, in the direction of longer cars, double trucks, and heavier motors. With reference to the selection of the steam plant, it is his opinion that the horse power of the engine should be at least 20 per cent. greater than the working capacity of the generator. In touching upon the question of inspection Mr. Bailey emphasizes the great importance of employing men thoroughly competent to perform such work. "We cannot overlook," he states in the latter part of his article, "the fact that there are still some complaints of excessive cost for repairs and maintenance of electrical apparatus, but I insist that the responsibility for this condition does not rest altogether with the manufacturers."

A word of comment here may not be amiss. Those who have had experience with either electric power equipments or electric lighting machinery, will realize the force of the above assertion. In the early days of the electric lighting business, men competent to take charge of a dynamo were hard to find, but the electric light man is not such a rarity now. History repeats itself, it might be said. The street car companies are going through with the process of educating men to handle a system which although simple in its working is nevertheless a mechanism with which the men are absolutely unfamiliar. Until, then, the calling of the motorneer or electric railway man, has become as distinctive as that of, say, the gripman or the horse car driver, it is not to be supposed that the cost of repairs will be at a minimum or that the companies will realize in the fullest sense the many advantages of the electric system.

Electricity in the Cheyenne Shops, Union Pacific Railroad.

The headquarters of the motive power department of the Union Pacific Railroad were formerly at Omaha. It became necessary, however, to build a larger plant, and to locate it near the center of the system. Cheyenne, Wyo., was chosen as the new site on account of its location and natural advantages. In the arrangement of the machine shop of the new plant a number of modern appurtenances were introduced. One of the most important improvements is illustrated in the cut. This electric traveling crane is the most novel feature in the shop equipment. As represented, the crane is supporting a test load of fifty tons of rails. The appliance travels the whole length of the building, has a span of 55 feet, and in general appearance looks like similar cranes run by wire rope and pulleys. A description of some of the details of this machine will be of interest: The heavy iron I-beams which carry the 75-pound rail on which the crane runs, are supported by wooden columns capped with iron. On each side there are two 30-inch wheels which are grooved to take the track. The two crane girders, which are 4 feet apart, are stretched between the supporting beams and are united in the iron trucks carrying the wheels. The two trolleys, weighing eight tons each, run on a light track on the girders. There are five motors used, one for the crane, as a whole, and two for each trolley. The operator's cage, which contains the switch-board, is suspended from one end of the crane. By means of a sliding copper tube, connection is made with two copper wires from the dynamo. One motor, by means of gear wheels, turns a shaft which runs the length of and on the outside of the crane. This shaft, by means of a pinion on each end, turns a gear wheel on the axle carrying the crane wheels, thus giving the motion of the crane up and down the shop. Each trolley works independently of the other, and there is a motor on the side of each which runs the gear for the traveling motion. On top are the motors for raising or lowering the load. The brake is worked by means of a separate small coil. The trolleys have two pairs of 18-inch wheels 5 feet apart, and each carries two 2x3½ feet drums which both wind or unwind simultaneously. The fixed pulley is between the drums, and before winding on, the chain passes three times between this and the movable pulley carrying the load. There are two brakes, one for safety in case the other fails. On the motor shaft is a small pulley, inclosed by a strap held by a spring. This spring flies out and allows the shaft to turn, but closes and holds the load when the motion is stopped. For the safety brake a cylinder containing a spring works a ratchet brake in the same manner. The entire crane is operated by five levers, one for each motor, both motions of any part being accomplished with one lever by moving it in opposite directions from the center. A lever at center is in position of "no motion," and the brakes are "on." Each motion is independent of the others, and thus either trolley may be used or both be used together. The crane is rated at 40 tons' capacity, but was tested by raising a load of 50 tons of rails. It is used to lift engines off their drivers. Its advantages in an erecting shop are evident. It was built in Milwaukee by the Shaw Electric Crane company of that city.



ELECTRICITY IN THE CHEYENNE SHOPS, UNION PACIFIC RAILROAD.

In the machine shop building there are three dynamos of 1,000, 250 and 250-light capacity respectively. Current to operate the crane is drawn from this system.

It may be mentioned that the transfer table between the erecting and boiler shops is run by electricity.

The transfer table for the car shops will also be run in the same manner as the other, getting its electricity from a dynamo in the new engine room. It is proposed to place here the two small dynamos, 500 lights' total capacity, which are now in the main engine room. They will furnish electricity for the transfer motor and light the paint, car, wood and freight car shops. This change will be followed by the placing of a 3,000 light dynamo in the main engine room, which, together with the one of 1,000 lights, will run the crane and table, and light all the remaining shops and round houses, including the offices and passenger station. The smaller dynamos will be run by a 50-horse power engine. The wires will be so arranged that in case of trouble, or when desirable, electricity from one system can be used to help the other.

The proposed system of lighting is well arranged, especially for the workman at his machine. The lamps are suspended from above, and covered with wire cages. The three-wire system is to be used. The cut is reproduced from the *Railway Master Mechanic*.

Submarine Telegraphy.

The members of the department of electricity of the Brooklyn Institute were addressed on November 14th, by Herbert Laws Webb, who gave an interesting account of the history and development of submarine telegraphy and also described in detail the practical operations connected with the manufacture and laying of ocean cables. The history of submarine telegraphy dates from the year 1850, when a cable was laid across the English channel from Dover to Cape Grisney. The line consisted merely of a gutta percha covered wire which was submerged by clamping leaden weights to it at intervals of a few hundred feet. This cable was put down to save the concession and only lived a day, but served its purpose; in the following year an armored cable was laid over the same route, and this one is working at the present time, having been frequently repaired but retaining much of its original material. During the next few years cables were laid between England and Ireland, Holland and other neighboring countries and also in the Mediterranean. In 1857 the Atlantic cable was begun and nine years later it was completed after no less than three unsuccessful expeditions, involving the sacrifice of a vast amount of capital. Mr. Webb referred to the energy and perseverance displayed by Cyrus Field, who took so keen an interest in the Atlantic cable and by the engineers and contractors, and said that Americans and Englishmen could but experience a feeling of pride in recalling this gigantic and long continued battle waged by their fathers against overwhelming odds and in spite of widespread disbelief in the possibility of a successful termination to the scheme.

The lecturer then described the method of manufacturing a submarine cable and pointed out the vast improvements that have been made in all the constituent parts of a cable since the early days of the art. Some of the early cables had a conductivity of only 50 per cent., nowadays 98 per cent. is generally reached. In 1859 it was considered a high insulation if the dielectric gave 125 megohms resistance per mile at 75 degrees Farenheit. To-day specifications call for 350 megohms per mile at the standard temperature and this figure is considerably exceeded. The specific inductive capacity of gutta percha cable has also been lowered by nearly one-fifth. Great improvement has also been effected in the outer protection of the ocean cables, mainly by the use of homogeneous iron and steel armor wires, and by the application of hemp and tape soaked in preservative compound, the armoring being thus protected from rapid corrosion.

The equipment of a modern cable ship, with water-tight tanks for carrying cable submerged in water while on the voyage, the machinery on board, the method of stowing the cable, the technical staff and various other details of this interesting branch of electrical engineering were next described.

Mr. Webb then proceeded to deal with the important

question of surveying the ocean bottom in order to select a safe route for a cable. A great impetus was given to this branch of the work by the introduction, in 1872, of the method of taking deep sea soundings by means of pianoforte wire. This innovation was made by Sir William Thomson who first made a sounding with steel wire from his yacht when cruising in the Bay of Biscay. The improved form of Thomson sounding machines was described in detail, and illustrated on the screen. The wire (No. 22 B. W. G.) is wound on a light iron drum to which brake power is applied by a strap or cord, the strain being increased as more wire runs out. In this way the drum stops the moment the sinker strikes the bottom soundings being correct within one or two fathoms, For picking up, the drum is geared to a small engine. With this machine a sounding in say 2000 fathoms can be made in less than one-sixth of the time employed by the old method of using a hemp line.

To emphasize the importance of systematic surveys of the ocean bottom Mr. Webb showed on the screen maps of various parts of the Atlantic, indicating that banks and submerged mountains had been discovered where deep water was supposed to exist; profiles of some of these banks, so fatal to the life of cables laid across them, were also shown, the extremely rugged outlines of some of them being plainly apparent. It was also pointed out that the constitution of the sea bottom requires investigation as well as the depth of water, materials having an injurious effect on the armoring sometimes being found. For this reason an analytical chemist generally accompanies a surveying expedition and analyses are made of any suspicious samples of the bottom brought up by the tubes or sinkers.

Passing on to the operation connected with the actual laying of the cable the lecturer described and illustrated the method of laying a shore-end, the cable being hauled on shore by a rope passed around sheaves anchored to the beach and taken to the picking-up gear at the bow of the ship, the cable being paid out over the stern. To avoid dragging it over the bottom, large India rubber buoys are lashed to the cable at intervals, and in this way it is floated ashore, the lashings being afterward cut and the cable allowed to sink to the bottom. The cable is buried in the beach and the end taken into a small cable but where testing instruments are set up and from which communication is maintained with the ship while paying out cable. During this operation an insulation test is maintained continuously, and any alteration in the electrical condition of the cable is immediately detected. Signals are exchanged every few minutes between ship and shore as a test for continuity. The routine work on board during the laying of a long cable was described and various views of the paying-out machinery were shown, illustrating the paying-out drum which holds the cable and indicates the length paid out, the dynamometer which registers the strain, the brakes and gear for holding the cable, and the various other appliances that crowd the deck of a telegraph steamer. Other operations connected with the work, such as jointing and splicing the cable, changing tanks when paying out, buoying an end at sea, navigating the ship up to the buoy and hauling the end of the cable on board, were reviewed and illustrated in a graphic manner.

Cable repairing was referred to by the lecturer as a very difficult branch of the telegraph engineer's work. Sometimes the cable may be caught by the grapnel almost immediately, but in this case the bottom must be smooth and the water not too deep. In deep water and over a rough bottom the difficulty and uncertainty of the work are greatly enhanced, and repairing ships sometimes spent weeks in weary and unsuccessful search for the slender iron cord concealed among rocks and hills and valleys a couple of miles down below the surface of the water.

In discussing the engineering problems connected with submarine telegraphy so much time was occupied that Mr. Webb was only able to make a slight reference to the methods of signaling over ocean cables. He pointed out the immense importance of Sir William Thomson's discovery of the action that goes on in a long cable, the current developing a long wave on which any number of wavelets can be successively impressed. Sir William Thomson, having discovered the law, invented the instruments, the mirror galvanometer and syphon recorder, by which the wavelets could be made to give signals at a speed practicable for commercial working.

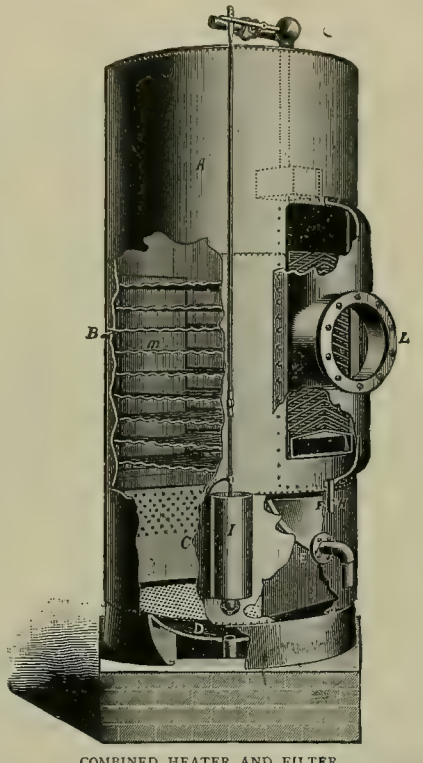
The Ferranti Mains.

The following is an extract from an editorial in the London *Electrician:* 'We have within the last few days heard of the Ferranti mains spoken of as though they were still in an experimental stage, and have been asked whether any satisfactory method of making the joints has yet been discovered. The fact is that when a short length on one of the bridges has been completed, no less than thirty miles of Ferranti main will be actually laid. Of upward of 8,000 joints, only fifteen have been found to be faulty. Several of these have been due to no electrical difficulty, but to the carelessness of the men in forgetting to remove the cotton waste from the socket end. There has been but one single fault from the inner to the outer conductor, and this was due to moisture. Those who were unwise enough to prophesy before they knew, said that the joints which are made with a plug in the inner tube, and a sleeve burnished or rolled down on to the outer conductor, would offer a considerable resistance, on account of imperfect contact and the absence of solder. It may interest these prophets to learn that the calculated resistance of the mains was 2.16 ohms, and the actual measured resistance is 2.2 ohms. The mains on one occasion were warmed up by a huge current, and as many joints as were accessible were felt, but no difference whatever could be detected. Immediately after this test, a pressure of 20,000 volts was put on without disclosing any defect."

The Ocmulgee Street railroad at Macon, Ga., will be six miles in length and will be operated by electricity.

Combined Heater and Filter.

No steam power plant using high pressure engines can be regarded as complete from an economical point of view, unless it is provided with an efficient heater, utilizing the exhaust steam for raising the temperature of the feed water for the boilers. If the heater can be so made that it will purify the water and thus prevent the formation of scale an additional advantage is gained. The heater shown in the cut is designed both to heat and purify the feed water. It has a large heating and filtering capacity and extended depositing surfaces for receiving the precipitated lime and other impurities. Facilities are provided for quickly cleaning the heater. Devices are also provided for separating and collecting the cylinder oil contained in the exhaust steam. The inflow of



COMBINED HEATER AND FILTER.

cold water is regulated automatically so that an even and steady feed is effected. The heater is manufactured by the Stilwell & Bierce Manufacturing company of Dayton, O.

Telegraph Statistics.

Lovers of statistics will find food for reflection in the following extract from *Iron:* There are now 942 submarine cables, exclusive of the seven Atlantic cables, with an aggregate of 112,740 nautical miles. The overland telegraph is already a world-wide institution, in which there is a total of 1,680,900 miles of wire, enough of the attenuated metal to go around the equatorial belt of the globe just thirty times. The number of words transmitted, the miles traveled, and the cash changing hands would tax the enumeration table. The United States have 776,500 miles of wire, and in 1889 no less than 56,000,000 messages were sent through the country. France has 220,890 miles of wire, on which in 1889 were transmitted 30,050,000 dispatches. Great Britain has 180,000 miles of metal line, and in 1889 sent 50,000,000 messages. Russia has spun out 170,500 miles, and in 1889 gave the operators 10,280,780 messages to dispatch. Australia has strung no fewer than 105,360 miles of wire across its surface, and transmitted in one year 12,000,000 messages. Italy has 19,500 miles and has made an annual record of about 7,000,000 electric messages. Canada has 58,500 miles of wire and did a business in 1889 of 4,027,581 dispatches. Egypt has 5,500 miles, and is in connection with India and England by submarine cables on which last year 1,600,205 communications were carried from one end of the world to the other. China has 5,500 miles of wire across Mongolia, and Japan owns no less than 16,500 miles of wire, over which 5,000,000 messages were sent in one year. New Zealand has strung itself with 11,375 miles of metal cord and dispatched 1,835,394 messages. Tasmania has 2,500 miles of telegraph wires. Persia claims in partnership with European wires, about 6,124 miles. South Africa has a credit of 4,310 miles, and even St. Helena, the island prison of the great Corsican, has thirteen miles of the universal wire cobwebbing its rocks. The telegraph systems of the world have unrolled the wire reel without stint, and if we add to the 1,688 900 miles used for telegraph purposes the wholesale appropriation by the telephone system, the sum total would be enormous."

The Belton, Tex., Electric Light company has decided to increase the capacity of its plant.

Electric Railways.[1]

By Theo. P. Bailey.

The practical development of electric street railways, and their commercial perfection, may properly be said to have been accomplished within two years, and yet there are at the present time 246 electrical street railway plants either in operation or ready to be put in operation within a short time. Two years ago, and even within the past twelve months, were asked many questions by intending purchasers, which to-day are not even hinted at. Some of the prevailing questions of that age were:

Can electricity be applied in our case?

Can a street railway, equipped with electricity, be made a practical and commercial success?

What will be the life of the apparatus?

What will it cost to keep the apparatus in repair?

Is not the current dangerous to human life?

Will it not ruin the watches of passengers?

The street railway people to-day appear to have become thoroughly satisfied on these questions, and consider it an idle waste of time to discuss them further. But in lieu thereof they ask us this: "How soon can you furnish the equipment for our road, and what will it cost?" Just think of this statement for a moment: Two hundred and forty-six electrical railways in operation, embracing 2,024 miles of track, and 3,830 motor cars, requiring in the neighborhood of 6,400 motors with a probable aggregate capacity of 174,435 horse power, employing an electrical generating capacity at the station of about 94,880 horse power! Did any one of you anticipate two years ago that such a condition of facts could under any circumstances be realized within so short a time? I attribute this wonderful development and success to the following causes:

First, the full practicability of the undertaking; second, the wonderful earning capacity of the electrically equipped car as compared with the horse car; third, a determination on the part of the electrical manufacturers to meet the requirements of the railway companies; and fourth, the untiring and indefatigable efforts of the exploiter or salesman.

Among the numerous and possibly fatal objections raised to the use of electricity, when it was proposed to apply it to street car propulsion, was that grades exceeding five per cent. could not be mounted. But experience and practice have shown that grades as high as fourteen per cent. can be ascended with reasonable safety and satisfaction. There is a grade of 13 2-10 per cent. at one point on the line of the street railway at Lynn, Mass., over which sixteen foot cars equipped with two 15-horse power motors are in daily and successful operation. At Milwaukee a grade of 10 3-10 per cent., 430 feet long, is encountered and successfully operated over by twenty-foot cars, equipped with two 15-horse power motors, the total weight of car complete with passengers, being 10½ tons. A similar grade is met with at Newport, R. I., and Omaha, Neb., and numerous grades almost as heavy are seen in the electric railway systems at Des Moines and Davenport, Ia., and Kansas City, Mo.

At the present time there are as nearly as can be ascertained 957 street railways in the United States and Canada. Of this number 589 are operated by horses; 49 by cable; 246 by electricity; 73 by steam.

It is estimated that the total money value of these combined properties is $164,400,000, proportioned as follows: Horse railways, $58,900,000; cable railways, $49,000,000; electric railways, $49,200,000; steam railways, $7,300,000.

These figures are at best only approximations, as it has been found impossible to secure absolutely accurate information.

This combination of motive powers is doing service over or upon 8 818 miles of track as follows: Horses, 5,713; cable, 527; electric, 2,024; steam, 554.

I find that the cost per car-mile for the several methods referred to, including all operating expenses and fixed charges, other than interest, is as follows: Horses, 5.7 cents; cable, 2¾ cents; electric, 2.2 cents; steam, 5 cents.

A large majority of the street cars equipped electrically at the present time are mounted upon a single truck, to which are attached one or two motors, as required by the conditions existing in each particular case. The lightest equipment with which I have had to do has been a single 15 horse power motor upon one truck; and the heaviest equipment has been two 15-horse power motors upon one truck. The tendency, however, at the present time seems to be in the direction of longer cars, double trucks, and heavier motors. This action is prompted very largely, no doubt, by the sad and costly experience of some companies where trailers were used in connection with the motor car; serious accidents, and in some cases death, having resulted from injuries sustained by passengers in falling between the motor and trail car while passing from one to the other.

The use of the longer car with double trucks is recommended further as a means of comfort to the passengers, and also on account of the longer life of the car and its equipments. This style of car is, of course, unattended by the oscillating motion found in the shorter car with a single truck. Where the shorter motor car is used with a trailer experience shows that there is a great loss in wear and tear by reason of the cars jamming together when the brakes are applied. This fault is obviated in the longer car, and while its seating capacity may not be equal to that of two shorter cars, it is approximately so. It is claimed further for the longer car with double trucks that less energy is required to operate it; also that it saves the expense of one man, decreases the expense of maintenance, and increases the facility for handling passengers.

In treating of the subject of electric railways from a commercial standpoint, I have considered only that branch designated as the single wire overhead system.

For obvious reasons too much care cannot be observed in planning and locating the various factors which go to make up a complete electric railway plant. Assuming that the railway company has secured the desired franchises and

[1] Read before the Chicago Electric Club, November 17, 1890.

rights of way, has laid out its lines of track so as to avoid all excessive grades, and yet reach the attractive and important points of the town or city, and that it has been fortunate enough to make proper selection of its apparatus, the next important work for it to determine is the location and arrangement of its power station. The selection of a site should be made with reference to obtaining the best facility for handling coal and securing water, and also with reference to the electrical center of the railway system, in order to realize the highest degree of economy in the operation of the plant. The arrangement of the power station is equally as important as its location, with regard to handling the work with the least cost for labor. The selection of the steam plant is a matter of great importance, and should be left with a thoroughly competent and reliable engineer to determine what particular type of engine, boiler, etc., should be used; and the matter should be left under his direction and care until the installation has been completed. It is manifest that in so doing serious blunders will be avoided. I do not think it can be justly claimed that the railway companies have been too liberal in the amount of horse power purchased for the operation of their generators. In order to secure the best results, with reference to reliability of service, the horse power of the engine should be at least 20 per cent. greater than that of the generator which it drives, in order to provide for loss in transmission and excessive loads which are thrown on the generator by reason of a large number of cars starting at the same time; or on account of a ground being accidentally thrown upon the line. The steam plant should be so arranged and connected to the generators that either engine or generator may be readily inter-changed; and the arrangement of the engines and generators should be made with reference to future extensions. The switchboard containing the indicating and regulating devices, should be located so as to be most accessible to the attendant.

Both the power and electrical plant when complete and ready for operation, should be placed in the hands of men of experience and learning in these departments, in order to insure reliability of service, and the greatest economy in operation and maintenance. I would rather provide in advance for the expenditure of $1,000 or more in this department than to run any risk of having to pay out four times that amount in repairs and losses occasioned by mistakes of incompetent men.

The location and arrangement of the car house is a question of considerable importance, and open to serious mistakes growing out of bad location or improper interior arrangement. Some advantages are secured by locating the car house immediately adjacent to the power station. In this case it may be heated with the exhaust steam from the power plant, and the services of employes utilized in both buildings, and repairs to apparatus concentrated at one point. The car house should be provided with suitable pits for the inspection of the motors and also have proper accommodations for cleaning the car bodies. If the car house is to accommodate more than twenty or twenty-five cars, it should be provided with running and turning tables, and should also have more than one exit.

I cannot pass from the question of inspection of apparatus without emphasizing the extraordinary importance of having this work done thoroughly by competent and faithful attendants. With electrical apparatus of standard makes we can reasonably expect that a motor car sent out in the morning for the work of the day, having passed through proper inspection, will perform its duty with a degree of certainty that need leave but little, if any, cause for anxiety. This feature is perhaps the most difficult one to impress upon the management of electrical railway companies, more especially where such railways have been converted from animal power. If railway companies will guarantee that degree of care and watchfulness in the operation of their motors indicated above we take practically no chances by giving them the broadest guarantees as to the durability of the apparatus, and the cost of maintenance and repair.

It is apparent that in the overhead construction the highest degree of care should be exercised as to its details and arrangement, for this part of the equipment is constantly open to criticism. We cannot blind our eyes to the fact that serious, and in some instances, fatal criticism has been made to this work. We must all avail ourselves of the experience which has attended our efforts and see to it that our overhead construction is not in any case, or for any reason slighted.

I think an iron pole 28 or 30 feet long, made in three sections of extra strong pipe six inches in diameter at the base, and four inches at the top, provided with wheel base and insulated cap, presents the most sightly appearance on the street and forms the most substantial construction that can be had. Next in reliability and appearance is an octagonal pole of Southern pine suitably painted; and lastly, and the pole most commonly used, the Western Union standard. These poles should be properly set with sufficient rake to allow of sustaining a strain of at least nine hundred pounds. To these poles should be attached by means of eye bolts a galvanized steel wire having a diameter of at least .204 of an inch and drawn taut so that the poles will come to a perpendicular position. To these span wires there should be attached a suitable insulating device over the center of each track with proper attachments for suspending the trolley wire. This insulating device should be small in its construction, consistent with strength and high insulation, and the insulating material formed in such manner that it will in itself constitute a protection against moisture. The trolley wire should in my judgment be at least $\frac{3}{8}$ of an inch in diameter, considering the objection that is raised to the multiplication of wires in the streets. This wire should be hard drawn copper in lengths of at least one mile each. In this case the number of splices is reduced to a minimum, and by means of a suitable splicing ear the joints can be neatly, perfectly and securely made.

Where the streets are of a width of at least sixty feet from curb to curb it is regarded as thoroughly safe and practicable in cases of double track roads to place the poles in the center of the street between the tracks, and whether these poles be made of iron or of wood of octagonal shape, I consider that this arrangement presents the best form of overhead construction that can be secured.

When a conduit can be constructed that will permit of the safe, reliable and economical operation of street railways by means of electricity, we will all rejoice, and be glad. If its first cost can be made sufficiently reasonable to permit its use in cities of, say 50,000 inhabitants, it will be a magnificent achievement, and one that will surely bring its just reward to the successful inventor.

This thought is not prompted by reason of any vexatious troubles or annoyances which have occurred in the operation of the overhead system, but wholly on account of the objections which have been raised to the rapid multiplication of poles and wires in the streets, occasioned by the remarkable development and progress of the electrical science.

One of the prominent electrical companies is, and has been for some time, carrying on extensive and elaborate experiments with conduits, but have not, I believe, fully satisfied themselves of the commercial success of their latest undertaking.

I find little or no objection to overhead wires in places of less than 50,000 inhabitants. For this reason, and the fact of its low first cost, the overhead system will no doubt continue to be used in such places for some time to come, regardless of developments in the conduit system.

One of the most important features of an electric railway system is the track or road bed. My experience has been that sufficient attention has not been given to that part of the equipment, especially until very recently. The track should be constructed of a good form of girder or "T" rail, weighing 54 or 40 pounds per yard respectively, and should be attached securely to suitable ties placed not more than 2½ feet apart. It should be well ballasted, and where crossings are made over other tracks solid castings should be used in order to prevent the jolting and jarring which occurs when passing over them. The rails should be kept as clean as possible where they are used as a part of the return circuit. In order to use the rails of the track in completing the return circuit they should be firmly connected together by a copper wire in addition to the ordinary fish plates, and in certain cases, depending wholly upon the length of the line, number and extent of grades, and number of cars and amount of traffic, there should be used a supplementary copper wire, the size of which must depend upon the conditions just named. It is asserted by some electricians that the efficiency of the return circuit is increased in all cases by the use of a supplementary wire; but my experience has been upon small roads where the grades and traffic are light, that satisfactory and economical operation is secured where the supplementary wire is omitted.

Some of the essential requisites of an electric motor car are proper controlling mechanism and reversing switch for controlling the speed and direction of the car, a lightning arrester and multiple fuse-box. It should also be provided with suitable life guards, bells, and head-lights. The wheels of the car should in my judgment be at least 33 inches in diameter and weigh 300 pounds each. This will give increased adhesion and allow the motors to be raised sufficiently high from the ground to prevent practically the possibility of its being injured by striking obstacles between the rails.

Increased speed with a very slight increase of power will result by the use of the 33 inch instead of the 30 inch wheel.

The possible speed of a car equipped electrically is measured only by the limit of safety. The regulation speed in the majority of places is twelve miles per hour, and the average mileage per car per day about 115. It is well known that upon well regulated steam railroads the locomotives rarely make a continuous run of over 100 miles per day; and considering the extraordinary care that is given to them, and remembering in the same connection the very slight degree of care given to the average electric street railway motor, I think the latter is entitled to a very handsome compliment for the good service it gives us; and when you know that the best average mileage that can be made by a car propelled by the Kentucky horse or Texas mule is sixty miles per day, and even in doing this it is necessary to make at least four changes per day, I think you will admit that the electric railway motor is doing most admirable service.

The smallest town in the United States which has an electric street railway in operation is Southington, Conn., with a population of 5,400. Two cars are in service over two miles of track, and the average daily receipts are $9.00 per car. The power for the operation of this road is furnished by the local lighting company and costs $1.25 per car per day. The largest electric railway is at Boston, Mass. The entire system comprises 284 miles of track, sixty of which are electrically equipped and there are 312 motor cars in operation. During the month of August they had 300 motor cars in service, making a total mileage of 384,700,000. The mileage of the tow cars was 59,948,000; making a total car mileage of 444,648,000. From August 10th to August 16th, 700,000 passengers were carried by these cars without a single delay. In the month of September 312 motor cars were in operation making a mileage of 343,466 000, and the mileage of tow cars 56,047,000, making a total car mileage of 399,513,000. Following is a statement of one road:

Average number of motor cars run per day	20
Average number of trail cars run per day	0
Average number of hours per car in service per day	18
Average number of miles per car per day	108
Electromotive force	500
Average ampere readings taken hourly	122
Average electrical horse power	81 8
Average electrical horse power per car	4 9
Number of passengers carried per day	11,060
Number of passengers carried per car per day	553
Cost of operating, per car mile	$ .0616
Receipts, per car mile	.2560
Cost of operating, per car per day	6.65
Receipts, per car per day	27.65

Most flattering testimonials have been received from railway companies who have adopted the electric system and while they express their absolute satisfaction with the new motive power they also state, that the earning capacity of their road has been materially increased. In some cases the increase is given as high as 400 per cent., and in others as low as 50 per cent., but in no case that I can now remember, has the increase been given lower than the amount last stated.

Inquiry is sometimes made as to whether a motor car can be safely and reliably operated without a conductor. The present form of trolley and overhead construction readily permits of this; but I do not regard it as practicable or advisable except in the smaller places where the business of the road will not justify the expense of a conductor. I am familiar, however, with a number of roads in towns or cities having a population of less than 30,000 where the car is in the exclusive charge of the motorneer, and no trouble is experienced in its operation. With a good track there is little, if any, possibility of accident when proper care is exercised in taking curves and switches. Where the business will warrant the expense, however, there should be a conductor with every car or train.

We cannot overlook the fact that there are still some complaints of excessive cost for repairs and maintenance of the electrical apparatus, but I insist that the responsibility for this condition does not rest altogether with its manufacturers. The managers of these electric roads must appreciate that they are exacting a greater mileage duty of their motors than is expected of the ordinary railroad steam engine and under conditions manifestly more unfavorable. If they will admit this, and see to it that their tracks are put in good order and so maintained, and the same degree of care and attention given to their motors that is given to the steam engine, I am satisfied they will have little to complain of. How rarely do you find an electric motor operated on a track like that prepared for the steam engine? And how seldom, do you find a man in charge of the motor car who has the intelligence, training and expeience of the steam engineer?

Several railway companies which adopted the cable system before the possibilities of the electric system were fully appreciated or understood, are now seriously considering the complete displacement of that system and the substitution of electricity in its stead. I was recently informed by the president of one of the electric railway companies, whose line is a competitor to a cable road, that the latter company, feeling keenly the effect of the competition of the electric system had about concluded to reduce the fare on their road to 4 cents per passenger. Before this action takes place, however, I have no doubt that some bright representative of the electric system will persuade our cable friend to join the procession of progress, abandon the cable, welcome and adopt electricity as the motive power, and thus preserve the independence and stability of his street railway system.

There is no system or method of rapid street transportation that is so universally popular as the electric system; its wonderful flexibility is unparalleled in the history of street railways; capable of moving in either direction with equal facility. its value is materially enhanced from the standpoint of safety. Its first cost is about the same as for the animal system, and considerably less than the cable system. Knowing what the possibilities of the electric system are, and how cheaply it can be maintained and operated under proper conditions, I think we will see street railways thus equipped in many towns of a population not exceeding 10,000, and in some cases even less, and at a period not very remote.

I have previously alluded to the remarkable growth of the electric railway business, and given some reasons for it, but I do not feel that full justice has been done to the pioneers—I mean the manufacturers of the apparatus. When you consider what they had to do, and what they did do, in order to inspire confidence in the undertaking, I think you will all agree with me that they have merited even greater success than has attended their efforts, if that be possible. Contracts with all sorts of guarantees were made, long trial periods were given, the cost of maintenance guaranteed to be less than for the same number of cars operated by animal power, the current guaranteed not to be fatal to human life, and the system warranted to work in a thoroughly practical and successful manner, with a general and sweeping provision that in case of failure in any of the guarantees the railway company could, at their option, throw the apparatus out and assess the electrical company any damages which they had sustained by reason of the alleged experiment. Was there ever a new industry vouched for so absolutely by its projectors? Had the electric companies been less liberal with their guarantees, and not exhibited such a marked degree of confidence themselves, we undoubtedly would have been able to-day to count the number of electric railways by tens instead of by hundreds, for it is but a short time since the financial world has given its unqualified indorsement to the system. Bankers and trust companies took no part in formulating public sentiment or confidence in this matter. The undivided burden was assumed and borne by the electrical company, and not until they had fulfilled their numerous guarantees faithfully and well, and demonstrated beyond all peradventure the full and complete success of the electric street railway was the moneyed man or corporation willing to assume any hazard or risk. How the conditions have changed in two short years! Every principal city in the United States now has its electric street railway; full confidence has been established, and unreasonable guarantees are no longer required.

In closing, permit me to offer this prediction, that within a few years surface and elevated railways operated by animal, cable or steam power, will be numbered with the events of the past, and electricity, with all its beautiful attributes, in all its grandeur and magnificence, and in the full measure of the wide range of its possibility will claim supremacy in the broad realm of street railway transportation.

Operation of an Electrolytic Copper Refinery.[1]

By Dr. G. Gore.

The entire economy of working depends essentially upon cheapness of motive power and minimum investment of capital, and nearly every attempt to improve the process, in the direction of such economy, involves a choice between two evils. For instance, if we try to save horse power by enlarging the electrodes and adding to the number and size of vats in series, we rapidly increase the loss of interest upon capital expended in stock of copper, solution, plant, working space, etc. If we increase the density of current with the intention of working more rapidly with the same stock of copper, solution, etc., we increase the loss of energy by causing polarization, and run a risk of depositing impure copper. And if we attempt to diminish the resistance by placing the electrodes nearer together, or by quickly stirring the solution, we get dirt upon the cathodes, or short-circuiting occurs; and if we endeavor to decrease it by considerably heating the liquid, we rapidly increase the chemical corrosion of the deposited metal, and quickly alter the chemical composition of the liquid; or if we diminish resistance by large additions of acid, we promote chemical corrosion, polarization, and separation of gases.

Difference of potential required is a large element in the economical deposition of copper. Whilst the same number of amperes of current passing through the ordinary solution deposits the same amount of copper in all cases, the necessary degree of difference of potential to overcome resistance, etc., varies in different cases; and the greater this difference the larger the cost; double the potential requires double the motive power. It is desirable, therefore, to lower the difference of potential as much as possible by diminishing the resistance throughout the circuit, and by avoiding all polarization and counter-electromotive force.

The degree of electromotive force required varies with every different kind of solution, and consequently of anode. It varies according as the anode is composed of pure copper, "black copper," or "copper matte," and whether the anode is clean or covered with an adhesive badly-conducting coating; it is also much greater when gas is evolved at either electrode.

Influence of Impure Anodes upon the Liquid.—I will only speak of some of those substances which are more or less likely to be present in "black copper," pimple copper," "Chili bars," "blister copper," containing from 89 to 98 per cent. of copper, and in cruder regulus of reduced pyrites of iron and copper. Those impurities include antimony, arsenic, bismuth, cadmium, carbon, cobalt, gold, iron, lead, manganese, platinum, silver, tin, zinc, suboxide of copper, sulphides of iron, copper, and silver in the particles of unreduced pyrites of those metals, alumina, lime, magnesia, silica, and alkalies in the inclosed portions of slag. Black copper has been found to contain "1.23 per cent. of arsenic, 1.0 of iron, .54 of sulphur, .4 silver, and .011 of gold" (*Engineering*, 1885, p. 306).

In an acidulated solution of blue vitriol the following of those substances, viz: cadmium, cobalt, iron, zinc, sulphide of iron, alumina, magnesia, and alkalies of the slag, dissolve readily; antimony, arsenic, bismuth, tin and silica dissolve imperfectly, and partly fall to the bottom; carbon, gold, platinum, and sulphur from the pyrites are insoluble, and precipitate entirely; lead is converted into sulphate, which almost wholly precipitates; silver is changed into chloride; provided a soluble chloride is present, which is usually the case, and is entirely thrown down; suboxide of copper, and the sulphides of copper and of silver, also precipitate. The lime is all changed into sulphate, a small quantity only of which enters into solution, while the remainder subsides.

One effect of using an impure metal or an alloy as an anode is that its different constituents are corroded unequally, both by the ordinary chemical action of the liquid and by the influence of the current. By both these actions the most electro-positive metals are attacked first, and the others in succession, in accordance with the thermal law which governs such actions; and those which are not corroded at all, together with those which form insoluble compounds, either remain upon the surface as a coating, or fall to the bottom as mud. In consequence of this irregularity of action, the anodes are often corroded deeply in places, even while containing much metallic copper in their coatings become rotten, and pieces of them fall to the bottom, and this occurs the most with very impure metal, and especially with cupreous matte. When the anodes are made by fusion of copper pyrites, they often swell on the sides toward the cathode after a few days of electrolytic action. If also the liquid is not kept homogeneous impure ones are rapidly corroded, and sometimes cut through at the surface of the solution and fall to the bottom.

If arsenic is present, it partly dissolves as arsenious or arsenic acid, and gradually unites with some of the constituents of the mud to form insoluble compounds; arsenious acid is sparingly, and arsenic acid freely soluble. It also partly forms arseniates upon the anode, which are non-conductors, and by adhering to that electrode offer resistance to the current.

Antimony partly dissolves, especially in acid solutions, and partly forms an insoluble basic salt, some of which adheres to the anode, oxidizes and increases in weight, and some falls to the bottom; any oxy-salt of antimony appears as a white cloudiness when the liquid is sufficiently dilute.

Bismuth behaves much like tin and antimony; it partly forms an insoluble basic salt, which precipitates, and partly dissolves as an acid salt, which ultimately also becomes basic and falls.

Tin behaves much like antimony; it forms a mixture of proto-salt and basic salt some of which adheres to the anode and some dissolves, the proto-salt is white when dry, absorbs oxygen from the air rapidly to form persalt The presence of dissolved tin in a neutral solution is said to greatly improve the quality of the separated copper, without the tin itself being deposited; this, however, probably only occurs under particular conditions, because in some experiments I made for the purpose, this effect did not take place. The presence of tin in the anode increases the electromotive force of the current, because tin is more electro-positive than copper in dilute sulphuric acid

Lead, being also more electro-positive than copper, is attacked before it, and aids the electromotive force; but its sulphate, being very insoluble, falls wholly to the bottom, and only a trace is dissolved. There is but little risk of lead being deposited with copper, not only because its sulphate is so very insoluble, but also because lead is electro-positive to that metal. Lead, by being electrolytically corroded in place of copper, and uniting with acid to form an insoluble salt, diminishes the amount of copper and of acid in solution.

If the anode contains metallic iron and manganese, those metals are dissolved before the copper, and being more electro-positive assist the current; they dissolve as proto-salts, and subsequently become oxidized to some extent, but not completely, to persalts by contact with the air. If, however, the current is very much stronger than that usually employed in refining copper, these proto-salts are also oxidized to persalts at the anode; and in any case their persalts are reduced to proto-salts at the cathode by the current and cause great waste of power. The only way to prevent waste of energy in deoxidizing persalts at the cathode is to keep those salts out of the solution. Iron by dissolving in place of some of the copper at the anode, takes up some of the acid, forms green vitriol, and diminishes the solvent power of the water and the amount of copper in solution.

Any suboxide of copper in the anode, being a non-conductor, falls to the bottom, and is subsequently slowly oxidized and dissolved as cupric sulphate by the free acid. If the anode contains much cupreous sulphide, some of it is decomposed by the current, its metal dissolving while its sulphur separates and subsides. If its amount is small (as it usually is in "black copper"), being a very inferior conductor it is unaffected by the current, and falls to the bottom as fast as the metal around it is dissolved.

In an anode containing copper, copper oxides and sulphides, the current goes most by the path of least resistance, *i. e.*, very largely by the metal, very little by the sulphides, and much less by the oxides. If, therefore, the anode contains very little sulphide or oxide, the whole of the current travels through the copper, and the oxide and sulphide fall to the bottom; but if it contains much sulphide, some of the current passes through it. At the same time, independently of the action of the current, the liquid is always acting chemically upon each of these substances, whether they form part of the anode or of the sediment.

It is evident that when the anode contains a large variety of impurities the chemical actions going on at its surface must be numerous and exceedingly complex, and modify each other, and make it very difficult to accurately describe them. One effect of those numerous impurities is to cause an almost infinite number of local electric currents all over the anode, attended by corrosion and solution of all the more positive substances without the aid of the external current, thus gradually neutralizing the free acid, and saturating the water with metallic salts.

Influence of the Impurities upon the Current.—Provided the anodes are wholly metallic, their lower degree of electric conductivity due to impurities has very little effect upon the total resistance of the circuit, because the resistance of the solution is so very much greater. Consequently, also, it has but little effect upon the kind of dynamo required.

Impurities in the anode, however, have in some cases a great effect upon the electromotive force and upon the strength of current, either by giving rise to polarization and counter electromotive force, or by the formation or accumulation of badly-conducting substances upon the anode. The greater the number of impurities also the greater the risk of waste of energy.

It is a fact that the electromotive force, and consequently also the strength of current, is increased when the anodes contain as impurities metals, such as zinc, cadmium, manganese, or iron, which are more electro-positive than copper in the particular liquid, because they constitute with the copper cathode a voltaic couple sending a current in the same direction as the working one. But this assistance to the current, except with iron pyrites, is usually so very small that it is hardly observable, and the advantage of it is more than counterbalanced by disadvantages. The presence of iron in the anode aids the current to only a small extent, but that of zinc helps it more.

Usually when fresh anodes are put in, the resistance of the vat gradually rises to a maximum, but when the film of impurities is removed from them the resistance falls at once slightly; it also usually increases with the thickness of the coating, but only slowly because the layer is porous and saturated with the solution. The coating acts chiefly by preventing ready access of unexhausted liquid, and thus promotes polarization.

When the solution contains persalts of iron or manganese those salts are reduced to proto salts at the cathode, and a portion of the current is continually wasted in reducing them, instead of being wholly employed in separating copper, and the copper costs more to refine than when no iron or manganese is present. As long as there is sufficient persalt of iron in the liquid, no hydrogen is evolved at the cathode. With a copper-depositing solution containing much salt of iron, the difference of potential of plates of pure copper of a single vat has been found by experiment to be .22 volt, with an anode of black copper .25 volt, and with one of copper pyrites .5 volt; when the solution was deficient in free acid, it was .35 volt with black copper, and .75 volt with copper pyrites (Kiliani, *Engineering*, Vol. XL, 1885, p. 306).

Effect of the Impurities of the Liquid upon Purity of the Deposit.—The electrolyte is always less impure than the anode, because various of the impurities of the latter are either loosened by the corrosion of the surrounding metal, and separate and fall to the bottom unchanged, or they are separated from their compounds by chemical or electro-chemical decomposition and subside; or they are converted by chemical action into insoluble compounds, which precipitate.

The more impure the anode, the less pure usually is the electrolyte. In addition to the proper constituents of the liquid, viz, blue vitriol, sulphuric acid and water, there may be present in a dissolved state the sulphates of iron, zinc, manganese, cadmium, cobalt, aluminium, magnesium, calcium, potassium, and sodium, basic sulphates of antimony, tellurium, bismuth, and tin, and arsenious or arsenic acid.

By far the largest in amount of these dissolved impurities is the sulphate of iron; but the most objectionable ones are the compounds of arsenic, antimony and bismuth, because they are the most likely to yield their metals at the cathode, and thus affect the purity and quality of the deposited copper.

During the process of deposition the electrolyte continually becomes more impregnated with impurities, especially with iron, and, in much less degrees, also with zinc, manganese, cobalt, nickel, tin, arsenic, antimony, bismuth, aluminium, calcium (within small limits), magnesium, potassium and sodium, and gradually poorer in free acid, and sooner or later, requires to be purified.

Influence of Impurities of the Liquid upon the Current.—The greater the number of impurities in the electrolyte, the greater the risk of waste of electric energy. All ordinary sulphate of copper solutions used in the electrolytic refining of copper contains, after a time, a greater or less proportion of dissolved ferrous sulphate, and this substance gradually combines with the oxygen of the air and becomes persalt. In such a mixture there is liable to occur a considerable waste of current and deficiency of deposited copper—1st, because much of the electric energy is wasted in deoxidizing the persalt at the cathode; and 2d, because a solution of persalt of iron corrodes and dissolves copper; the free acid therefore decreases, and the liquid acquires greater specific gravity. The presence of green vitriol, however, prevents polarization at the anode, because it absorbs oxygen.

In a solution of green vitriol partly oxidized by the air, and being suitably electrolyzed with platinum electrodes, a mixture of iron and hydrogen is deposited at the cathode, and persalt is formed at the anode; and, owing to the absorption of oxygen from the air, the proportion of persalt increases.

Purity of the Deposited Copper.—It is a mistake to suppose that electro-deposited copper must be pure; if it has been deposited rapidly from an impure solution it may be very impure.

The purest electro-deposited copper is apt to contain traces of tellurium, bismuth and silver. These have been detected by photographing the spectrum of the copper. The presence of the first two of these would be due either to the density of the current at the cathode being too great, the liquid insufficiently stirred, or the proportion of copper being too small, or to all these causes combined; but most likely to a combination of the first and second. The presence of silver may be due to absence of soluble chlorides, or to sediment falling from the anode.

Of all the various circumstances already described which tend to produce purity of the copper, the most important are:—1, Absence *in solution* of all the metals which are the most readily deposited with it: these are silver, bismuth, antimony, arsenic, and tin; 2, using a sufficiently moderate density of current at the cathode; 3, keeping the solution perfectly clear and well circulated; and 4, not allowing any of the mud from the anode to touch the cathodes. All other conditions being alike, the most slowly deposited metal is the most pure.

There is usually not much risk of depositing any other metal than copper (and silver or bismuth if in solution) under the ordinary conditions of working when the density of current does not exceed 5 amperes per square foot, or the rate of deposition is not more than 70.7 grains per square foot per hour, and the increase of thickness is not greater than 1.07 millimetres, or .04 of an inch per week of 156 hours. At Stolberg, with an impure solution, and a density of current of 1.482 amperes per square foot, the purity of the deposited copper is stated to be "99.92 and 99.95 per cent. in two analyses." One source of impurity is fine powder from the anodes diffused in the liquid.

The difference of purity of the deposit obtained with different qualities of anodes depends very little upon the electric conductivity of the metal, because with every quality of copper the large mass of the anode has vastly less resistance than the electrolyte; but it depends very greatly upon the kind of impurities. If the impurities are soluble and readily deposited along with the copper, it is then necessary to reduce the speed of deposition but this greatly increases the cost. According to a German writer (Dingler's *Polytechnisches Journal*, Vol. CCLV., p. 531), the copper deposited at the Oker refinery is extremely perfect, while that of some English electrolytic refineries is less so; probably the latter had been too rapidly deposited. Some samples of American deposited copper have also been found to be impure. A minute proportion of antimony or bismuth destroys the good qualities of copper.

Cost of Electrolytic Refining.—The cost of refining copper by electrolysis varies with the magnitude of the installation, and depends essentially upon the expense of motive power, and of interest upon invested capital; also largely upon the degree of "commercial efficiency" of the dynamo, and upon the kind and amount of impurities in the crude metal, which are continually varying, because the composition of each batch of unrefined copper differs. The larger the proportion of foreign metals which are easily deposited with the copper, and the purer the refined copper required, the greater the cost of the process, because it must be conducted more slowly. The cost when anodes composed of the unreduced sulphides of copper and iron are employed instead of metallic copper, as in "Marchese's process," is considerably different.

Where motive power or fuel is cheap, advantage is taken

[1] Continuation from the Western Electrician of November 15, 1890. From advance sheets of Dr. G. Gore's Book on the "Art of the Electrolytic Separation and Refining of Metals," published by the Electrician Printing and Publishing company, London.

of the circumstance to economize the expenditure upon vats and copper by using it more freely. At Casarza, where water power is cheap, the proportion of copper deposited is 1.4 lb. per horse power per hour; at Pembrey, where coal is cheap, it is 2.6 lb.; but at Hamburg, where motive power and fuel are dear, it is 6.87 lb. The amount of electric energy and of horse power consumed in depositing the same weight of copper differs in nearly every electrolytic refinery. Where coal is cheap and the process is conducted on a large scale with a good steam engine, at least 110 indicated horse power is obtained during one week by the consumption of 50 tons of coal, and with good dynamos will deposit 20 tons of copper per week, at a cost of £20. The interest upon capital invested in plant, etc., during the same period will amount to about a similar sum. Or, if we reckon the cost of one mechanical horse power at one penny per hour, the cost of such power for electrolytic refining of copper is about one farthing per pound of that metal refined. Difference of potential required to overcome resistance and polarization is also an element in calculating the cost of depositing a given amount of copper, because double the electromotive force expended costs quite double the money.

The chief elements of cost are:—1. Interest upon capital expended upon copper, electrolyte, vats, steam engine, boiler, dynamo, and other plant. 2. Fuel, water and oil for the engine. 3. Rent and taxes. 4. Labor. 5. Depreciation of steam engine, boiler, dynamos, vats, etc. 6. Incidental expenses.

The total stock of copper required in order to refine a given amount of that metal per day or week varies in different works. In each refinery, besides the amount of copper in the vats, there is at least an equal quantity in the form of main conductors, raw copper for making anodes, new anodes ready for immersion, and residues of old anodes also the stock of refined copper. The value of the stock of copper alone in one of the installations at Hamburg has been estimated at £8,000. Practically, to refine 30 tons a week of ordinary "Chili bars," with a current density of 8 or 10 amperes per square foot, requires a total stock of about 400 tons of copper, which, at £50 a ton, costs £20,000, to which we must add about £10,000 for plant and premises.

A number of workmen are necessary, probably about twenty, working day and night, when depositing thirty tons of copper per week, to manipulate the electrodes, examine the vats and attend to the steam engine and dynamo, melt the cast anodes, wash dirty ones, etc. A chemical analyst is also employed to analyze the copper and the electrolyte. As stoppages in the process do not often occur, they are not a large element of expense; there is, however, the cost of occasionally emptying the vats, evaporating and purifying the solution, collecting and treating the mud, etc.

The cost of one of the latest forms of dynamo for electrolytic refining of copper by Messrs. Siemens and Halske, viz., their "H C" type, constructed to give 1,000 amperes at a difference of potential of 60 volts, was £420. and that of a 50-unit one, by Messrs. Chamberlain and Hookham, giving 500 amperes at 100 volts, about £400. With large vats, and large currents of low electromotive force, the cost for the same rate of deposition is less, but that of the dynamo and conductors is greater than with small vats and small currents of higher electromotive force. A vat containing one cubic metre costs about 130fr., and one of three cubic metres "double that sum." The vats at Biache cost 350fr. each. One cubic metre of the ordinary copper solution costs about 70fr.

The total cost of M. Hilarion Roux's installation at Marseilles, including the baths, dynamo, and steam engine to refine "250 kilogrammes per day" (=89½ tons yearly), is stated to have been £1,000, and the amount of invested capital "£5,000 to £6,000." The "Societa Anonima Italiana di Miniere di Rame e di Elettro-Metallurgia," in Genoa, whose works are at Casarza, was established with a capital of 4.8 million marks (=£240,000) (Dingler's *Polytechnisches Journal* 1885, Vol. CCLV., p. 201).

It might be supposed that the silver and gold recovered constitutes a considerable profit, but all this has to be paid for extra in purchasing the crude metal.

In consequence of the numerous circumstances which affect the cost, an approximately satisfactory estimate of the total amount of capital required to be invested in establishing an electrolytic refinery to deposit a given amount of copper daily, can only be arrived at by means of a knowledge of all the essential particulars in the given case.

Recapitulation.—In establishing an electrolytic copper refinery the chief points usually require to be settled in the following order—1st. The amount of copper to be deposited per week. 2d. Amount of mechanical power required and the kind of motor. 3d Degree of purity of the solution and of the crude metal. 4th. Rate of deposition per square foot of cathode surface per week. 5th. Total amount of cathode surface necessary. 6th. Total number of vats in series. 7th. Magnitude of each vat. 8th. Electromotive force and strength of current necessary. 9th. Kind of dynamo. 10th. Magnitude of the main conductors. There are, of course, other important points to be first considered, such as the most suitable locality for cheap motive power, cheap conveyance, etc., but those do not come within the intended scope of this article.

Electricity in the Summer Hill Mines.

The Summer Hill mines at Woodville, Pa., have just been equipped with a complete electric plant of mining machinery. The power plant consists of one Westinghouse Junior engine, one 30-horse power three-wire, four-pole Westinghouse alternate current generator, six Hercules coal mining machines, a twelve-foot fan with a capacity of 30,000 cubic feet per minute, centrifugal pump, etc. The mining machines and the pump are operated by 3-horse power Tesla motors. The entire equipment has been furnished by the Westinghouse Electric & Manufacturing company. A careful record of the work of the mining machines in the Willock mine, which is also operated by Westinghouse electric mining appliances, shows that from July 1 until August 8 each cut represented about one and one-tenth tons of coal. It was found that it was impossible to keep the rooms clear of the coal which was brought down so fast that the machines were not given a chance to show their full capacity. Each machine is doing the work of from twelve to fourteen pick miners.

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 15.—Since Jay Gould was reported as saying that the Manhattan Elevated Railway company was making experiments with a view of adopting electric traction, the discussion of the probability of electrical propulsion for elevated roads has continued. The discussion has been followed by an agitation of the question of lighting cars by electricity. If the elevated people would put their electricians and engineers at work to devise a practical motor for hauling the trains, there would be no need for Col. Hain to bother his brain about lighting and such minor details. He is reported to have said that the electric lighting companies have found insurmountable difficulties in the way of a handy equipment, and that he did not think a practical system of lighting the cars would be devised until something of a different nature was undertaken to greatly perfect the electric system. Col. Hain practically admits, however, that his company has received various estimates for lighting the cars by electricity, and it is hoped that through the adoption of electricity for lighting the question will be so thoroughly looked into that a practical method of hauling the trains by electricity will be devised.

At the regular monthly meeting of the Electric Club next Thursday, Prof. E. L. Nichols of Cornell University, will deliver an address on the topic: "The Artificial Light of the Future," and in his lecture he will endeavor to "point out the nature of certain limitations which seem to preclude hope of any marked improvement in the efficiency of our present methods of lighting; then to discuss the properties of certain sources of light, not made use of at present, with a view to the more or less remote possibility of their development as practical luminants. The lecture will include the presentation of some original work not yet published, together with the collation of various researches, which have not attracted general attention, taken singly, but which seem to Prof. Nichols to be significant."

The Brooklyn Institute announces lectures in the Department of Electricity for Friday evenings during November. Dr. S. S. Wheeler will address the department next Friday evening on "Some Applications of Electricity."

Just south of the new depot of the Long Island Railroad company, in Long Island City, a brick building has been erected to accommodate the electric plant that is being put in. It will consist of four tubular boilers, with a capacity of 320 horse power, two 80-horse power Westinghouse engines, and four dynamos with a capacity of 160 lights of 2,000 candle power each. Two boilers will be used to supply steam heat to the station and offices, and also to keep the cars heated while they are standing in the yard detached from the locomotives, just before starting.

W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Nov. 15.—Considerable interest is felt in Minneapolis in regard to the outcome of the agitation of the question of municipal lighting, which was an element not without influence in the recent city election. Alderman E. G. Potter, who was the republican candidate for mayor, was favorable to the project of establishing a city electrical plant for lighting purposes, as well as a good many other similar innovations in the conduct of the municipal business. He was defeated, and lays the blame at the door of the larger corporations of the city, among which may be mentioned the companies which hold the lighting contracts and the street railway franchise. Potter is still a member, and a very influential one, of the republican majority of the city council, and it is not unlikely that, in memory of the late occurrences which interest him, he will undertake to bring the question of municipal lighting to a focus, and possibly to exact from the street railway company some unpleasant conditions which the peculiar status of its franchise renders possible. At any rate it is certain that both these matters will come before the council within a short time, and it is expected that fur will fly, whatever the outcome may be.

One of the most important of the new electrical lines in the city will be started in operation next Tuesday. This is the one which follows Twentieth avenue to Penn avenue, thence on Penn to Thirty-second avenue, and thence to the city limits, where it connects with the new suburban line running to Robinsdale. Not all of it is completed. The first motors will only run to Penn avenue, but work is being very rapidly pushed and it is hoped to complete it to the city limits without interruption. The Robinsdale company is also pushing work on its line and is making satisfactory progress, notwithstanding the fact that frost has already penetrated a considerable distance into the earth and grading is a slow process.

The Northern Car company at Robinsdale has got its new foundry in working trim, and finds it an invaluable addition to its plant. Much life has been infused into this company by the acquisition of a few local stockholders of wealth and energy, and it seems destined to play a not unimportant part in the street railway development of the Northwest. It is now furnishing cars for electric railways in Cleveland, O., Tacoma, Wash., St. Paul and Minneapolis, and within a short time will commence work on the equipment of the line in which its stockholders are principally interested between Robinsdale and Minneapolis.

Another new electrical line of railway is projected by local capitalists. W. A. Barnes and Jacob Barge, large owners of North Side and suburban property, are interested. The new line is to be an extension of the Bloomington & South avenue line of the Minneapolis Street railway, from Penn avenue to Medicine Lake, one of the popular resorts of the vicinity and a residence suburb of growing importance. As a preliminary to the plan the city council will be asked to boulevard Sixth avenue, between Penn avenue and Medicine Lake. The design of the projectors is to lay the track themselves and to turn it over to the operating department of the city railway but in the event of failure to make satisfactory arrangements with that company they will operate it themselves. It is believed that this line will take rank with the First avenue line to Lake Harriet and Calhoun as soon as it is built.

Manager Scott of the St. Paul City Railway company denies the assertion that President Lowry promised to have cars running on the Rice street extension by Dec. 1. That line, however, will be the next one to be completed in St. Paul. West Side citizens of St. Paul have threatened an injunction against the company, restraining them from using cleats on the Wabasha street bridge for the safety of horses in the winter. The grade of the bridge makes these cleats necessary.

Last night's meeting of the city council was fraught with consequences of moment to the western suburbs of the city. Lines of electrical railway were ordered constructed on the Hennepin boulevard from the junction of Lyndale to Thirty-fourth street and thence to Lake Calhoun boulevard, and also from Twenty-seventh street and Lyndale avenue, along Lyndale to Thirty-first street, thence to Bryant avenue and via that street to Fortieth; also beginning at Twenty-eighth street and Lyndale, west to Hennepin avenue The company will be allowed to abandon the present Twenty-seventh street line when these new lines are completed. A few weeks ago there was a determined controversy among the property owners on Hennepin boulevard over the proposal to lay track on that beautiful thoroughfare, but the result has been definitely settled by this action of the council. The anticipated protest over the company's delay in getting the inter-urban line in operation did not materialize. Charges have been made that the street railway company has been in collusion with the short line railways between the two cities, and might possibly abandon the line. This is idle talk, however, as the inter-urban line will be started when the company has power enough to operate it successfully.

F. A. Greenlaw is announced as the future managing editor of the *Electrical Northwest*.

Platt S. Bates of Minneapolis, is the inventor of a simple apparatus by which the trolley may be guided without disturbing the connection in cases where changes are necessary. The object is to keep the cars lighted during the operation.

N. O. F.

Kansas City, Mo.

KANSAS CITY, Nov. 15.—Alderman Hunter is full of municipal lighting ideas just now but so far he has not touched up electric lights. The city charter does not give the municipality power to enter into a long contract. It prohibits the city from issuing any orders for work or service of any kind unless the money is in the treasury to meet the payment. The gasoline lighting company has a ten years' contract which is soon to expire. The council believes the charges are too high, the service too poor, and the contract not binding. It has thus far adopted resolutions stopping the payment for the lights and an ordinance providing for the removal of the lamps from the streets has been prepared. Another ordinance which affects gas and electric lights as well as gasoline lamps is under consideration. It provides for a complete record of all public lights, the location of the same, and the date on which they were ordered.

There has always been much uncertainty and lack of method in the city's system of dealing with the street lighting question, and until recently there was not an

official of the city who was able to give the total number of lights on public use or the number of any class of lights without referring to the monthly bills presented by the lighting companies. The charter provides that the board of public works shall discharge the duties of a light commissioner in lieu of the appointment of such an officer.

A successful test of the Kansas City, Kan., Fire and Burglar Alarm company's striking system was made last week. The company will make a proposition to furnish boxes for the city.

The directors of the West Side Street Railway company of Kansas City, Kan., held a meeting last week at which the bonds and all the final papers necessary to the construction of the proposed electric line were signed and delivered.

Under the terms of the agreement with several donors of land, the work of construction is to begin before Dec. 1, 1890, and the line is to be completed and in successful operation by May 1, 1891. The directors of the company are highly pleased with the changes in the route made by the council at its last meeting, by which the southern terminus will be at Fifth and Minnesota avenues. This, they say, will not only give them access to the business portion of the north side, but will also give them an outlet to the south, it being the intention of the company to increase the system until it has twenty miles of double track electric street railway in Kansas City, Kan. This will not be done, however, until the proposed North Side line is completed.

For the past six months the telephone exchange has been experimenting with methods to prevent induction and has decided to use the common return wire system, which, while not entirely successful, is an improvement. Already 2,000 subscribers have been connected.

The Postal Telegraph company has completed the extension of its lines to Memphis, Nashville and Murfreesboro, Tenn. Next month the extensions will have been completed to Mobile, New Orleans and other principal Southern points, and a new territory opened. Since the Baltimore & Ohio sold out two years ago the Postal company has had no Southern connections. P.

Pittsburg, Pa.

PITTSBURG, Nov. 15.—At the last meeting of the city council an ordinance was passed granting the Market Street Railway company and the Grant Street Railway company, whose roads will form the down town loop of the Duquesne Traction company, rights and privileges over certain thoroughfares. Another ordinance was adopted granting the Duquesne Traction company the right to use the streets now utilized by the Central Passenger Railway company and the Transverse Railway company, on securing the consent of these companies.

Some time ago it was announced in this correspondence that the Second Avenue Electric Street Railway company of this city intended to extend its line from the present terminal point in Pittsburg as far as Homestead, a distance of ten miles. What was then a rather visionary project seems likely now to become speedily realized.

Homestead is a very thriving suburb of this city, which suffers from its inaccessibility. It is situated on the south side of the Monongahela river, and as the Second Avenue Electric Railway company operates on the opposite side, it will be necessary for the company to build a bridge across the Monongahela. For this purpose the company has asked the governor of Pennsylvania for a charter, which will be issued on Dec. 4. In the meantime, however, the company is going ahead with the construction work of the new line, and intends to start with the bridge as soon as possible; there is very little doubt that the road from Pittsburg to Homestead will be in operation next summer. The company promises to carry the passengers over the entire distance in forty-five minutes. In addition the line will open up a very desirable location for private property.

The Second avenue line, which has now been in operation since last April, has been very successful. While the company worked the line with horse power it was considered the worst street car line in the city. It never paid dividends. From the very moment, however, the company commenced to run with the motor system the patronage of the line has been on the increase. At first the company thought it would be sufficient to begin by operating ten cars on the line. Very soon, however, the traffic became so heavy that the company was forced to increase this number, and now it is operating eighteen cars. Mr. Murphy, the superintendent of the street car line, is a practical street railway man, and a good deal of the success of the road is to be attributed to his energy and business ability.

At a shop for repairing electrical and other instruments in this city, an old surveyor compass turned up a few days ago, which is quite a curiosity in its way. The compass was made by Rittenhouse & Evans, the first instrument makers in this country. The compass bears the date of 1800, and the name of Richard Scherer as the owner of the instrument. Scherer was the first postmaster of Lewistown, Pa., and the compass has been in that gentleman's family ever since. The instrument is perfectly graduated in degrees, and is much lighter than the ordinary compass now made. When the needle is remagnetized the compass will be as good as the day it was made. E. H. H.

Louisville, Ky.

LOUISVILLE, Nov. 15.—The new mammoth building of the Louisville Steam & Electric Power company on Third street, is well under way. The front is up to the second story, and the work is even further advanced on the rear portion of the building. The work, it is hoped, will be completed by next spring. Capt. J. G. McCollough is the president of the company. As has been stated, the object of the company is to furnish power both to occupants of the building, and to persons outside. The company will not furnish light except in the building itself. The building is to cost $100,000.

The bids for furnishing the city of Louisville with electric lights have been received and contracts have been awarded by Mayor Jacob. There were three bids. The Louisville Gas company offered to furnish 150 arc lights for $66 a year per light; the Central Thomson-Houston company made a bid of $8.25 a month for each lamp, and the Brush Electric Light company of this city, made a bid of $79.20 a year per lamp. The mayor made the award to the Gas company, as the lowest bidder and he says it is the lowest price for electric lights in the United States. The contract, together with the bond of the company, will be presented to the general council for approval, and if approved, the contract is to go into effect at once. The Gas company will put in fifty or sixty lamps immediately, and will have the entire 150 lights in operation by next June. The lights will be supplied with a current from the old Louisville Electric Light company's plant, which was bought out by the Gas company. There is some talk to the effect that the general council will refuse to ratify the award. The council will not have a chance to act until the 20th inst.

The Gas company is also looking out for other large contracts. The Louisville & Nashville has finally rejected all bids for lighting the Union Passenger and Freight Station at Tenth street and Broadway, and now, it is said, the light will be be furnished from the central power house of the Gas company. Already, it is said, the L. & N. has commenced to secure rates for lamps and for wiring. Some of the bidders are complaining because the railroad corporation after putting bidders to the expense of preparing plans twice, has again rejected all bids.

There has been great boom in the sale of electric lamps the past few weeks. The Gaynor company has just placed an order with the Edison General Electric company's agents here for 10,000 incandescent lamps. These are to supply the Gaynor company's regular trade and the prices are said to have been made at a low figure. The order was increased by the Gaynor company this week, and the Edison company has sold 5,000 to various other companies the past week.

Campbell Scott of the Edison General Electric company, stationed here, has returned from New York. J. W. L.

Ogden, Utah.

OGDEN, Nov. 12.—Recently the city council granted A. S. Garetson of Sioux City, Ia., and Boston capitalists a blanket franchise for an electric street railway. The old company which propels its cars by smokeless steam motors and mules, enjoined the city council and the new company from entering into any agreement for the new enterprise, claiming for themselves an exclusive franchise. Late last Saturday afternoon the Garetson company put an army of men and teams to work in the heart of the city tearing up the streets and laying tracks. They paralleled the principal streets and obstructed the crossings so that car service was abandoned. Representatives of the companies met at the corner of Twenty-fifth and Washington avenue, and an effort was made to stop the work of the new company, which was interfering with the old company's lines, but track laying and the placing of crossings continued vigorously. The result was the old company discontinued running their cars entirely and appealed to the Territorial Supreme Court for a temporary injunction, which was granted. The two companies are preparing electric plants for operating both systems. The new company is developing the water power of an adjacent canyon to run the plant. It will also supply power for manufacturing and other uses. An application for an injunction will be made by the old company on the ground that the two plants paralleling each other with heavily charged wires is detrimental to abutting property. Public sympathy is strongly in favor of the new company. The majority of the stock of the old company, which represented $250,000, is held by the Jarvis-Conklin Trust company of Kansas City. G. M.

Nashville, Tenn.

NASHVILLE, Nov. 10.—The Rapid Transit company has completed its power house buildings and is putting the necessary machinery in place. The buildings are well built, of brick, and located on the corner of Hudson and Pearl streets. Its roadbed and tracks are about completed, and the work of putting up poles and wires is being rapidly pushed. This line covers a large portion of the city that has never had street car facilities. The United Electric company includes all the lines formerly operated by mule power, one steam dummy line, and some recent extensions. All these lines had to be provided with heavier ties and rails. This work has been about completed in a thorough manner, and the entire system works to the satisfaction of the public and the shareholders. There are still in operation two steam dummy lines, one running south and the other west, to important suburbs. It is only a question of time and financial ability, when these two lines will abandon steam and substitute electricity. Negotiations to that end have been going on for some time, but as yet have resulted in nothing definite. A tightness in the money market for a few weeks past has depressed the prices of all kinds of local stocks and securities except those based on Southern iron and coal industries.

When the new manufacturing suburb of this city was first laid out all the wise men, the stockholders, the newspapers, and pretty much everybody else, became interested in choosing an appropriate name for the new "boom" town. The committee appointed for that purpose, after daily sessions of three weeks or more, and considering all the suggesting offered, finally adopted the name of "West Nashville." But wise men may adopt names, but only the common, everyday, working people can give them currency. The latter persisted in calling it the "New Town," and by that name it is known. It is not a name that is calculated to create any wild enthusiasm on the part of cash investors, and the stock of the "West Nashville Land Improvement company" gradually crawled downward from sixty-seven cents on the dollar to eleven cents. The Rapid Transit company will soon have its electric cars running to the "New Town," and from this cause, aided, perhaps, by some others, the stock of the "Land Improvement company" has advanced within the past three weeks, under a pronounced financial stringency, to eighteen and three-fourths cents. As the "New Town" already has four regular freight and passenger railroad trains both ways every day, and a steam dummy passenger train both ways every fifty minutes, of course the electric car line will have a heavy competition at the start. But there is an ease and comfort in riding on an electric car that is absent in most all other modes of rapid passenger traffic, and the certainty of reaching a destination on schedule time will command the patronage of that increasing class of every day working people who have neither the time nor inclination to walk.

The blast furnaces in the "New Town" have resumed operations, and employ several hundred hands, and Mr. Silberhorn, a pork packer of Chicago, Mr. Garrettson, an Omaha banker, and some local capitalists, have purchased about 1,000 acres of land adjoining, and will erect a million dollar packing house within eighteen months. These, together with the wood-working industries already in operation in that suburb, will insure the Rapid Transit company a good patronage.

The Postal telegraph people have secured all the rights of way and franchises they asked for in this city, but are making slow progress in the erection of the line.

The Nashville & Chattanooga railroad has about completed new shops in this city covering about thirty acres of ground, and will soon install a complete electric light plant B.

Des Moines, Ia.

DES MOINES, Ia., Nov. 15.—The desire for a better system of rapid transit has been expressed by the citizens of Clinton, and the city council has been asked for a charter for an extensive electric railway system. The company proposing to build the line is backed by Eastern capitalists. The line proposed will cover the business center of Clinton and through South Clinton and Chancy, with spurs in various directions, so as to cover the entire territory. Storage batteries are to be used and a double track will be laid in the business part of the town. If the charter be granted soon, as now seems probable, work will be carried on all winter, giving employment to many men.

Charles Harriman of this city, has been granted a patent for an electric trolley. The invention consists of an extra arm run from the center of the top of the car along the top

to the end. The trolley proper is fastened to the end of the extra arm, so that the trolley wheel is brought directly over the rear, as in the ordinary trolley. The inventor claims that this will keep the wheel always running evenly and smoothly on the wire in passing around curves.

The Burlington city council and the electric street railway company are engaged in an animated war concerning the charter granted the company. The council claim that the horse lines were to give place to an electric system during the present year, while the company maintain that no time was specified. The council has given the management its ultimatum, which is that it must deposit a $10,000 bond as a forfeit if the system is not rebuilt, equipped and operated with electricity by the first day of next June; that the equipment must be the latest improved Westinghouse manufacture, and with a bonded guarantee that it is capable of maintaining a ten-minute service; that a car must pass a given main point every ten minutes, and that the tranfer system which prevails in Des Moines must be adopted.

Marshalltown newspapers are agitating the question of building an electric railway to replace the present horse car system.

The Perry city council has before it a request from the Edison Electric Light company for a franchise giving the company the right to the streets and alleys for light, heat and power purposes for twenty years. The council unanimously passed a resolution submitting the proposition to a vote of the electors of the city. F. M. C.

THE ELECTRIC LIGHT.

Salem, Va , is considering several propositions for the installation of a city plant.

The South Charlestown, W. Va., Improvement company will install an electric light plant.

The Athens, Tenn., Electric Light & Power company has secured a franchise from the city to erect an electric light plant.

The Thomson-Houston Electric company of Chicago has sold to H. H. Shufeldt & Co., distillers, Chicago, a 400-light incandescent plant.

The Fort Wayne Electric company is remodeling the plant of the Louisiana Electric Light & Power company at New Orleans. The station has been enlarged and new dynamos and engines installed to replace the old apparatus. Four 3,000-light incandescent dynamos have been placed in position.

The Chicago Illuminating company owns and operates the plants formerly controlled by the Central Illuminating & Power company, Fidelity Electric Light company, and the South Side Electric Light company. The Illuminating company also operates the electric light plant of the Office Toilet Supply company.

The General Electric Light company of Seattle, Wash., has been awarded the contract for city lighting. At present the city is operating sixty-four 2,000-candle power arcs, 386 15-candle power incandescents, and 143 30-candle power incandescents. The cost of operating these lights under the new contract will be $2,137 per month.

The Joliet, Ill., Electric Light company, the Thomson-Houston company of Joliet, and the Hyde Park Water Power company, have been sold to the Economy Light & Power company of Chicago for $400 000. The officers of the new company are John L. Norton, Lockport, Ill , president; J. C. McMullen, vice-president; L. E. Ingalls, secretary, treasurer and general manager.

The electric light company of Anaconda, Mont., is building a new power house. It will be a substantial brick structure 60x96 feet. The company will install twenty dynamos: Two 1,500 light machines, three 500-light dynamos, one 60-light arc machine of the Westinghouse pattern, seven United States dynamos, and the generating plant for an electric railtoad. Water power will be utilized in the operation of the plant.

A Siamese electric light company has been formed in Bangkok, and a contract made with the Brush company to supply engineers and material for the establishment of a system of electric lighting in the city within a radius of five miles from the central station in Bangkok. There being no supply of gas except on the road in front of the Royal Palace and the thoroughfares being but dimly lighted with oil lamps, the employment of electricity in illuminating the public roads and buildings will, no doubt, place Bangkok in a position superior to that of many Oriental cities. The owners of large rice and saw mills, too many of whom keep their mills working day and night, will undoubtedly find the use of the electric light on the mill premises desirable from an economical point of view, apart from the consideration of increased illuminating power. The shares of the company are now quoted at a premium.

A couple of Stillwater men went to St. Paul recently, according to the Minneapolis *Journal*. One was named Michael Kelly and the other Smith. A dispute arose over the efficacy of the insulation of electric light wires. Smith claimed that whenever a light wire crossed a telephone wire it burned out an instrument, and Kelly maintained that if such was the case the town would be full of dead people in two hours. To settle the matter Kelly climbed a pole near by and gripped a live wire in his hand without sustaining injury. He was about to descend when he touched the wire again accidentally and this time at a point where the insulation had been removed for a connection. Kelly received such a shock that he fell, but his coat catching on the spikes in the pole kept him suspended twenty-five feet from the ground. He recovered sufficiently to make the descent with the help of his friends. He was taken into a drugstore and it was found that he had only received a small percentage of the strength of the dynamo. He was unable to walk, and was taken to the Minnesota house in a hack. But for the accidental catching of his coat on the spike Kelly would probably have been killed by the fall.

The Chicago Edison company has installed two 450-light compound wound incandescent machines for Nelson Morris & Co at the stock yards, Chicago, and two Sperry 20 light arc machines. Selz, Schwab & Co. have added a 450-light machine to their plant, making the capacity 1100 lights. The Chicago Sugar Refining company has also increased its plant by the addition of a 450-light machine. In Young & Farrell's stone yard a 500-light plant was installed, enabling the men to work nights. The Chicago Ship Building company has installed a 270-light plant at its Calumet docks. The lights are carried out 400 feet on the docks. A 25 horse power Rice engine was also installed to drive the dynamo. The Chicago Edison company has also secured contracts for furnishing light from its central station on Adams street to the world's fair offices in the Rand-McNally building, making a total of 1,400 furnished from the station to that building. The company recently put in a 500-light plant for Rand & McNally's printing establishment in the same building. The Watson building on LaSalle street, and the Kimball building on Wabash avenue, are also connected with the station. The former is wired for 340 lights and the latter for 717 lights.

THE ELECTRIC MOTOR.

The Spokane Falls Electric Railway company will construct an electric road from Spokane Falls, Wash., to Altamont.

The Los Angeles, Cal., Electric road has begun operations. Work on the Belt Line Electric company's road will be begun immediately.

The Anniston, Ala., Street Railway company will experiment with the storage battery system, which will be adopted if found satisfactory.

A company with a capital stock of $300,000 has been formed at Greenville, S. C., for the construction and operation of electric roads.

A franchise has been granted E. W. Meeks, C. E. Palmer, W. J. Sanders and E. B. Stone for an electric road from Oakland, Cal., to Hayward.

The Astoria, Ore., Electric Power & Transit company, capital stock $150,000, has been incorporated by J. M. Moore, A. P. Sharpstein and C. E. Belding.

James M. Thompson, president of the Pacific Cable Construction company, has arranged to build an electric motor line from Front and Stark streets, Portland, Ore., to Willamette Heights.

J. H. Allen and associates have been granted a franchise to construct a street railway at Cedartown, Ga., with the privilege of using electric, steam or horse power. Work is to commence within thirty days.

Gen. M. H. Sherman, Col O. B. Carr and others have a plan to construct a belt line electric railroad around and through Los Angeles at an estimated cost of $1,500,000. It is claimed that $500,000 have already been subscribed.

A recent dispatch from Alton, Ill., states that the papers have been signed transferring the two street railroads between Alton and Upper Alton to the Holmes syndicate. The new company will also build a new line to North Alton and operate all three by electricity.

Work has been commenced on the Queen Anne extension of the North Seattle electric road. The line will be extended up along Olympic avenue about half a mile to the top of the hill. The extension will be double tracked, and it is expected to have it in operating order in about six weeks.

The electric railroad and franchises of the South Side Land & Improvement company and the property of the Richmond & Manchester Railway company have been consolidated and the latter company reorganized with A. H. Rutherford of Baltimore, Md., president. The capital stock is $300,000.

Savannah, Ga., has had a little experience with electric railways, and it is now clamoring for an extensive system to replace the time honored mule lines. The Enterprise Street Railway company has accordingly petitioned for a franchise granting the right to construct and maintain a complete electric system covering the entire city.

The Home Electric company, Seattle, Wash., is building a new power house 130 feet square and two stories high. The company will install six boilers, 160-horse power each, and three 250-horse power Armington & Sims engines. The new electrical apparatus will give the company capacity for 5,500 incandescent and 350 arc lamps in addition to its motor service.

The Electric Power & Transit company will build an electric road in Clatsop county, Ore , to begin at the intersection of Cushing's Court and Sixth street in the city of Astoria, and extend southerly to the north side of the Walluski river, and near its junction with Young's river; also, and as part of the system, the road is to be built from Twelfth and Main streets, Astoria, to Smith's Point.

The Short Electric Railway company announces for the month of November the following contracts for electrical equipment: The Schuylkill Electrical Railway company, Pottsville, Pa.; the Watervliet & Turnpike Railway company, Albany, N. Y.; the Texarkana Street Railway company, Texarkana, Ark.; the Lindell Avenue Railway company, St. Louis, Mo., and the Syracuse & Onondaga Railway company, Syracuse, N. Y.

The Rainier Electric Railway & Power company is proceeding with the construction of its electric railway at Seattle, Wash. The company has in view two franchises, one from the terminus of the Lake Union line of the Seattle Electric Railroad company along the west side of Lake Union to Latona, the other from the same point along the south side of the lake, thence along Republican street and Olympia avenue to the intersection of Olympia avenue and Illinois street. The former line is now under construction and is expected to be in operating order within six months. It will be two miles long and double track. The roadbed has already been graded for nearly a mile, and work is being done at the Latona end. It is the purpose of the company to construct a bridge across the neck of the lake, and make Latona the terminus of the line. After this branch is completed work will be commenced on the construction of the Queen Anne branch. According to the plans of the company a power house will ultimately be built near the Western Mills, but at first the power will be probably furnished by the Seattle Electric Railway & Power company.

The Park Electric system of the Buffalo Street Railroad company made an excellent showing during the summer. Four cars are running on this branch, a distance of about one and three-quarter miles. The traffic on pleasant Sundays is extremely heavy, and each car is required to draw two trailers for a large portion of the day. Under these circumstances the following figures will be of interest: On July 16th the road carried 17,000 passengers; on July 20th, 8,000; on July 27th, 11,000; on Aug. 3d, 5,000; on Aug. 10th, 9,000; on Aug. 17th, 3,000; on Aug. 25th, 10,000. On August 3d the day was cold and disagreeable; on August 17th the weather was cold and rainy, which accounts for the small number of passengers carried. This road is equipped upon the Edison system, and has been in operation now for about fifteen months with remarkable results, the repair bills having been merely nominal, although the service called for has been excessive, particularly in the summer. The largest load ever carried was a little over twenty thousand, the occasion being a large picnic, and the time being two days after the road commenced operations in July, 1889. But three motor cars were in service on that day, and this remains the greatest record ever made by an equal number of cars.

THE TELEPHONE.

The Hirsch Telephone and Telegraph company has applied to the Fresno, Cal., trustees for a franchise for a telephone line. Extensions will be made to Merced and other points, and San Francisco and Sacramento will be connected with Fresno.

THE TELEGRAPH.

A New York correspondent writes: Officers of the Western Union Telegraph company say there is no truth in a statement which has been printed to the effect that they are negotiating for the purchase of a large block of shares in the Postal Telegraph Cable company. No consolidation scheme is on foot. There is an agreement between the two companies that one company must notify the other before making any change in the tariff for the transmission of messages.

M. Emile Laurent, a telegraph operator in the French Soudan service, has just been promoted for distinguished service. In April, 1886, during an Arab incursion, Laurent sheltered the women and children of the village of Bakel in the telegraph station, and, aided by six native soldiers, beat off all the attacks of the Arabs. In May of this year, accompanied only by one assistant, Laurent followed in the steps of a flying column sent in pursuit of 4,000 Arabs, and repaired in four days 100 kilometers of wire destroyed by the enemy. Owing to the commander of the column being so rapidly placed in telegraphic communication with his base, he was able to take measures which ended in the complete defeat of the Arabs.

Personal Mention.

E. R. Weeks of the Kansas City Electric Light company, was in Chicago this week.

J. C. Hobart, of the Triumph Compound Engine company, visited Chicago this week.

C B. Hopkins of Spokane Falls, Wash., one of the World's Fair national commissioners, and a member of the committee on electricity, is in Chicago this week.

Business Mention.

The Elektron Manufacturing company of New York has just finished a 25 horse power motor for direct connection, without gearing, to a high speed passenger elevator at the show and warerooms of the Bergmann Electric & Gas Fixture company, 79 Fifth avenue, New York.

The Short Electric Railway company has issued a handsomely illustrated catalogue describing the system of that company. It also contains views of the electric railways operated in Rochester, N. Y., St. Louis, Indianapolis, and Muskegon, Mich., in which the Short system is used.

The Stilwell & Bierce Manufacturing company of Dayton, which for a quarter of a century has made a specialty of machinery for heating and purifying feed water for boilers has just put on the market a new feed water heater,

for which many advantages are claimed. Catalogues will be sent on application.

The Electric Merchandise company, Chicago, has issued a special circular containing descriptions and illustrations of apparatus manufactured by the Thomson-Houston Electric company, and handled by the Electric Merchandise company. The company announces that it has issued special catalogues for each system.

The Standard Paint company's P. & B. electrical compounds are praised for their many excellent qualities in a pamphlet recently issued by that company. Letters approving the compounds are printed from many leading electrical concerns. The chief of the electrical bureau, Philadelphia, has approved these compounds in an official communication.

The Electrical Supply company of Chicago has reason to congratulate itself upon the success it is meeting with in the sale of the Sunbeam incandescent lamps. It is claimed for these lamps that they combine high efficiency with long life, and the Electrical Supply company reports that where sample orders have been sent in, large stock orders have followed. The company is evincing keen business foresight in the specialties it is handling in all departments.

The C. W. Hunt company of 45 Broadway, New York, is making a specialty of the "Stevedore" rope. This rope is manufactured exclusively by the company, and its strength and durability in rope driving are, it is claimed, remarkable. It is thoroughly lubricated internally with tallow and plumbago, so that in passing over pulleys the strands and fibers, in moving over each other, do not chafe internally. Every coil is accompanied by a guarantee.

The Hawkeye Electric Manufacturing company of Davenport, Ia., reports that it is exceedingly busy at present as it has under construction apparatus for central stations at Sigourney, Avoca, Stuart, Greenfield and Clarinda, Ia. Each station will have a capacity of from 800 to 1,200 incandescent lamps. The company recently shipped two 25-horse power motors and one 10 horse power motor to Dubuque. A 20 arc light machine was recently sold to the Bettendorf Metal Wheel company of Springfield, O. The company is building an addition to its works to provide for the increasing demands for its apparatus.

In the WESTERN ELECTRICIAN of September 13th a description of a novel incandescent lamp bracket was published. The special feature of this fixture was the introduction of a ball-and-socket joint at the base next to the wall. By this simple arrangement the bracket is made movable and may be swung into almost any desired position, like the ordinary gas fixture. Within the last few weeks the inventors of this device, Messrs. E. C. Bennett and E. C. Freize, have organized a company to exploit the fixture. The new concern will do business under the name of the Electric Incandescent Adjustable Joint Manufacturing company and its headquarters will be at 815 Rookery building, Chicago The company expects shortly to have on the market a number of different designs of brackets, chandeliers, etc., in all of which the improvement will be embodied.

Queen & Co. of Philadelphia, have received a large number of testimonials from persons who have used their portable testing sets. They have received letters from the following, speaking in the highest terms of the instruments: Prof. T. C. Mendenhall, superintendent of the United States coast and geodetic survey; N. J. Davies, secretary of the Brooklyn Street Railroad company; R. Fleming, assistant engineer of the Edison General Electric company; H. A. Wagner, superintendent of the Missouri Electric Light & Power company; the Schaefer Electric Manufacturing company, and Lieut. McLean of the Newport torpedo station. Queen & Co. state that up to date the orders for these sets have come so fast that it has been impossible to turn them out fast enough. They have employed an additional force, however, and hope soon to be able to carry a supply equal to the demand.

On Aug. 20, 1890, Chas. A. Schieren & Co. of New York, furnished the Metropolitan Street Railway company of Toronto, Ont., with 48 feet of 12 inch, and 85 feet of 28 inch, double electric perforated belt. Chas. D. Warren, president of the company, has written of the belts as follows: "In regard to the belts, as we are able to judge, they are giving every satisfaction. We have certainly realized that the power required for electric railway purposes is very exceptional, and the demand is very irregular. We are glad, however, to state that the belts seem to meet all requirements. We have not had so far the slightest trouble with slippage, and cannot but express ourselves as greatly pleased. If they will stand the test of time we do not see that we can desire any improvement. If any parties in this market require anything of the kind we shall be very pleased to have you refer them to us, and will show them our belts in operation."

When Chadbourne, Hazleton & Co. took the agency for the United States for the Wenstrom Consolidated Dynamo & Motor company last June, it was the intention of that company to equip its old factory at Locust Point, Baltimore, with new machinery. It determined, however, later to build a new factory, and purchased 100 acres of ground and commenced operations. The building of the new factory has been somewhat delayed owing to the extremely rainy season, and there is such a demand for Westrom apparatus that the company is entirely unable, with its old facilities, to fill orders. At a recent meeting of the directors the situation was discussed, and in order to hasten matters the Wenstrom company has rented a larger factory in Baltimore already equipped with boilers, engines and shafting. The new factory is 60 feet front, 200 feet deep, and is three stories high, and will be in working order by the last of this month. It expects to be able to turn out enough machines here by working day and night to fill the most pressing orders, and in the meantime will push to completion its large new factory at Calverton, which will be ready for operation by the early spring to meet the spring trade and the demand for street railway apparatus, to which this new factory will be almost entirely devoted; this will give the Wenstrom company as good facilities as any company in the country, and by the first of the year they will be able to fill all orders on time.

The Fibrone Manufacturing company, New York, has arranged with Alexander, Barney & Chapin to handle exclusively everything of an electrical character which the Fibrone company produces. This gives Alexander, Barney & Chapin control over this line of goods throughout the United States and Canada. The specialties which the Fibrone company are manufacturing are Plasticon, Fibrone, Alexite and Herculite, all well-known to the trade. Plasticon is especially adapted for switch handles and push buttons and can be made in any color. This material will withstand a high degreee of heat, is waterproof and can be given a beautiful finish. Brass parts which may be necessary for use in connection with articles made of Plasticon, can be embedded in the mould. Fibrone, which in appearance is not unlike Plasticon, has the advantage of standing a higher degree of heat. The many forms in which this material can be made, and the ease with which it can be put into practical shape, are shown by the fact that it can be tapped and drilled, turned on a lathe and made in sheets of any thickness. Any color may also be produced. The insulating pieces in sockets can be made of this material. It is not only waterproof, but if high polish is required, that can also be produced. Alexite is different from the compositions already mentioned in that it is absolutely fire, water and acid proof. The name is already well known to the electrical public, likewise the material itself, some switch bases, cut-outs and rosettes having been shown a short time ago. Brass parts can be embedded into Alexite, effecting a saving in the cost of manufacture, and greatly adding to the appearance of an article. Herculite is also fire, water and acid proof, and somewhat similar in composition to Fibrone. This material can be manufactured in sheets as large as ten feet square, and as it can be drilled and tapped, will be extensively used where the making of a mould is not justified by the quantity required. This material is very light in weight, and is said to be exellently adapted for switch-boards. It can also be made in any color. The factory of the Fibrone Manufacturing company at 300-302 Monroe street, New York, has been enlarged, and sixteen new hydraulic presses have been added to those already in use, in anticipation of the very large business which will be done. Messrs. Alexander, Barney & Chapin will have on exhibition at their warerooms a full line of these materials.

Electrical Patents.

Issued Nov. 11, 1890.

440,164 Telegraph Circuit. David H. Keeley, Ottawa, Canada.

440,165. Multiplex Telegraphy. David H. Keeley, Ottawa, Canada.

440,173. Battery Zinc. Archibald J. McDonald, North Tiverton, R. I.

440,175. Secondary Battery. Friedrich Marx, Berlin, Germany.
The compound electrode is composed of carbon and a metal, and rendered resistant by an envelope or coating of carbon only.

440,189 Electric Motor Truck and Gear. Edgar Peckham, New York. N. Y.

440,199 Induced Current Telegraph. Abner M. Rosebrugh, Toronto, Canada.
The object of this invention is twofold: First, to construct an improved secondary current telegraph system so that relays and sounders, or their equivalent, may be used, and second, to combine said secondary current telegraph system with the ordinary Morse single or multiplex system, so as to be able to use the two simultaneously on the same wires.

440,208. Station Indicator for Railway Cars. George N. Vanderhoef, Bayonne, N. J.

440,210. Electrode for Secondary Batteries. Edward B. Weed, Detroit, Mich.

440,213. Electric Switch. Malone Wheless, Nashville, Tenn.
The invention consists in a bifurcated armature, one fork of which is on each side of the main circuit at the point of separation.

440,216. Secondary Battery Plate. Albert E. Woolf, New York, N. Y.

440,224. Distribution of Electric Energy. Sebastian Z. de Ferranti, Hampstead, England.

440,241. Electric Actuating Mechanism for Clocks. Herman T. Schlegel, Akron, Ohio.

440,267. Process of Producing Porous Crystallized Metal Plates Clement Payen, Philadelphia, Pa.

440,268. Process of Producing Crystallized Metallic Lead Plates Clement Payen, Philadelphia, Pa.

440,269. Process of Producing Crystallized Lead Plates. Clement Payen, Philadelphia, Pa.

440,270. Art of Producing Crystallized Metal Plates. Clement Payen, Philadelphia, Pa.

440,271. Porous Crystallized Metal Plate. Clement Payen, Philadelphia, Pa.

440,272. Method of Making Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa.

440,273. Process of Making Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa.

440,274. Process of Producing Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa.

440,275. Process of Producing Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa.

440,276. Process of Producing Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa.

440,277. Process of Producing Crystallized Metallic Lead Plates. Clement Payen, Philadelphia, Pa.

440,289. Dead-beat Mechanism for Electrical Measuring Instruments. Edward Weston, Newark, N. J.

440,290. Temperature Regulator for Electrical Measuring Instruments. Edward Weston, Newark, N. J.

440,291. Index Controlling Device for Electrical Measuring Instruments. Edward Weston, Newark, N. J.

440,303. Electric Switch. Arthur R. Bush, Boston, Mass.

440,326. System of Electrical Distribution. Walter S. Richards, Natick, Mass.

440,361. Combined Lightning Arrester and Cut-out. John A. McManman, Milwaukee, Wis.

440,362. Electric Railway. James K. P. Nourse, Boston, Mass.

440,384. Adjustable Resistance for Electrical Circuits. Charles Wirt, Orange, N. J.
Of the twelve claims the fifth is given:
"The resistance coil consisting of a flexible sheet wound with wire and bent into a cylinder."

440 391. Insulating Composition. Frederick E. Blaisdell, Camden, N. J.

440,395. Method of Manufacturing Insulating Tubing for Electric Conducting Wires. Henry B. Cobb, Wilmington, Del.

440,420. Galvanic Battery. William Cohlman, Philadelphia, Pa.

440,424. Dynamo Electric Machine. Walter K. Freeman, Brooklyn, N. Y.

440,425. Current Collector for Dynamo Electric Machines. Walter K. Freeman, Brooklyn, N. Y.

440,431. Electric Meter. Etienne Mares, Paris, France.

440,441. Electric Clock. Frank Schwartz, Halifax, Canada.

440,502. Electric Railway Switch and Signal Mechanism. Joseph Ramsey, Jr., and Frederic C. Weir, Cincinnati, Ohio.

440,503. Electric Switch and Signal Mechanism. Joseph Ramsey, Jr., and Frederic C. Weir, Cincinnati, Ohio.

440,505. Electrolyte for Secondary Batteries. Bernard Renault and Maurice Desvernay, Paris, France.
The first claim reads as follows:
"A depolarizing gelatinous silica for electric batteries consisting of a mixture of water, bichromate of soda, and silicate of soda."

440,508. Electric Train Signal. Fitzwilliam Sargent, Aurora, Ill.

440,534. Method of and Apparatus for Making Metallic Wheels by Electricity. William P. Bettendorf and Joseph W. Bettendorf, Davenport, Iowa.
The first claim:
"The improvement in the art of attaching metal spokes to metal wheel hubs and tires, consisting in introducing the ends of the spoke into the other member, heating the contiguous portion of the two members to a welding temperature by directing an electric current therethrough, and finally upsetting the spoke to complete the welding operation."

440,548. Manufacture of Wire, Bands, Etc. Francis E. Elmore and Alexander S. Elmore, Rothwell, near Leeds, England.

440,557. Dynamo Electric Machine. Walter K. Freeman, Brooklyn, N. Y.

440,563. Combined System of Fire Alarm and Police Patrol Telephone and Telegraph. George C. Hale and Albert Barrett, Kansas City, Mo.

440,567. Thermometer. Madison G. Hawke, Saratoga Springs, N. Y.

440 575. Process of Producing Crystallized Metal Plates. Clement Payen, Philadelphia, Pa.

440,584. Shipper for Trolleys. Herbert H. Brooks, Cambridge, Mass.

440,590. Electrical Governor. Franklin D. Hardy, Chicago, Ill.
The last claim reads:
"5. In an electrical governor the combination of an electric motor, the speed of which is variable, according to the tension or electromotive force of the current generated by a dynamo and passing through the motor, with a governor actuated by centrifugal force and attached to the motor shaft, the centrifugal force varying with the speed of the motor shaft and brush holder of the dynamo attached to the governor actuated by centrifugal force, any variation of the speed of the motor thereby shifting the brushes on the commutator of the dynamo in return varying the current passing through the motor placed in the circuit of the dynamo."

440,595. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

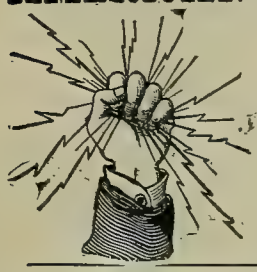
440,596. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

440,597. Contact Device for Electric Cars. Rudolph M. Hunter, Philadelphia, Pa.

440,604. Arc Lamp. Samuel E. Nutting, Chicago, Ill.
Claim one is:
"In an arc lamp the combination of an electrode, a covering for the same of a material that disintegrates under the heat of the arc at a temperature lower than is necessary to consume the electrode, with its edge next to the arc at a distance therefrom to cause it to be disintegrated with the same degree of rapidity as the electrode is consumed, and a holder bearing against the edge of the covering next to the arc and holding the electrode from advancing until the edge of the covering is changed, consumed or destroyed."

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

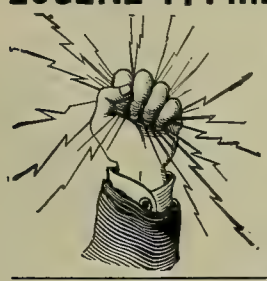
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS
4 LASALLE AVE
MAKE ANYTHING IN BRASS. CHICAGO.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS: W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., { Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

EXPERIMENTAL, MODEL AND ELECTRICAL Work, Intricate and Special Machinery, and anything that can be done in a first class experimental machine shop, is solicited.

E. D. STIFF, 67 & 69 So. Canal St., Chicago.

Light Manufacturing under Contract.

FOR SALE.

One 8½x10 Armington & Simms Automatic Engine.

One 20-Light Fuller-Wood Arc Light Dynamo and Lamps.

A. L. IDE & SONS,

SPRINGFIELD, ILL.

ELECTRIC LIGHTING,

FRANKFORT, INDIANA.

PROPOSALS are wanted until December 19, 1890, for lighting by electricity and gas, the Public streets, etc. of this city for a period of five years.

Address **S. A. COOK,**

City Clerk as above.

By Order of Committee. { J. H CHAMBERLAIN, J. W. HAMMOND, J. S. VANARSDAL.

DO YOU USE
THE LAW BATTERY?
IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

—THE—

WRITING TELEGRAPH

instruments and system have been perfected, and also proven by the test of time.

The instruments are adapted for

EXCHANGES,
NEWS REPORTING,
PRIVATE LINES.

It is desired to form Sub-Companies in the different WESTERN STATES to introduce this system of communication, which has its many advantages.

For particulars address WRITING TELEGRAPH CO., P. O. Box 1322, New York, N. Y.

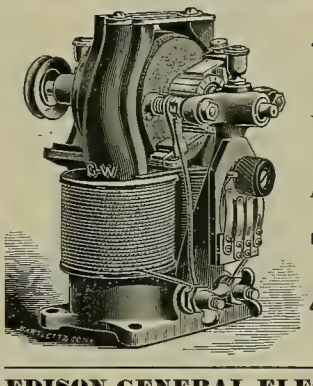
N. B.—The patents of the Writing Telegraph Co. for CANADA, AUSTRALIA and SOUTH AMERICA are for sale, or desirable arrangements will be made with proper parties to operate the instruments in said countries.

Sealed Proposals.

SEALED PROPOSALS will be received by the Common Council of the city of Big Rapids, Michigan, at the City Recorder's office until Monday evening, Dec. 1st next, for lighting said city with twenty-six (26) to thirty-five (35) 2000 candle power electric lights, from January 1st, 1891 to January 1st, 1892. Said bid to state price for lights running from dusk until 12 o'clock, and also price to run from dusk until daylight. Each bid to be accompanied by a bond in the sum of $1000 as a guarantee that the parties tendering such bid will enter into a contract for operating such lights if their bid is accepted. The Common Council reserves the right to reject any and all bids.

S. G. WEBSTER, Recorder.

Big Rapids, Mich., Nov. 5, 1890.



THE **CROCKER-WHEELER**

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base—Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies o be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

EDISON GENERAL ELECTRIC CO.,
FLEISCHNER BUILDING,
PORTLAND, ORE. **Pacific Northwest District.**

PORTLAND, OREGON, Oct. 30, 1890.

JAS. W. QUEEN & CO.,

GENTLEMEN:—In reply to your favor of the 22d inst., I would say that the portable testing set I bought of you recently has given every satisfaction, and for an instrument of its class surpasses anything I have ever seen for accuracy and reliability. I would heartily recommend it to electricians. Yours very truly,

R. FLEMING, Assistant District Engineer.

The set referred to was manufactured by

QUEEN & CO., - Philadelphia.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL **OKONITE COMPANY,** Limited, - - 13 Park Row, NEW YORK.

BRANCHES Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

EDISON LAMPS REDUCED TO 44 CTS.

16 CANDLE POWER LAMPS.

Lots of 25 to 150 .....44 cents each.
Lots of 150 to 500.....42 cents each.
Lots of 500.....40 cents each.

Other sizes in proportion. All sizes in stock, with bases to fit any make of lamps or sockets.

Full Line OKONITE WIRES in Stock. Safest and best wire made. Full Line of Edison Sockets and Appliances.

STANDARD ELECTRICAL WORKS, CINCINNATI, OHIO.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

YOU make a mistake if you don't buy your Electrical Supplies from F. & E., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

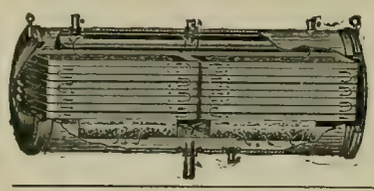
25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

A MODEL RAILWAY.

The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

ALUMINUM ALLOY COMPOSITE. Reduced from $2.00 to 75c. per lb. in 100 lbs. (sample) containing 7½ per cent. Aluminum sent prepaid for only **$7.** We desire to establish an Agency in every large city for our Metal Alloy. For terms and city rights address **THE SCHMIED-BARENGUSS FURNACE CO., Newport, Ky.**

Electrically and Mechanically Yours,
JAS. McLAUGHLIN,
Pioneer in Arc Lighting and Electric Railways.
14 YEARS' PRACTICAL EXPERIENCE

Manufacturer of New Parts and Repairs of all Systems of Electric Light, Railway and Power. Electric Specialties. Raising and Lowering Device for Arc Lamps, my patent. Simple Automatic Lightning Arresters (patents applied for). Arc Lamps for all Systems; Arc Lamps for Incandescent Circuits. Consulting Electrical Engineer. **Office and Works: 48, 50 and 52 North Clinton St., Chicago Ill.**

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.

THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

A PUBLIC BENEFIT.

The traveling public has already been greatly benefited by the combination between the Chicago & Northwestern and the Union Pacific Railway systems and the establishment of what is now known as the "Chicago, Union Pacific and Northwestern Line," through greatly improved train service from the East to the Pacific coast. Features of the new service are solid vestibuled trains running through from Chicago to Denver and Portland without change. These trains carry through Palace sleeping cars from Chicago to Omaha in 15¾ hours, Denver 33½ hours, Portland 82 hours, San Francisco 85 hours, and for the benefit of passengers who do not wish accommodations in first-class sleepers, luxurious reclining chair cars are run through to Denver and Portland without change, in which accommodations are free. Colonist sleepers are also run through from Chicago to Portland, in which the charge for a completely furnished berth is nominal, and as all meals en route are served in the best of dining cars, the Chicago, Union Pacific and North-Western Line affords all classes of passengers the very best accommodations.

Another feature of the service provided by the Chicago & Northwestern Railway which is highly appreciated by the traveling public, is the fast vestibuled train (coaches, sleeping cars and dining cars) running daily between Chicago and St. Paul and Minneapolis, carrying through vestibuled sleepers between Chicago and Duluth.

The North-Western, which now operates over 7,000 miles of first-class railway, was the pioneer in railroad building in the West and is still in the lead in supplying the traveling public with all the benefits that are conferred by superiority of equipment, through train service and fast time between Chicago and all points West and Northwest.

You Will Oblige

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

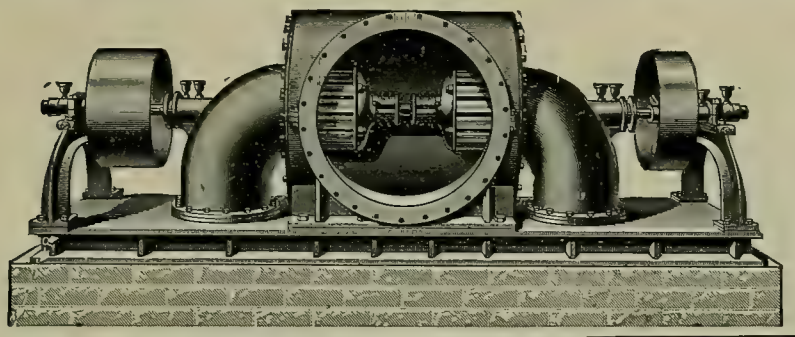
PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,

We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

ENGINES

CORLISS OR HIGH SPEED WITH BOILERS, Etc.

For Driving Dynamos.

Complete Steam Plants Furnished and Erected.

ENGLISH, MORSE & CO.

1221-1223 Union Ave.

KANSAS CITY, MO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

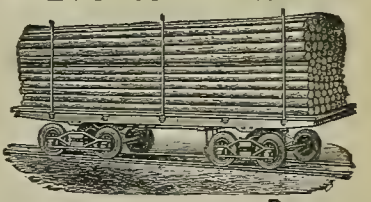
COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. Western Sales Office, 225 Dearborn St., CHICAGO.
Eastern Sales Office, 35 Broadway, NEW YORK. North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

25 PARK PLACE, NEW YORK.

Pumpelly Storage Batteries

For Central Station Lighting, Isolated Plants, Running Stationary Motors and Street Car Traction.
Specially adapted for Physicians' Cautery Purposes. Send for Circulars and Prices.
Correspondence Solicited.

PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 229 La Salle Street, CHICAGO, - ILL.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

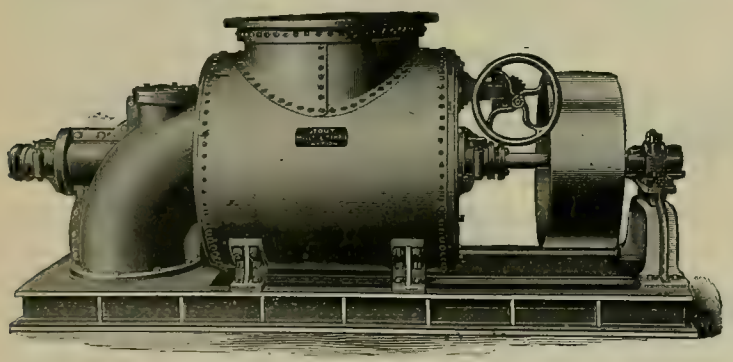
Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators.
Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

Electrical Testing Apparatus manufactured to order, repaired or calibrated.

WESTERN ELECTRIC COMPANY, - - NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,
Oral, Electric, Pneumatic, and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.
W. R. OSTRANDER & CO.,
21, 23 and 25 Ann St. New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

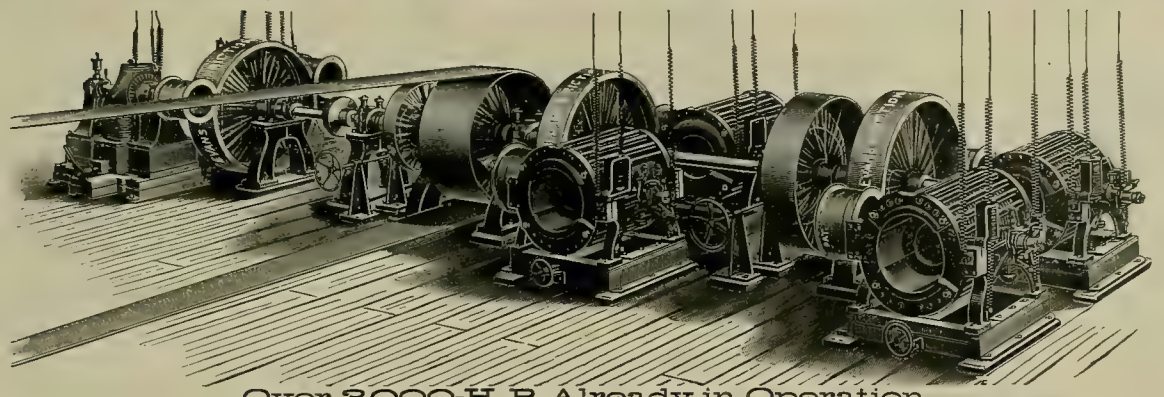
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

(STATION OF THE NORTH ATTLEBORO STEAM AND ELECTRIC CO.)

This Station has been in Successful Operation Since March, 1890.



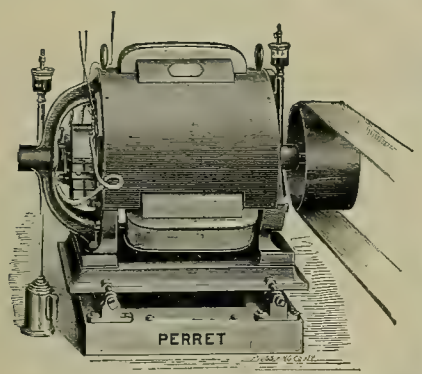
Write for Full Particulars and List of Parties who are Using.

Over 3,000 H. P. Already in Operation.

Send for Catalogue "D" to **THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.**

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



Perret 20 H. P. Motor, Speed 550, Weight 1,300 lbs.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY, LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power. Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., C. M. Barclay, 205 Canal St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
BALTIMORE, MD., W. W. Donaldson, 215 N. Calvert St.
ST. PAUL, MINN., F. J. Renz, 327 Minnesota St.
PHILADELPHIA, PA., Cleverly Electrical Works, 1018 Chestnut St.

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

—Manufactured by—

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

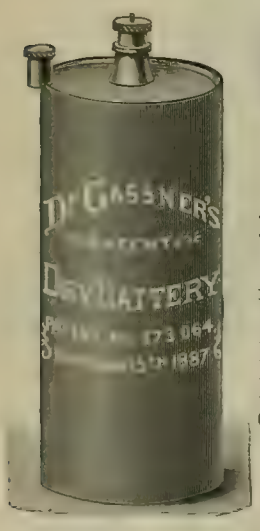
NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.



DR. GASSNER'S

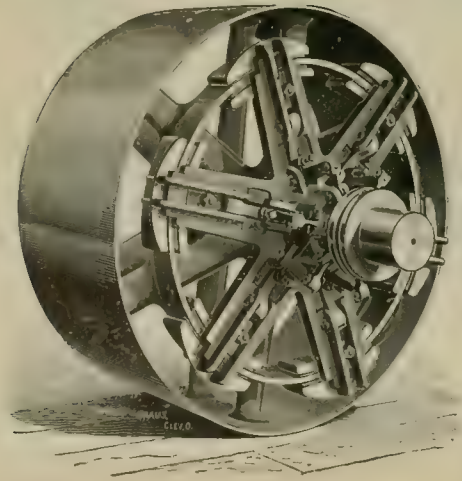
DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3¼ in.
17.	"	7⅛ "	3⅜ " x 1⅝ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer.
111 Chambers St., New York.



HILL

Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

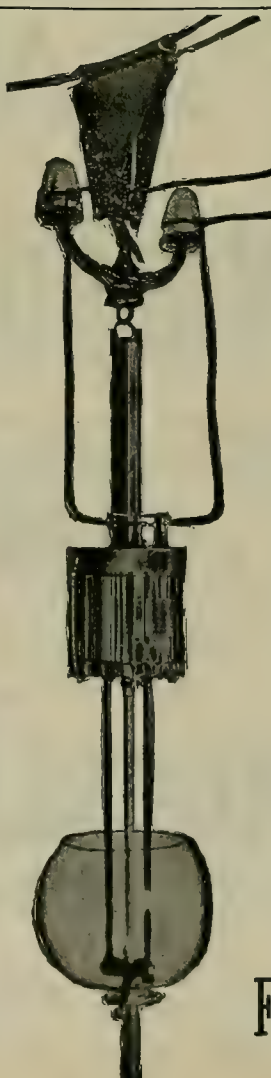
CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.



THE FOREST

LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.

OKONITE TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING Co.

Manufacturers of

SHULTZ PATENT
IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP
FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt
ALL LEATHER
NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.
BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER

BRANCHES: 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | St Louis, Mo.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

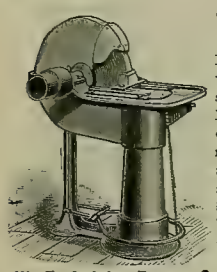
COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

THE BARNES WATER EMERY Tool Grinder.



It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.

Sold subject to approval. Send for full description and price.

W. F. & John Barnes Co., Rockford, Ill., Address No. 761 Ruby Street.

Barnes' Patent UPRIGHT DRILLS.

20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.

Barnes' Patent ENGINE LATHE,

15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.

They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to W. F. & JOHN BARNES CO., Rockford, Ill., Address No. 761 Ruby st.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,

MANUFACTURING ELECTRICIAN,

Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

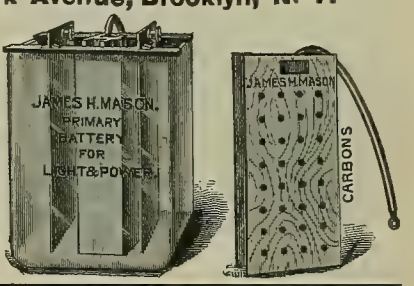
COMPLETE PLANTS FOR SMALL STORES.

Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



EDISON MANUFACTURING CO.,

EDISON-LALANDE BATTERY.

(UNDER AUTHORITY OF THOMAS A. EDISON.)

——MANUFACTURERS OF——

Primary Batteries for Telegraph "Mains" and "Locals,"

Electric Motors, Telephone Transmitters,

Electro-Plating, Electro-Medical Instruments,

Annunciators and Burglar Alarms,

And all Classes of Closed and Open Circuit Work.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP

and 1914 Olive

CORRESPONDENCE SOLICITED.

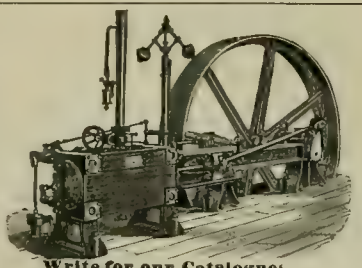
All dealers in Electrical Supplies keep, or should keep, these Cells in stock. If unable to purchase from dealers in your vicinity, communicate with

JAMES F. KELLY, General Sales Agent, 19 Dey St., NEW YORK.

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

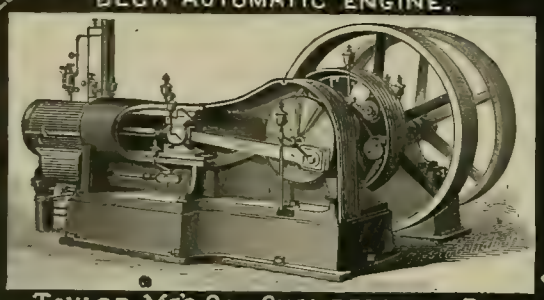


Write for our Catalogues

SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.

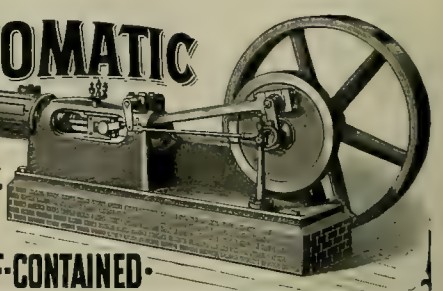
Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.
CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.
ECONOMY UNEXCELLED
REGULATIONS PERFECT
HOT BEARINGS UNKNOWN
PRICES MODERATE



TAYLOR MFG CO. CHAMBERSBURG, PA.
COMPLETE STEAM PLANTS A SPECIALTY

THE RICE AUTOMATIC



GUARANTEED ECONOMY
REGULATION · DURABILITY ·
SIMPLICITY · SELF-CONTAINED ·
8 TO 300 H.P.
PAIR & TANDEM · COMPOUNDS
THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

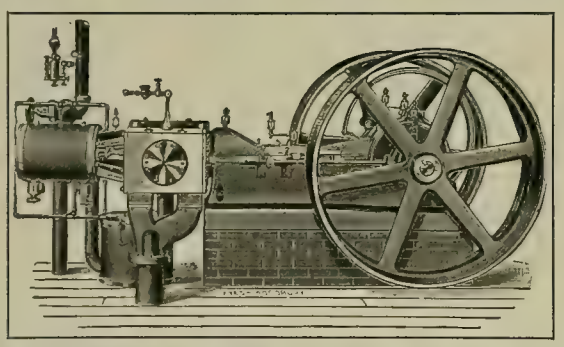
FAIRBANKS, MORSE & CO.,
St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul.
SELLING AGENTS.

Chicago Electric Club

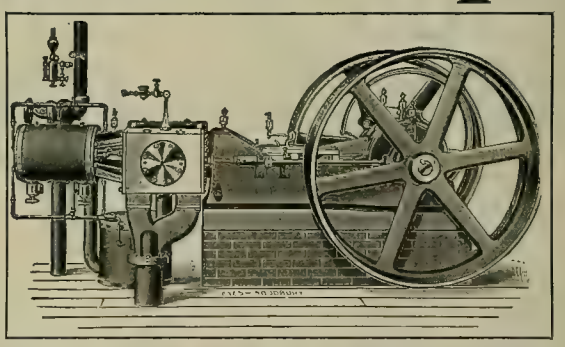
Will hold its next regular meeting at the Club Rooms, Monday Night, December 1.

CINCINNATI HEADQUARTERS
ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.
WEATHERPROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE ·
· FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·
THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.
The JONES · BROS · ELECTRIC · CO. 28 30 & 32 WEST COURT ST.

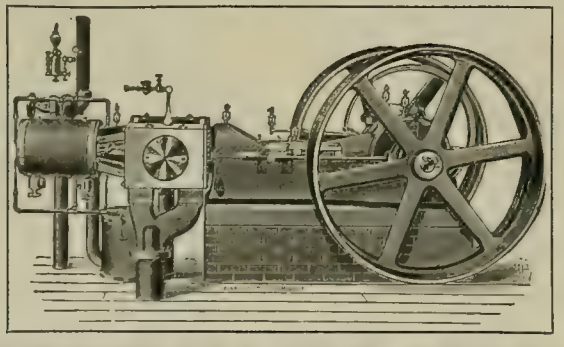
None so Good, None to Equal.



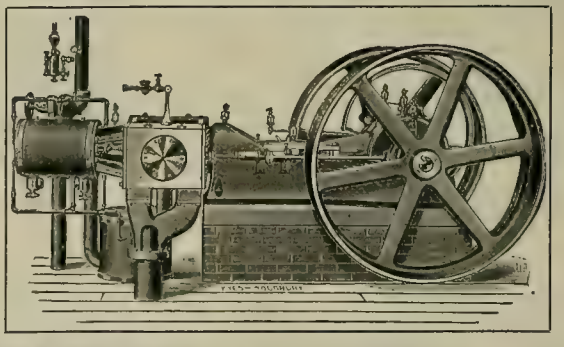
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 to 300 Horse-Power. Compound and Valveless.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.

NO ECCENTRICS.

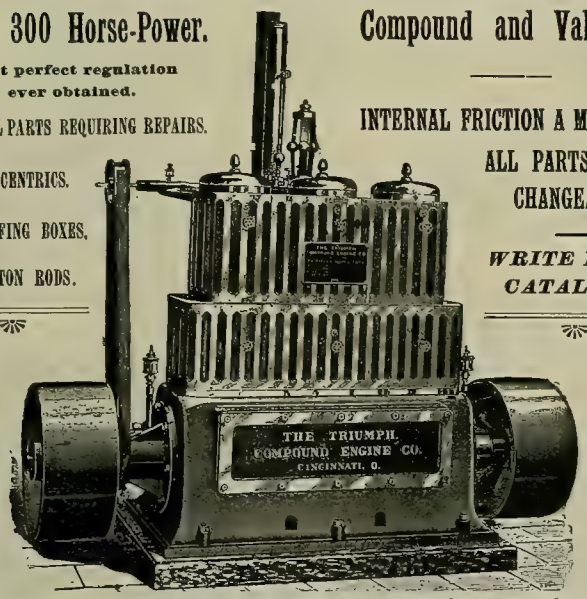
NO STUFFING BOXES.

NO PISTON RODS.

INTERNAL FRICTION A MINIMUM.

ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.



The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

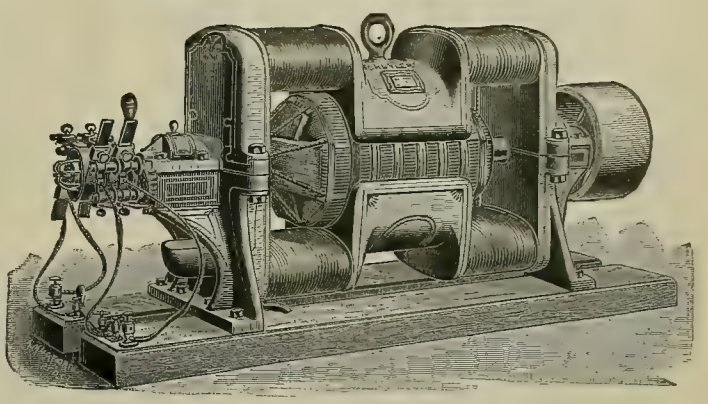
The LECLANCHE BATTERY CO., NEW YORK.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

THE THOMSON-HOUSTON ELECTRIC CO.'S RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

Companies desiring Centre Pole Construction should see the Indianapolis Plant, illustrated below. Also Washington, D. C., Rochester and Brooklyn, N. Y.

Citizens' Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

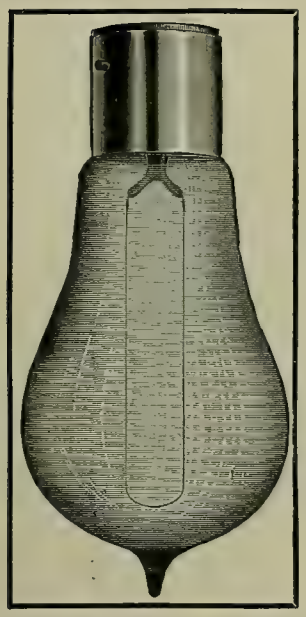
PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 408 Sibley Street.

KNAPP ELECTRICAL WORKS,



General Western Agents

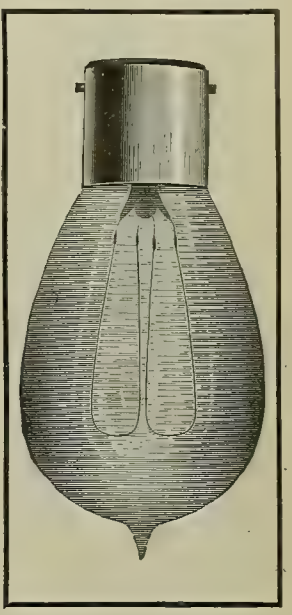
THE

Perkins Electric Lamp Co.

ALL CANDLE POWERS,

TO FIT ANY SOCKET, ANY VOLTAGE,

ANY EFFICIENCY.



GRIMSHAW WHITE CORE

WIRES and CABLES.

FOR

TELEGRAPH,
TELEPHONE,
ELECTRIC LIGHT.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

SWITCH-BOARD CABLES,
GRIMSHAW WHITE TAPE,
GRIMSHAW BLACK TAPE,
GRIMSHAW SPLICING COMPOUND.

ANNUNCIATORS AND

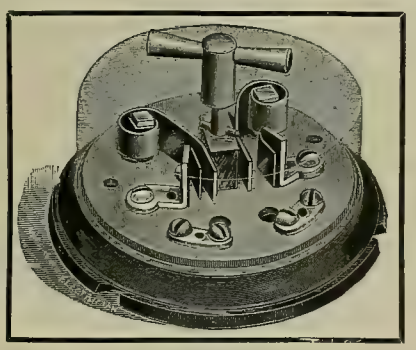
ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

WE CALL SPECIAL ATTENTION TO

THE DIAMOND

"K"

SWITCH AND FUSE BOX.



DOUBLE POLE

FOR

INCANDESCENT CIRCUITS.

GALE'S COMMUTATOR COMPOUND

NO ELECTRIC LIGHT PLANT CAN AFFORD TO BE WITHOUT IT.

KNAPP ELECTRICAL WORKS, 54 & 56 Franklin St. CHICAGO, ILL.

WHERE TO BUY.

We are headquarters for the following lines:

Annunciators.

Arc Lamp—The Universal.

Batteries.

Battery Jars.

Bells, Electric.

Bells, Magneto.

Belting.

Books—Electrical.

Burglar Alarms.

Cables.

Carbons—Points and Plates.

Cars—Electric Railways, Supplies for.

Copper Wires and Cables.

Cross-Arms.

Cut-outs and Switches.

Electrical Instruments.

Electric Railways — Supplies for.

Electroliers and Combination Fixtures.

Fire Alarms.

Gas Lighting—Electric.

General Electrical Supplies.

Globes and Electrical Glassware.

Hard Rubber for Electrical Purposes.

Insulators and Insulating Materials.

Insulated Wires and Cables.

Magnet Wire.

Lamps—Incandescent.

Mining Machinery—Wires and Supplies for.

Pins and Brackets.

Poles—round or octagon—also Iron Poles.

Push Buttons.

Railways—Electric Supplies for.

Speed Indicators.

Tapes—Insulating.

Telegraph Apparatus.

Test Instrument.

Wire—Bare or Insulated.

Our Catalogue, No. 560, should be in the hands of all interested in Electric Light and Power Supplies.

Our Catalogue, No. 648, should be in the hands of all selling or using House Goods, such as Bells, Batteries, Annunciators, Gas lighting apparatus, etc. District Telegraph and Telephone Companies, will also find much information of interest in this catalogue.

When you are in a hurry order from The Electrical Supply Company.

When you are particular regarding quality order from The Electrical Supply Company.

When you do not have time to write for quotations, and do not want to pay more for goods than they are worth, order from The Electrical Supply Company.

The *Electrical World* of recent date, in speaking of Habirshaw rubber covered wires, states: "The United States naval vessels will not have any other wire, and the largest and finest electric light and power plants are making extensive use of it. The big Edison station in Brooklyn uses it altogether; the demand has become so great that the company is now putting up an entire new factory." The Electrical Supply Company, 171 Randolph St., Chicago, are sole Western Agents for the celebrated Habirshaw wires, cables and cores.

Mr. W. A. Richmond, superintendent electrical department Concord Gas Light Co., Concord, N. H., in speaking of Shield Brand insulation says: "We have between 12 and 14 miles of two and three braid Shield Brand in use here, running through trees—and bad ones at that—and it has given perfect satisfaction thus far, after being in use two years."

If you don't know all about the Bradner Adjustable Hanger write to The Electrical Supply Company for circular No. 671½.

The B. W. Ampere indicator fills a "long felt want" in every station.

The Ajax Dry Battery challenges any open circuit battery in the world to a contest of merit.

Mr. Alex Dow, expert electrician Brush Electric Company, writes: "Answering your inquiry about the sample of Shield Braid, No. 4, I handed you last summer, the circuit from which the sample was taken had been up nearly a year, including a severe winter. The current on same varied from 3 to 18 amperes; the pressure 2,100 volts, constant potential. In my opinion the wire showed up well, and the insulation was worth the higher price paid for it."

The Ellis Oil Filter. If you want a filter, try it; then buy it.

The "E. S." detachable Fuse Rosette is neater and better arranged for safe and satisfactory service than any other rosette or cut-out made.

Geo. A. Mayo, electrical engineer Rockford Electrical Manufacturing Company, has a high opinion of Shield Brand insulation. He states: "Shield Brand has given us entire satisfaction wherever used, and is, in our opinion, one of the best Water-Proof Wires on the market at present."

Carl Kammeyer, superintendent National Electrical Manufacturing Company, renders the following verdict regarding Shield Brand: "It is a first-class Moisture-Proof Wire, and I would have no hesitation in using it for the most trying overhead circuits."

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

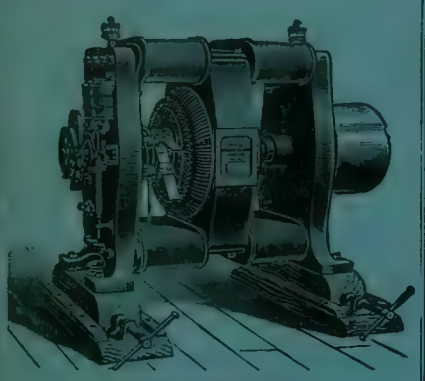
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



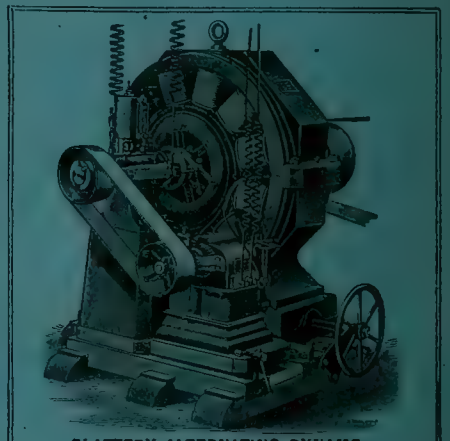
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

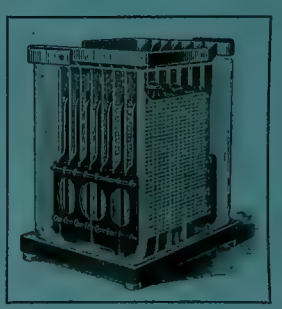
BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR CO.,

44 Broadway, NEW YORK.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 Carter Street, Philadelphia, Pa.
CHICAGO AGENCY:—239 La Salle St. SAN FRANCISCO:—220 Sutter St.
BOSTON:—HOLTZER-CABOT ELECTRIC CO., 111 Arch Street.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, NOVEMBER 29, 1890. No. 22

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin' ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

CHICAGO, Aug. 6, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—Some months since, we had a great deal of difficulty with our Ball Engine running with bearings hot, and used a great deal of oil without causing the bearings to become any cooler by increasing the amount of oil used upon the bearings.

The Ball Engine is 100 H. P., 14x13 inches, 270 revolutions per minute, and carries 90 lbs. steam pressure. Bearings, 4¾-in. diameter by 4 in. length. There is but 1-32 in. play allowed in the bearings, and makes a very close fit.

We have had the most excellent results from the use of your Magnolia Metal, and could not ask for better service. We trust that this report will be explicit and pleasing to you. We remain,

Yours truly, THE WESTERN LIGHT & POWER CO.,
By W. M. Talcott, General Manager.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a **black, Weather-Proof** Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, / 133 and 135 Wabash Ave., Chicago, Ill. FACTORIES: ANSONIA, CONN.

E-D-I S-O-N

Miniature Incandescent

ELECTRIC LAMPS.

1-2 to 36 Candle Power.

For use with Batteries or Dynamos. 3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

MILLIKEN PATENT ELECTRIC RAILWAY POLE.

Manufactured by

MILLIKEN & CO.,

No. 55 Liberty St. New York. | No. 59 Dearborn St. Chicago.

ADOPTED BY

New York, Jersey City, Paterson, Buffalo, Pittsburgh, Hamilton, O., and many others.

Recommended by best Engineers.

Over 6000 Ordered in Last 6 Months.

Western Department, 59 Dearborn Street.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave., CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment. Electric Motors.

THE ONWARD MARCH!

Some Facts in Electric Lighting.

No. of Companies using Thomson-Houston Arc Apparatus, Jan. 1, '90	516	
No. of Companies using Thomson-Houston Arc Apparatus, July 1, '90	587	
Increase 6 months, ending July 1, '90		71
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, Jan. 1, '90	68,203	
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, July 1, '90	79,387	
Increase 6 months, ending July 1, '90		11,184
No. of Co.'s using Thomson-Houston Incandescent Apparatus, Jan. 1, '90	337	
No. of Co.'s using Thomson-Houston Incandescent Apparatus, July 1, '90	436	
Increase 6 months, ending July 1, '90		99
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, Jan. 1, '90	281,555	
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, July 1, '90	408,515	
Increase 6 months, ending July 1, '90		126,960

There are also in the United States Isolated Plants using in the aggregate
20,000 Thomson-Houston Arc Lamps,
and over 100,000 Thomson-Houston Incandescent Lamps.

ELECTRIC RAILWAYS.

Roads in Operation, July 1, 1890	80
Number of Motor Cars	1,069
Roads under Construction, July 1, 1890	43
Number of Motor Cars	408

Grand Total.

Number of Roads 123 Number of Motor Cars 1,477
Total Length of Track (in miles) 897

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co. xxviii
Abendroth & Root Mfg. Co.. xv
Alexander, Barney & Chapin. xii
Allis, E. P. & Co. xxii
American Electrical Works. . xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co. vii
Baggot, E. xvi
Bain, Foree. xvi
Ball Engine Co. xvi
Barnes, W. F. & Jno. xxi
Barton, Geo. P. ..... —
Baxter Electric Motor Co. xxviii
Bernstein Electric Co. xxi
Bleckert & Nelson. xvii
Brown, Frank T. xvi
Brush Electric Co. xxvii
Bubier Publishing Co. ..... —
Bunnell & Co., J. H. xiv
Butler Hard Rubber Co. xx
C. B. & Q. R. R. xvi
C. & C. Electric Motor Co... xlii
C. & N. W. R. R. Co. ..... —
Central Electric Co. xi
Chicago Electric Club xxii
Cleverly Electrical Works... iv
C. M. & St. P. R. R. Co. ..... —
Colburn & Co., I. W. xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co. vii
Consolidated Electric Storage Co. iv
Continental Dynamo Co. iv
Cowles Electric Smelting and Aluminum Co. xvi
Crocker-Wheeler Motor Co... xv
Crosby Electric Co. iv
Curtis Regulator Co. ..... —
Day's Kerite Insulation i
Dayton Globe Iron Works Co. xviii
Eastern Electric Cable Co. xv
Eddy, Henry C. xvi
Edison Mfg. Co. xxi
Edison General Electric Co.,— Lighting Dept. viii
Edison General Electric Co.,— Lamp Dept. i
Electric Construction & Sup. Co iv
Electrician Publishing Comp'y xx
Electrical Supply Co. xxvi
Elektron Mfg. Co. xix
Empire City Electric Co. xviii
Empire China Works. xvi
Eureka Tempered Copper Co.. xvii
Evans Friction Cone Co. xix
Fibrone Mfg. Co. xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works.... —
Fort Wayne Electric Co. xxviii
Gibson Co., W. D. iv
Globe Carbon Co. xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S. ..... —
Harmount, G. A. vii
Hawkeye Electric Mfg. Co.... iv
Hazelton Tripod Boiler Co... xvi
Heisler Electric Light Co.... xii
Hill Clutch Works. ..... —
Holmes, Booth & Haydens..... xvii
Holmes & Co., C. H. xvii
Holtzer-Cabot Electric Co. i
Humphrey, H. H. ..... —
Ide, A. L. & Son... xv
Illinois Electric Material Co.... xiv
India Rubber & Gutta Percha Insulating Co. i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L.. i
Jewell Belting Co. xv
Jones Bros. Electric Co. xxii
Knapp Electrical Works..... xxv
Laminar Fibre Goods Co..... xvii
Law Telephone Co. xv
Leclanche Battery Co. xxiii
Leffel & Co., Jas. xvii
McLaughlin, James. xvi
Magnolia Anti-Friction Metal Co i
Mason, James H. xxi
Milliken & Co. i
Monitor Electric Co. vii
Munsell & Co., Eug. xv
Munson Belting Co., Chas..... xiv
National Carbon Co. iv
National Electric Mfg. Co..... x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T... ... —
N. Y. Belting & Packing Co... xiv
Okonite Co. xv
Ostrander & Co., W. R. xviii
Page Belting Co. xvi
Paiste, H. T. xiv
Peckham Street-Car Wheel & Axle Co. vii
Partrick & Carter xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co. xxviii
Pond Engineering Co. xxi
Powell Co., Wm. ..... —
Queen & Co. xvi
Roeblings' Sons Co., Jno. A... xix
Sawyer-Man Electric Co. xiii
Schieren & Co., Chas. A xiv
Schmiedbarenguss Furnace Co.. xvi
Schoverling, A. ..... —
Schuyler Electric Co. xxiii
Shultz Belting Co. ..... —
Southern Electrical Supply Co. xxi
Sperry Electric Co. xviii
Standard Electrical Works... xvi
Standard Paint Co. xiv
Standard Underground Cable Co. i
Standard Carbon Co. xx
Stanley & Hall. xiv
Star Electrix Co. ix
Stephenson & Co., Jno. xxii
Stiff, E. D. & Co. xv
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xvi
Taussig, S. xvi
Taylor Mfg. Co. xxii
Thomson-Houston Electric Co. Lighting department. ii
Thomson-Houston Electric Co., Railway department. xxiv
Triumph Compound Engine Co xxiii
Turner Brass Works. xv
Union Hardware Co. xiv
United Electric Traction Co.... xxiii
United States Electric Lighting Co. xiii
Van Nuis C. S. ..... —
Wanted. xv
Western Electric Co xviii
Western Power Construction Co. xxii
Westinghouse Electric and Mfg. Co. xiii
Weston Electrical Instrument Co. ..... —
Wollensak, J. F. iv
Woodbridge & Turner. xvi
Wrigley, Thos. xii
Writing Telegraph Co. xv

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co

Aluminum.
Cowles Electric Smelting & Refining Co.
Schmiedbarenguss Furnace Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
McLaughlin, Jas.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bubier Publishing Co.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanché Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.

Belting—continued.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
McLaughlin, Jas.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Con td
Southern Electrical Supply Co.
St. Louis Electrical Supply Co
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Elektron Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
United E ectric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard E ectrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Queen & Co.

Springs.
Gibson Co., W. D.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.
Writing Telegraph Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

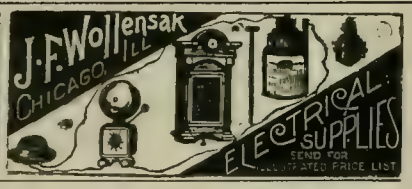
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



Cleverly
1018 CHESTNUT ST. PHILA.

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

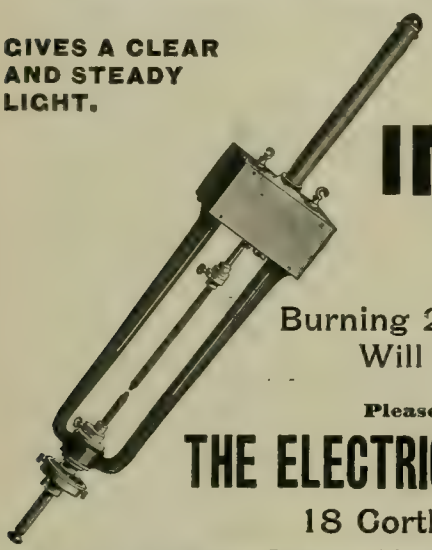
THE WM. D. GIBSON CO.,

NO. 63 NORTH JEFFERSON STREET,

MANUFACTURERS OF SPRINGS.

Springs for Electrical Machinery a Specialty.
Trolley Springs for Electrical Railroads Made to Order.
Also Car Seat Springs.

GIVES A CLEAR AND STEADY LIGHT.



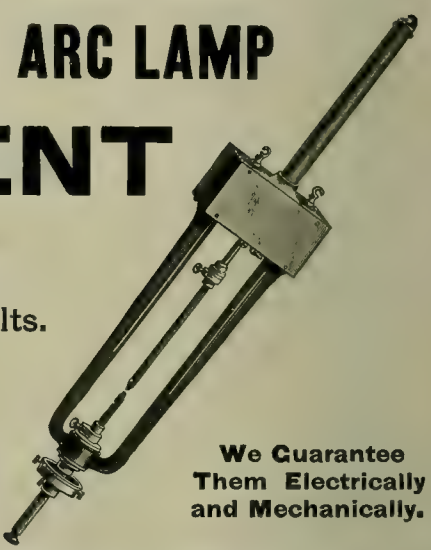
THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.



We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT,
CLEAN,
EFFECTIVE,
SIMPLE,
COMPACT,
PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

87 and 89 South Fifth Avenue, - - NEW YORK.

THE HAWKEYE ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station AND ISOLATED PLANTS, ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps***, Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192 FIFTH AVE., CHICAGO.

Makers of the Choicest Electrical Supplies.

ELECTRIC SHADES

IN LARGE VARIETY.

OPAL SHADES,
ETCHED SHADES,
OPALESCENT SHADES,
COLORED SHADES,
AND
CUTTER'S COMBINATION TIN SHADES.

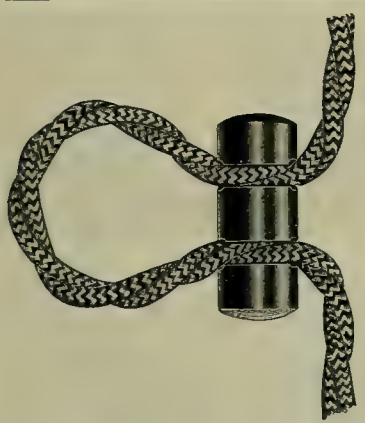
FINE LINE OF

ELECTRIC AND COMBINATION

FIXTURES

—TO SUIT—

ALL ARTISTIC TASTES.



IMPROVED LAMP-CORD ADJUSTER.

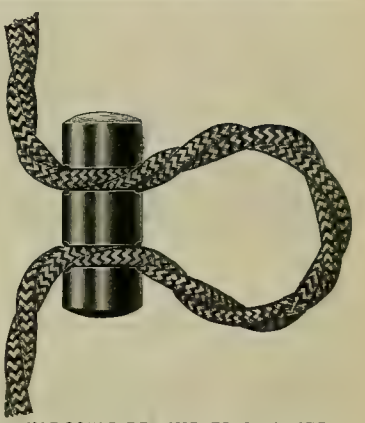
WE HAVE THE MOST RELIABLE

SAFETY DEVICES,

MAIN CUT-OUTS,
BRANCH CUT-OUTS,
WOOD ROSETTES,
HORSESHOE CUT-OUTS,
PORCELAIN ROSETTES,
FUSIBLE PLUGS.

—TRY US ON—

TESTED FUSE WIRE.



WHAT COULD BE SIMPLER OR NEATER?

The Wire that gives
The Highest Line Insulation,

SIMPLEX

The Wire that Pays Best
In the Long Run.

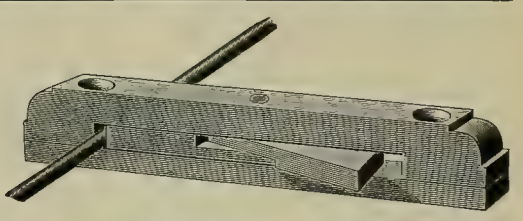
Why not use the Best?
We sell it entirely on its merits.

INSULATORS

Of All Patterns and Sizes in Quantity.

TAPE,
FIBRE,
HARD RUBBER.

GOOD FIGURES ON INSULATORS.



SELF-BINDING CLEAT.

You draw the Wires Taut,
This keeps them so.

DO YOUR CEILINGS BLACKEN?

WHY DON'T YOU USE THE ONLY PRACTICAL CURE:

Cutter's E. L. Insulator,

It keeps your ceilings clean, looks well, and gives high insulation.

INCANDESCENT
LAMP CORD,

—ALL SIZES—

COTTON OR SILK.

SOCKET BUSHINGS
—AND—
RUBBER TUBING.

ALL OF OUR

Specialties

WEAR WELL.

A SINGLE TRIAL WILL PROVE IT TO YOU.

For the Choicest Goods at the Lowest Prices, Remember Our Address.

IMMENSE STOCK!!
BOTTOM PRICES!!

Electrical Supplies

OF ALL KINDS.

NORTHWEST
THOMSON-HOUSTON
ELECTRIC CO.,

403 & 405 SIBLEY ST., - ST. PAUL.

OUR POLICY:

First Class Goods, Small Margins and Quick Delivery.

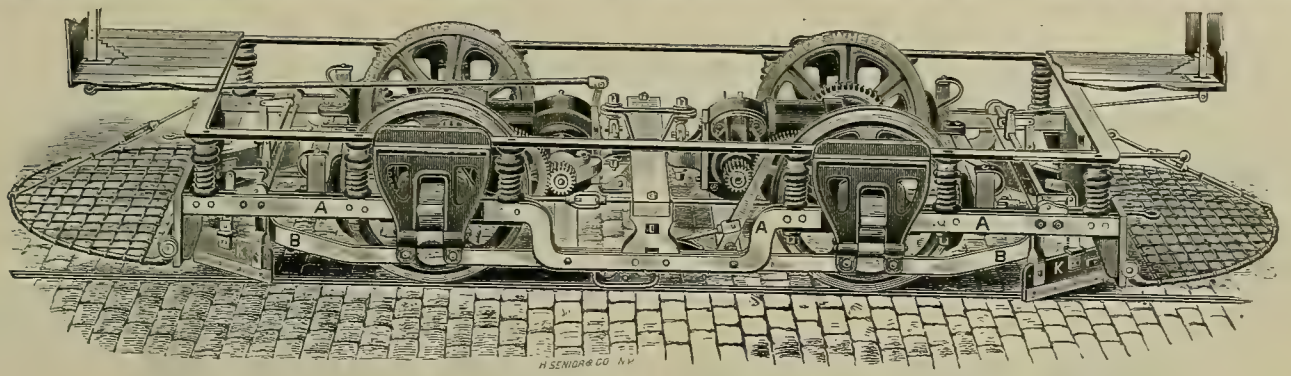
LARGE STOCK OF

Grimshaw White Core,
Holmes, Booth & Hayden's "K. K."
Underwriters' Line Wire & Magnet Wires.

FULL LINE OF PORCELAIN GOODS.

"ELECTRIC BLOCK", 403 & 405 SIBLEY STREET, ST. PAUL, MINN.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

'Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

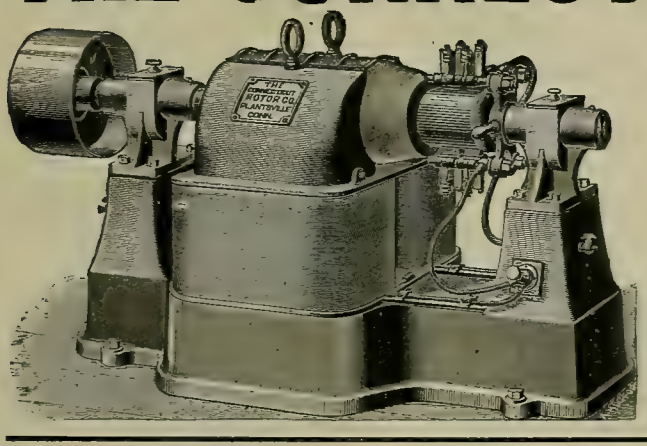
WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W Sixth St.
HARTFORD, 14 State St. ST. LOUIS, 823 Locust St. CHICAGO, 302 Insurance Exchange Building.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED, 1880.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM
AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

EDISON PATENTED APPARATUS.

For Sale by all Parties in U. S.

Except for use in certain localities already exclusively licensed, list of which will be furnished upon application.

SAMPLE PRICES.

GENERATOR.	MOTOR.	RATING.	PRICE TO PURCHASER.
5 light,	*¼ H. P.*	*.250 Kilowatts.*	*$37.84*
10 light,	*½ H. P.*	*.500 "*	*58.76*
20 light,	*1 H. P.*	*1. "*	*106.83*
45 light,	*2½ H. P.*	*2.5 "*	*177.02*
90 light,	*5 H. P.*	*5. "*	*278.77*

ARTICLES.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.	ARTICLE.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.
Standard Keyless Socket,	*1*	*.297*	*Porcelain Ceiling Cut-out,*	*397*	*.3575*
Standard Key Socket,	*2*	*.627*	*Porcelain Double Pole 10-light Switch,*	*511*	*$ 1.2925*
Standard Keyless Receptacle on Porcelain Base,	*3*	*.275*	*Pendulum Ampere Meter up to 200 Amperes,*	*377*	*12.10*
Attaching Plug,	*V 69*	*.1925*	*Standard Pressure Indicator,*		*41.25*
Two-Wire Branch Cut-out,	*1935*	*.44*	*Ground Detector,*	*152*	*4.125*
Safety Plugs for Cut-outs, 1 to 30 Lights,	*181*	*.0715*			

16 C. P. LAMPS {in lots of 25} 44 CENTS EACH.

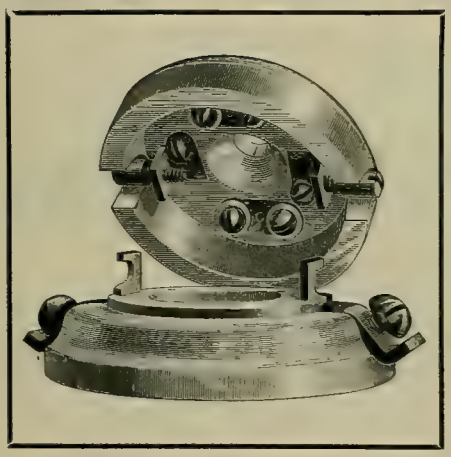
Write to nearest district office or any Electrical Supply House, or Electrical Engineering Concern.

EDISON GENERAL ELECTRIC COMPANY.

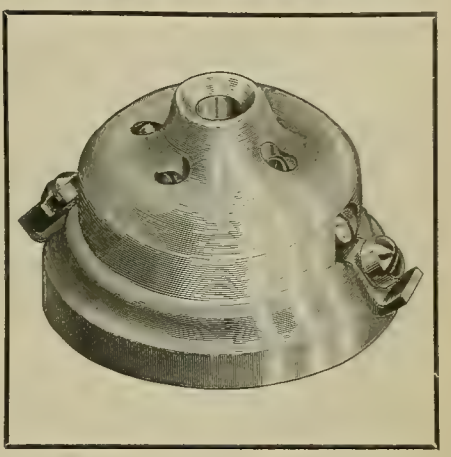
MAIN DISTRICT OFFICES:

Canadian District, Bank of Commerce Bldg, Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 38 Pearl Street, Boston, Mass.
Rocky Mountain District, Masonic Building, Denver, Colo.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg, Portland, Ore.
Southern District, Cotton Exchange Bldg., New Orleans, La.

ELECTRIX!



This week we add to our line of Specialties a ceiling cut-out. The "ELECTRIX" ceiling cut-out is pronounced by all who have used it, to be the best thing of its class up to date.



ARTISTICALLY DESIGNED,
EASILY WIRED,
SATISFACTORY IN OPERATION.

The Wiremen like them. Architects specify "ELECTRIX" for fine work. Dealers say they sell like hot cakes.

Send for Samples.

"ELECTRIX" Switches need no further introduction; they are now on sale by dealers from the Atlantic to the Pacific.

Correspondence Invited.

THE STAR ELECTRIX COMPANY,

1320 Wallace St., PHILADELPHIA, PA.

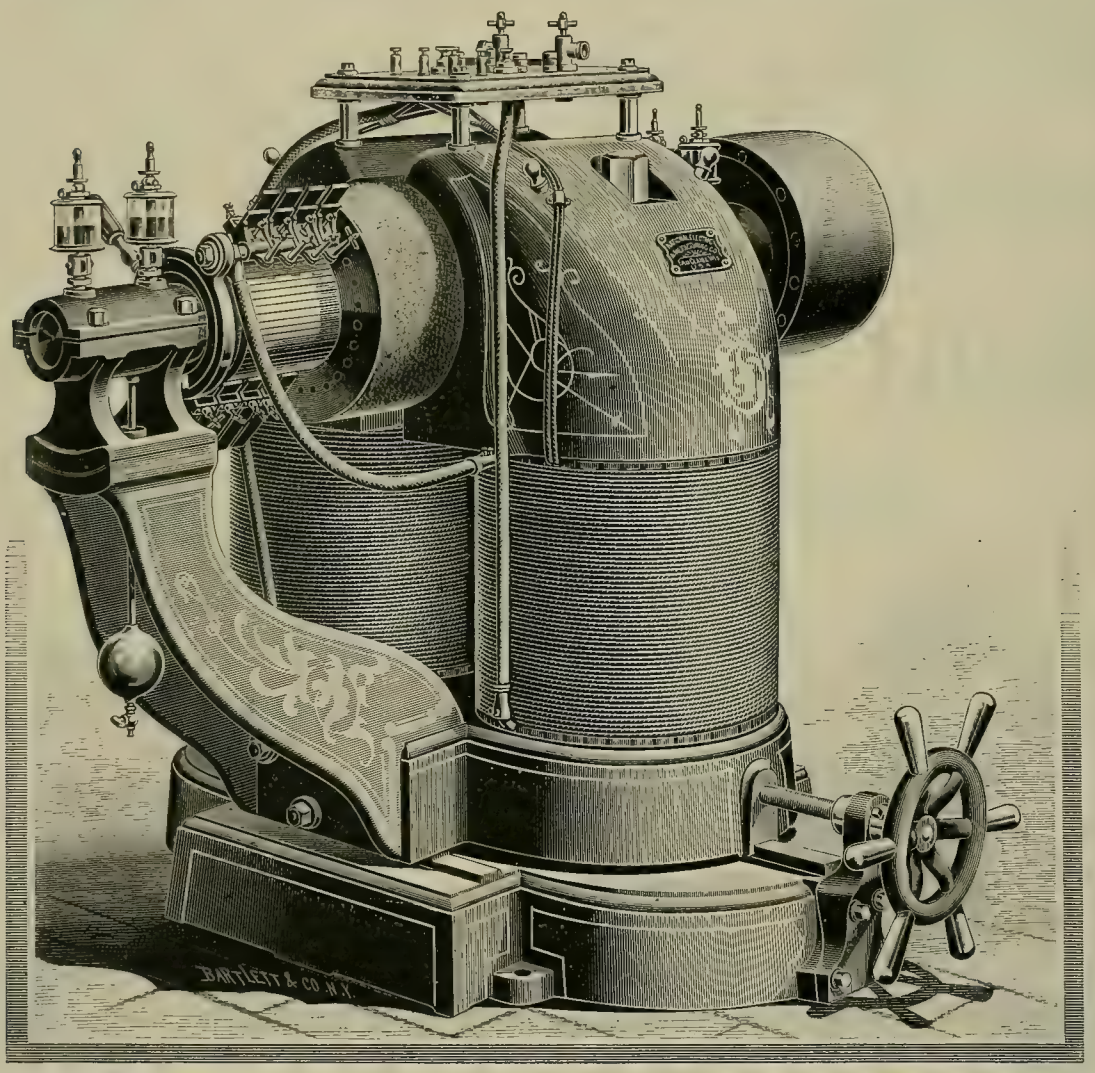
NATIONAL ELECTRIC MFG. CO.,

GEO. B. SHAW, General Manager,

EAU CLAIRE, WIS.

TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



DIRECT CURRENT AUTOMATIC DYNAMO—CAPACITY 500-16 C. P. LAMPS.

COMPLETE
Central Station Equipments
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation and
PROTECT OUR CUSTOMERS.

COMPLETE
Direct Current System
—FOR—
ISOLATED
LIGHTING.

SEND FOR ESTIMATES TO US, OR THE FOLLOWING AGENTS:

BAKER, BALCH & CO., Gen'l Agts.....Seattle, Washington.
THOMAS WOLFE, Southwestern Agt.....Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts.....141 East Seneca St., Buffalo, N. Y.
METCALF REED & CO., Western Agts.....1517 Larimer St., Denver, Colo.
SIMPSON DAVIS ELECTRICAL CONSTRUCTION CO.....Winnipeg, Manitoba.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO.,
Tower Building, No. 50 Broadway, New York City.
CHAS. M. BLANCHARD, Agent.....Girard Building, Philadelphia, Pa.
L. N. COX, Agent.....16 Fifth St., S. E. Washington, D. C.
W. N. GRAY, Special Agent.....Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agents.....531 Wood St., Pittsburgh, Pa.
A. IRVINE.....Emilie Building. St. Louis, Mo.
NATIONAL ELECTRICAL DEVELOPMENT CO.,
History Building, 723 Market St., San Francisco, Cal.

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

We Have no Time to Write an Advt.
This Week,
Being Too Busy Selling Goods.
Write Us for Estimates on
SUPPLIES
And Prices of Incandescent
LAMPS.

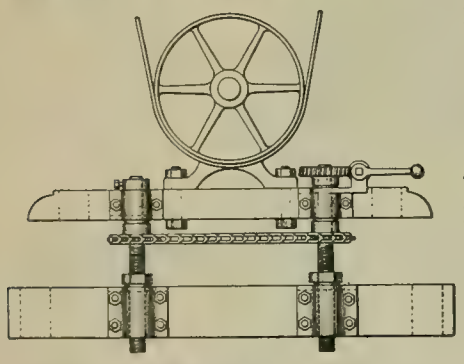
TRADE A.B.C. MARK

ALEXANDER, BARNEY & CHAPIN,

GENERAL ELECTRICAL SUPPLIES,

TELEPHONE BUILDING,
20 Cortlandt Street,
NEW YORK.

VERTICALLY-ADJUSTABLE DYNAMO SUPPORT.

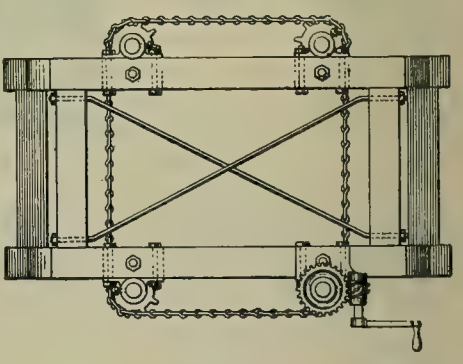


Patented August 12, 1890. For full description see article in WESTERN ELECTRICIAN of September 20, 1890, or Patent Specifications 434,011.

The Best and Cheapest Adjustable Support

In Stations where Dynamos must be placed either above or below the power. In use exclusively in the Chicago City Lighting Stations. Will license users to manufacture the apparatus on royalty, or will sell the patent outright.

CORRESPONDENCE INVITED.



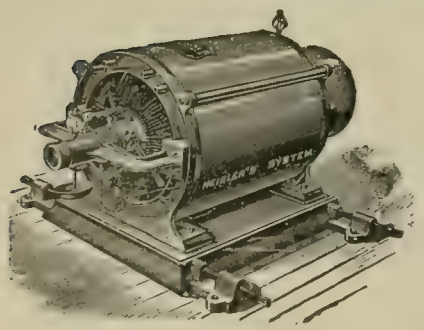
Manufactured and for Sale by

THOMAS WRIGLEY, 85 Fifth Avenue, CHICAGO.

THE HEISLER PATENT LONG DISTANCE

INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



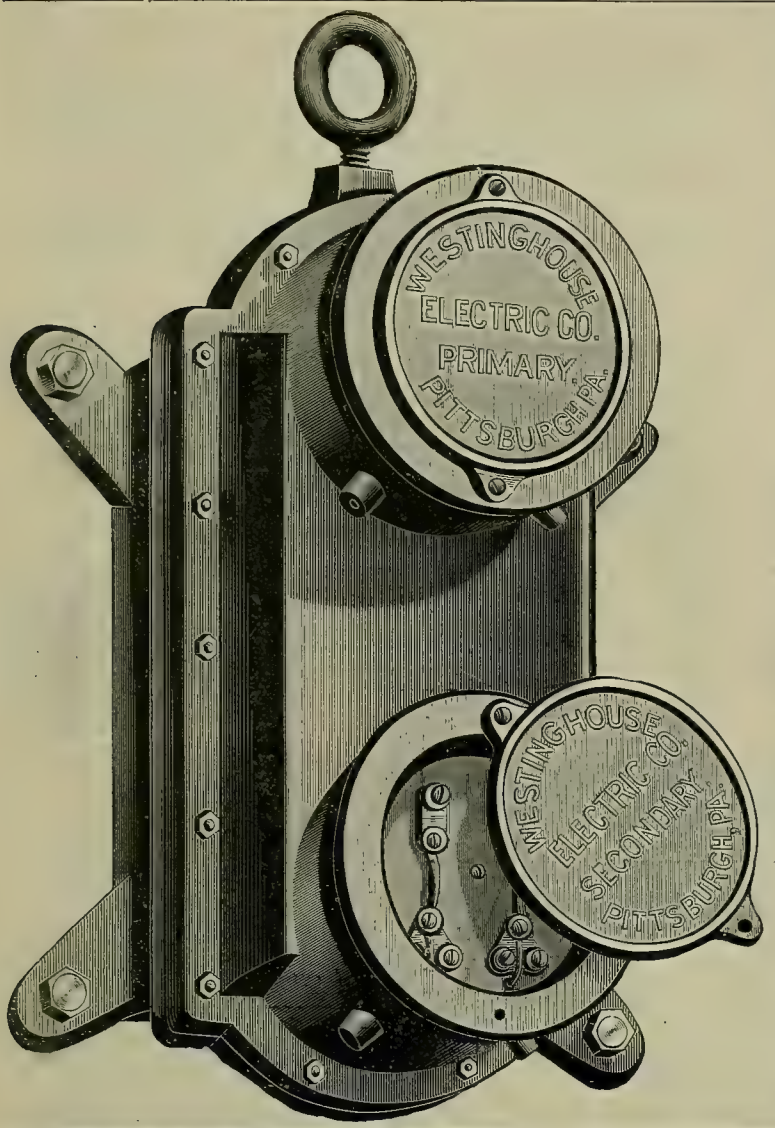
"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.



CONVERTER EFFICIENCIES

It will Pay You to Throw Out Your Present Converters, and Substitute Our Make.

COMPARISON OF CONVERTERS.

	Total Efficiency.	*Converter Capacity Tested*
THOMSON-HOUSTON,	**87.50 Per Cent.**	**25.**
FT. WAYNE JENNEY,	**87.**	**25.**
NATIONAL,	**88.**	**20.**
WESTINGHOUSE,	**95.**	**20.**

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

INCANDESCENT ALTERNATING CURRENT

Dynamos, Converters, Meters, Motors.

325 CENTRAL STATIONS and 600,000 LAMPS.

Alternating Current Arc Lighting Apparatus.
Lamps burn 40 hours without renewal of carbon.
Arc Lighting revolutionized.

SEND FOR SPECIAL CIRCULAR.

55 Plants and 5,000 Lamps Sold Within a Few Months.

CORRESPONDENCE SOLICITED.

WESTINGHOUSE ELECTRIC AND MFG. COMPANY,

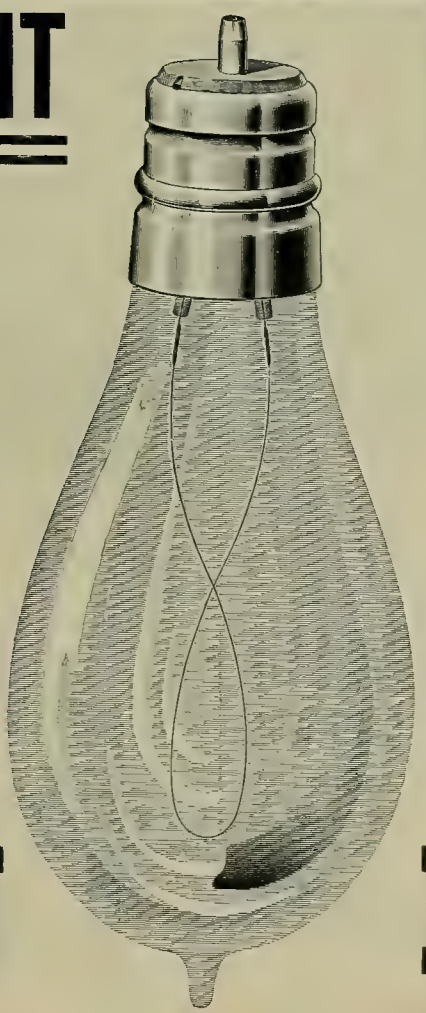
Pittsburgh, Pa., U. S. A.

Boston, New York, Chicago, Cincinnati,
St. Louis, San Francisco, Portland.

INCANDESCENT LAMPS.

To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.



Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS

THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, NEW YORK.

620 Atlantic Avenue, BOSTON, MASS.

217 La Salle Street, CHICAGO, ILL.

BURNLEY DRY BATTERY

PATENTED January, 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:--Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO. ILL.

DUST-PROOF BELLS.

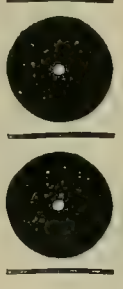
None Genuine Without the Washer.

STANLEY & HALL,

(Formerly HAZAZER & STANLEY,)

32 and 34 Frankfort St.,

NEW YORK.



NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
ST. LOUIS, 616 Locust St.

THE THING for Electric Railways. "CANVAS JACKET" FEEDER WIRES.

INDESTRUCTIBLE PATENT WOVEN INSULATION.

POLES. POLES.

ELECTRIC LIGHT SUPPLIES ELECTRIC RAILWAY.

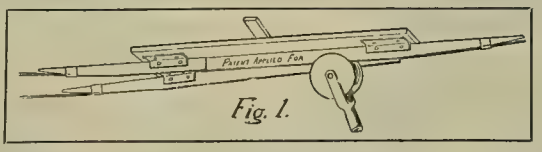


Fig. 1.

MURRAY OVERHEAD TROLLEY SWITCH.

CUSTOMERS REPORT:
"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."

Send for descriptive circulars, THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co

MANUFACTURERS OF

EAGLE and DYNAMO BELTING.

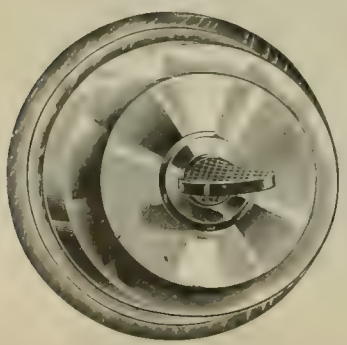
PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.

28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE PAISTE SNAP SWITCH

FOR INCANDESCENT WORK



Recognized as the best, simplest and most durable circuit breaker in existence.

H.T.PAISTE,

12th and Market Sts.,

Philadelphia, Pa.

KEPT IN STOCK AND FOR SALE BY ALL PROMINENT SUPPLY HOUSES.

GET THE BEST!

P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N.Y. 59 MAIDEN LANE.

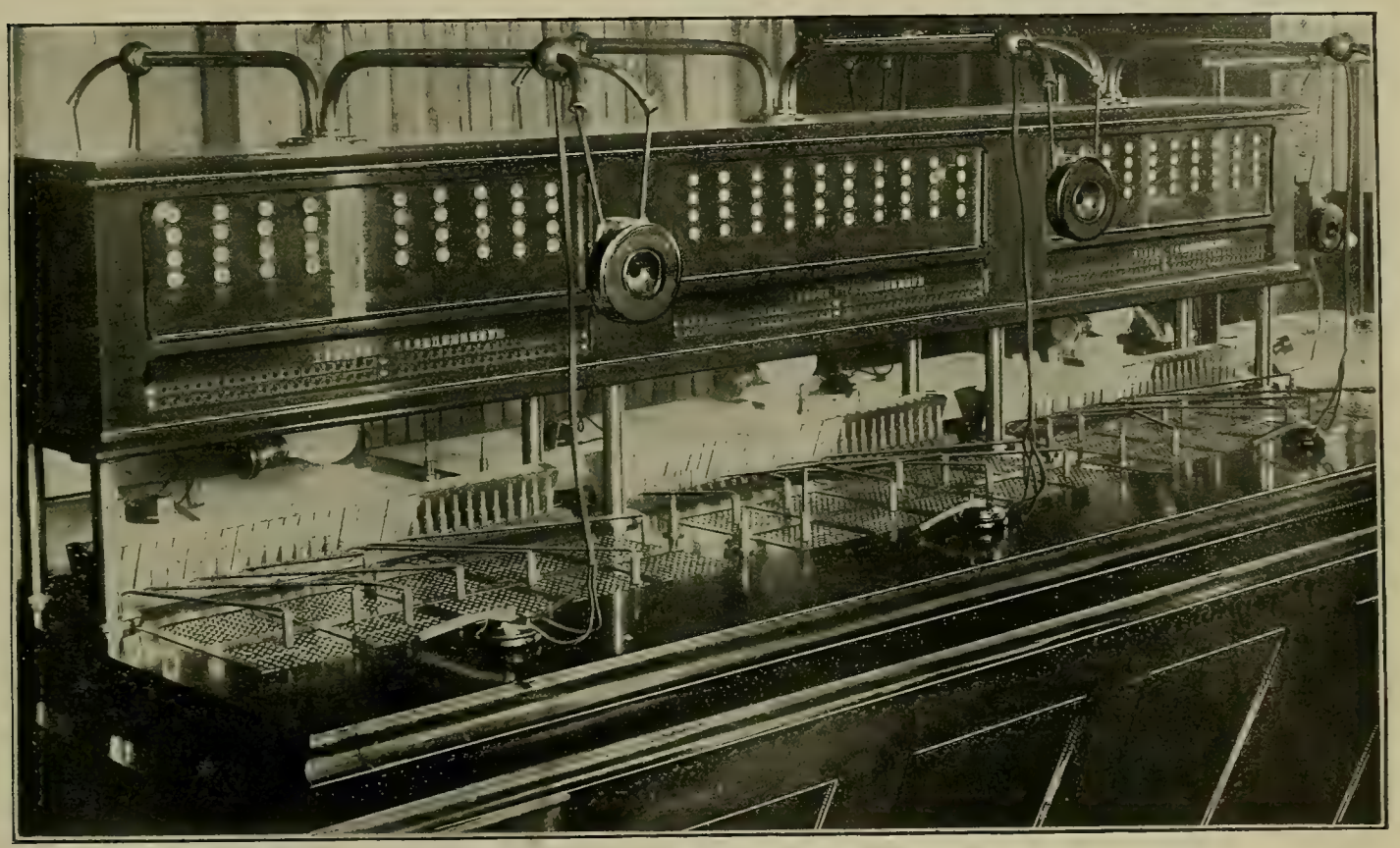
Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, NOVEMBER 29, 1890. No. 22

The New Target Board at the Chicago Telephone Exchange.

The volume of business at the Chicago Telephone exchange has increased during the past year to such an extent that the company recently felt obliged to call upon its electrician, J. J. O'Connell, to design something through the use of which it would be possible to provide a more satisfactory service. For some time the operators have been so pressed with business that it was almost impossible to take up and reply to "busy" calls in their proper order. It was with the view of relieving the regular operators from the responsibility of watching for a "ring in front of her terminals of tap wires from every line running into the exchange. There are also in front of her several rows of annunciators or targets. These targets appear black when the busy line is cut out of service by the main switch-board operator. The targets are white when the line is in service. When the target-board operator receives a ticket she first places it in one of the little brass pockets shown in the cut, in under the lamps. She then takes the plug corresponding with that particular pocket and inserts it into the socket belonging to the tap wire of the line wanted, say "1446." When "1446" becomes disengaged on the main



NEW TARGET BOARD AT THE CHICAGO TELEPHONE EXCHANGE.

c ff" that the target or "busy" board illustrated in the cut was designed.

Since this new department has been inaugurated a call first comes in to the regular operator on the main multiple switch-board as usual. This operator, it will be assumed, finds the line wanted busy. She then records the number wanted on slate; telephones it to a ticket maker at the target board. This ticket maker is also at the same time given the operator's number, the number wanted, and the number of the line calling.

When the ticket maker at the target board receives an order she records it on a small strip of cardboard, placing the numbers in the order already designated. This ticket is passed from the ticket maker across the target table or board to an operator whose duty it is to watch for a line to become disengaged.

A word of explanation will now be necessary. The last named operator at the target board has office switch-board, the target of that particular card and plug shows black. The target-board operator then plugs in on a special talking wire and tells the operator that the line wanted, "1446," is not busy. When the main switch-board operator takes "1446," the target will again show white.

So long as the target shows white this line is left undisturbed. When black shows again a new ticket is taken up. This operation is carried on until all tickets waiting for "1446" are disposed of. The arrangement of circuits is such that when a line is connec ed on the target-board a test current is thrown on this line so that operators on the main office switch-board will not take it during the interval of time consumed in making the change.

The Western Carolina Land & Improvement company will, it is reported, build an electrical railroad from Anderson, S. C., to a new town it contemplates building 36 miles distant.

Wisconsin Electric Club.

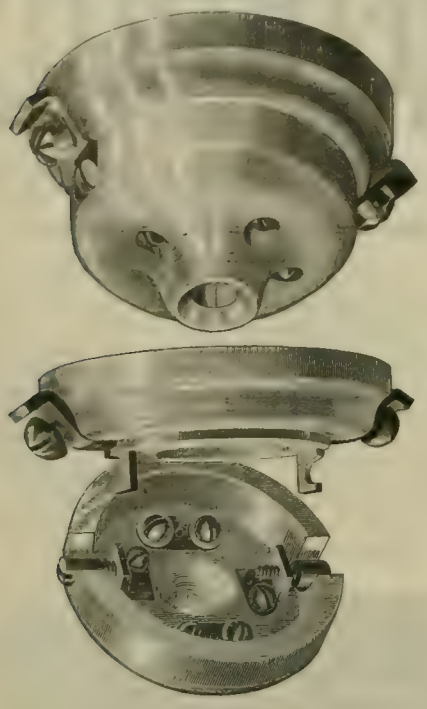
The Wisconsin Electric club of Milwaukee held its second literary meeting of the season last week. The paper of the evening was read by J. A. McManman of the Wisconsin Telephone company, and treated of the development of the telephone and its application to commercial work. Reference was made to several switch-board improvements rendered necessary on account of the growth in the business, and the features of the glass switch-board recently illustrated and described in the WESTERN ELECTRICIAN was discussed. Long distance telephony also occupied the attention of the speaker. The attendance at the club showed that the interest in its proceedings was increasing, and that the organization was growing. It is probable that it will occupy an even more extended field at an early day. It is proposed to combine with the mechanical and civil engineers now forming an association. This would strengthen the organization materially and bring in a number of new men who would be very desirable members. The matter will probably be disposed of at the next meeting of the combined forces.

The National Electric Manufacturing company of Eau Claire, Wis., has secured a contract for an electric light plant at Tarboro, N. C., and it will also build an electric railroad at the same place.

The Belt Electric Line company has been incorporated at Lexington, Ky., by W. J. Loughridge, J. C. Rogers, C. H. Stoll and others, to lease, control and operate the street railways of the Lexington Passenger & Belt Railway company. The capital stock is $500,000.

Ceiling Cut-Out.

The cut-out shown in Figs. 1 and 2 is manufactured by the Star Electrix company of Philadelphia. The main wires are screwed just 2½ inches apart so that bending the wires at the cut-



FIGS. 1 AND 2. CEILING CUT-OUT.

out is avoided. It is easily wired and there are no screws on the side to disfigure it.

The Rice Lightning Arrester.

Lightning or atmospheric discharges of electricity while they may not be sufficient in themselves to materially injure electric light and power apparatus, often provoke a path for the current generated by the apparatus and are thus indirectly the cause of burn-outs.

In the device illustrated diagrammatically in the cut the static charge finds escape from cloud to earth, or from earth to cloud, around the apparatus, through a circuit that has a much lower self-induction than the circuit through the fields and armature of the machine.

The arrangement, which is the invention of E W. Rice of Lynn, Mass., consists, in the application of a self-inductive coil into the circuit containing the apparatus to be protected. A safety fuse and an arc-rupturing magnet are also placed in circuit at a point such that the self-induction of the coil of the arc-rupturing magnet shall tend to shunt the lightning-dis-

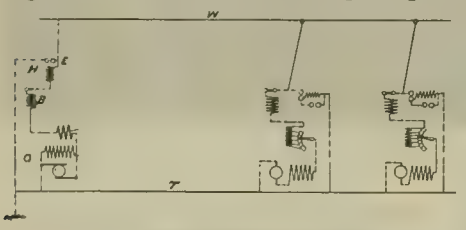


FIG. 1. RICE LIGHTNING ARRESTER.

charge over the electrodes of the lightning-arrester.

Referring to the diagram which represents an overhead railway circuit, *G* is a compound wound generator, *W* a trolley wire, *T* the track, *E* indicates the electrodes of an ordinary lightning arrester. *H* is the coil of an arc-rupturing magnet similar to that employed in the Thomson arrester, *B* is a self-inductive or reactive coil placed in the circuit including the dynamos. This last named coil is made with an adjustable core as shown in Fig. 2. The connections at the motors are similar to those at the generator except that the arc-rupturing magnet-coil for the lightning-arrester, is included in the branch containing the electrodes. The action of the apparatus will now be understood.

An atmospheric charge induced by an atmospheric discharge has an exceedingly high potential, so that its rate of flow is enormous and attended by great self-induction. The self-inductive coil *H* opposes a large self-inductive resistance in the circuit of the generator to the passage of a lightning-stroke over the connection including the generator. This action tends to force any lightning-stroke to take the path of lower resistance across the electrodes *E*. The charge will not divide itself through the multiple paths to earth in accordance with the ohmic resistance, but move proportionally to the self-inductive resistance. In the case of the circuit through the lightning arresters the self-induction resistance is exceedingly small, and in the case of the generator and motor circuits very great. The charge is therefore diverted from the generator and motor circuits through the lightning-arresters to earth. Any

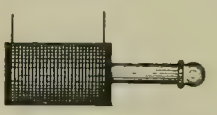


FIG. 2. RICE LIGHTNING ARRESTER.

arc formed by the generator-current is dissipated and destroyed by the arc-rupturing magnet.

Claims the Name.

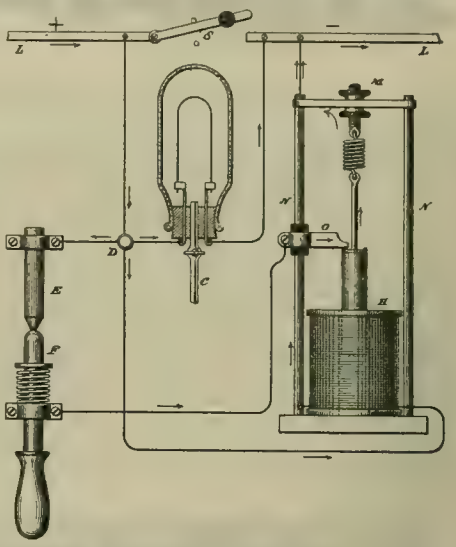
A suit has been instituted by the Electrical Supply company of Chicago against the Great Western Electric Supply company of the same city, to enjoin the latter company from using the name "Electric Supply" as a part of the title of the corporation. The plaintiff alleges that it was the first company in the United States to adopt the name "Electrical Supply," since which time it is asserted it has become popular, and a confusion which is detrimental to the Electrical Supply company has resulted. It is stated that other suits will probably be commenced against other companies using the words "The Electrical Supply."

Automatic Filament-Flashing Apparatus.

The object of the device illustrated in the cuts is to so control the filament flashing process that when the filament reaches the desired resistance it will be automatically cut out of circuit.

In using this apparatus, which is the invention of Hermann Lemp of Hartford, Conn, a constant current is employed. A number of the devices for flashing two or more filaments may be therefore arranged at the same time in series.

Referring to the cut, the construction of the device will be readily traced out. The operation of the apparatus is as follows: When the switch S is thrown open, the current splits at D into three portions. One of the portions passes through the carbons E F to the insulated contact-arm O, and thence by way of the core and spring to the frame N, and then to the negative terminal of the line L. This circuit when intact is of low resistance. Another portion of the current passes by way of the high-resistance solenoid H, to the frame N to the negative terminal of the main line. The third portion of the current passes through the filament B to the same terminal. The arrows in the figure indicate the paths of the current. When it is required to flash a filament, the parts are in the position shown in the drawing, an initial filament having been sealed in the globe and a hydrocarbon vapor or liquid passed into the globe through the pipe C. The carbons, E and F, are now separated so as to draw an arc of gradually increasing resistance. This forces the current through the solenoid H, and through the filament. The latter is now rendered incandescent by the passage of the current and decomposes the hydrocarbon. This action causes a deposit to be made on the filament. The solenoid H also becomes energized, drawing down the core and breaking the contact at O. The continuity of this circuit is thus destroyed, as is the arc between the carbons. The filament at the start being at its highest resistance causes the greater part of the current to pass through the solenoid and draw the core down to its lowest point. As the deposit upon the filament decreases its resistance and the difference of potential between its terminals also decreases, the core in H will gradually rise until it reaches its highest point. It will then come in contact with the insulated arm O, and automatically shunt the filament, the carbons in circuit having been allowed to assume their normal position after the arc goes out. This operation may be timed by adjusting the apparatus so that the filament

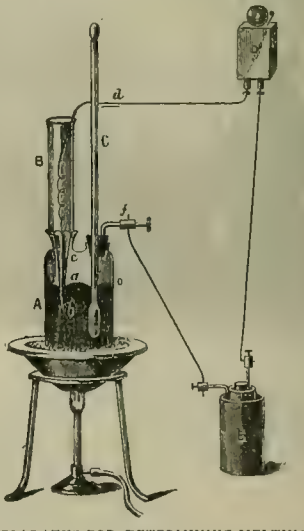


AUTOMATIC FILAMENT-FLASHING APPARATUS.

will be shunted when it has reached any desired cross-section. The thumb-nut N can be regulated so as to produce this effect, or the solenoid H adjusted for this purpose. It is necessary that the filaments be of a certain standard length; otherwise the variation in length, giving rise to a difference of resistance, would interfere with the successful operation of the apparatus. This method the inventor claims makes the flashing of filaments entirely independent of the pressure of the hydrocarbon gas, its temperature, and the time of flashing.

Electrical Apparatus for Determining Melting Points.

The apparatus illustrated herewith, was designed by A. C. Christomanos and described by him in the *Berichte der Deutschen Chemischen Gesellschaft.* The inventor claims that by means of this arrangement a more correct de-



ELECTRIC APPARATUS FOR DETERMINING MELTING POINTS.

termination of the melting points of substances may be insured.

The essential features of the apparatus are as follows: The cylindrical vessel, *A*, provided with two apertures, is heated on a sand bath or in an air bath. A thermometer, *C*, and a platinum wire, *f*, pass through a cork fitting into one of the apertures. The other aperture, *c*, is conical and fluted, and serves for the reception of a drawn out test tube *B*. The vessel, *A*, is filled with pure mercury to such a depth that the end, *b*, of the test tube is below the surface, *a o*, of the metal.

The substance to be tested is first introduced

in a melted condition into the end, *b*, of the drawn out test tube. It is so introduced that it forms a layer at the end of the tube. When it has completely solidified again, the test tube is placed in position, and the space, *a c*, immediately above the substance is filled with mercury, into which dips the platinum wire, *d*.

On applying heat, the mercury in *A* is uniformly heated throughout its whole mass, so that the thermometer and the substance are always at the same temperature. The moment the substance melts the two mercury columns come in contact, thus completing the circuit and ringing the bell. The temperature is then noted.

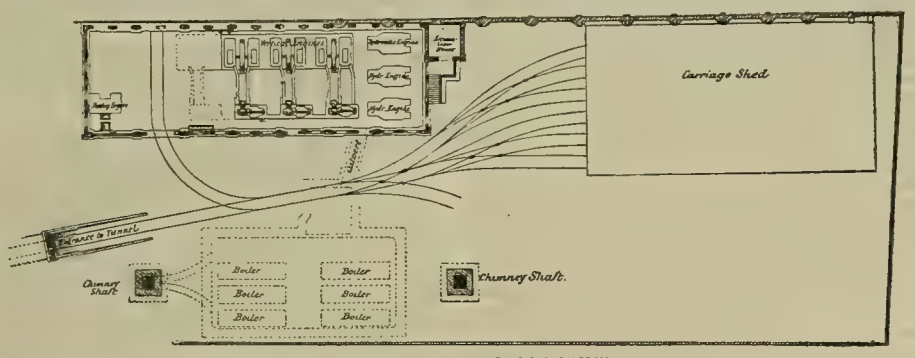


FIG. 1. CITY & SOUTH LONDON RAILWAY.

Storage Battery Car in Chicago.

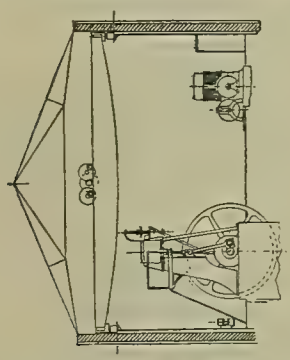
The first storage battery car operated in Chicago was started from the car barns of the North Chicago Street Railway company on North Clark street last Saturday afternoon. It was a 16-foot car equipped with two 15 horse-power motors operated by 88 cells of the Accumulator company type. The car was fitted up by the Accumulator company of New York city. It is lighted by incandescent lamps, and has electric headlights. The cells are arranged in rows under the seats on both sides of the cars. William Hood, manager of the western department of the Accumulator company, New York, had invited a number of street railroad men and others interested in electrical work to be present.

At the hour appointed for the trial a large crowd gathered about the barn and when the car was started by M. Pfatischer, it was greeted with applause by the spectators. Among those comprising the party on the first trip were the following: Superintendent J. M. Roach, Master Mechanic John Miller, General Manager F. L. Theedy and L. F. Ziegler of the North Chicago Street Railway company; S. B. Wadsworth, C. D. Etnyre and E. H. Sheefe, Council Bluffs, Ia.; C. B. Hanna and William Mattison; Fred Bauerlin, Chicago *Tribune;* L. E. Florey, Chicago *Herald;* D. B. Dean, *Electrical Review;* W. Foreman Collins, *Electrical Engineer;* F. M. Ireland, *Electric Age;* S. L. K. Monroe and E. V. Cavell, *Street Railway Gazette* and John B. O'Hara, WESTERN ELECTRICIAN.

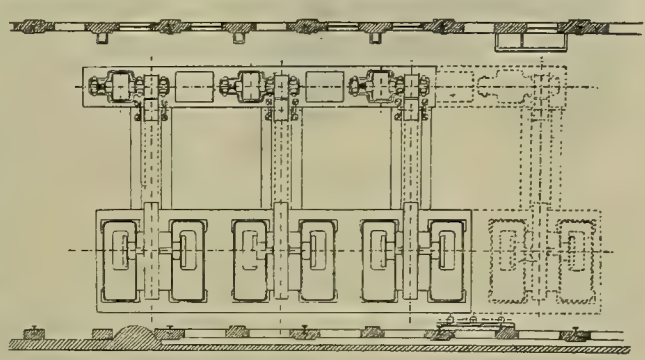
The car was run out three and a quarter miles on North Clark street on the horse-car line, an extension of the cable system. It made a number of stops to take on passengers who seemed delighted with the excellent time made, and the prospect of free rides. The out-going trip of three and a quarter miles was made in seventeen minutes and the return trip in thirteen minutes. On the return trip several horses became frightened and considerable time was lost in slowing up while passing teams.

The officials of the street car company and the representatives of companies from out of town expressed themselves as greatly pleased. After the trial trip two more trips were made and everybody who desired was permitted to ride. On the second trip a trailer was attached and although the car was loaded down the batteries performed their work in admirable style.

Sunday afternoon five trips were made Nearly all the officers of the North Side company made a trip and examined the batteries. They too were pleased with the operation of the car. During the afternoon the car traveled about 40 miles, and carried 700 passengers. One round trip was made with a trailer carrying 140 passengers. Everybody was highly pleased with the operation of the car, and property owners along the line were extremely anxious to have the system adopted as they realized the fact that it would enhance the value of their property.



FIGT 2.



CITY & SOUTH LONDON RAILWAY. FIG. 3.

A temporary plant for charging the batteries has been installed in the limits car house on the North Side. The car will be operated on the North Side until the end of the week and then put on the Dearborn street line. Three trips will be made each morning beginning at 7 o'clock, and three each evening starting at 5:30 o'clock.

William Hood, on behalf of the Accumulator company, extends a general invitation to the electrical fraternity and all interested in street railway work to examine the operation of the system.

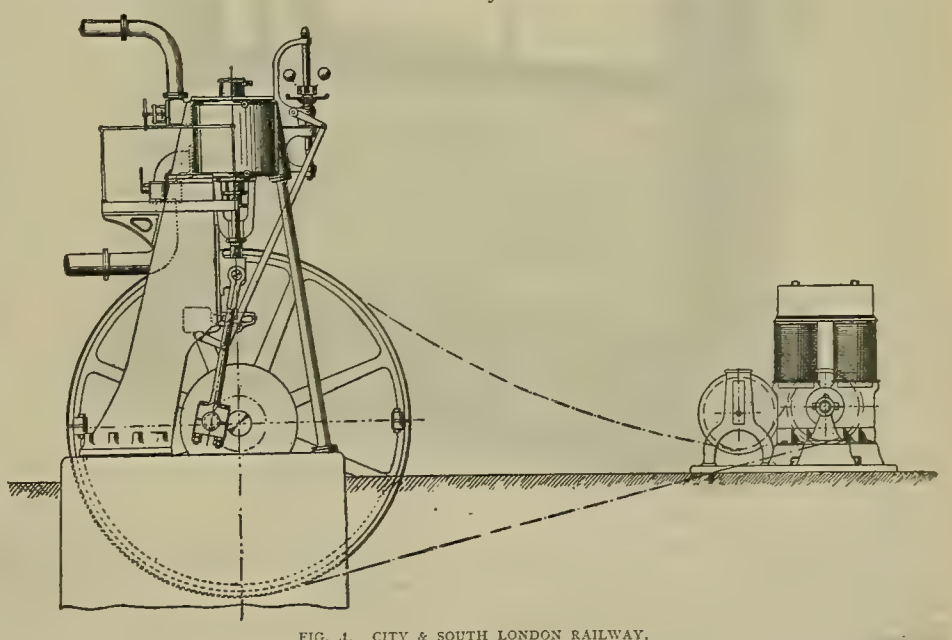


FIG. 4. CITY & SOUTH LONDON RAILWAY.

The City and South London Railway, London, England.

The City and South London railway was recently finished and it is expected that in a few weeks the regular passenger traffic of the road will commence.

This railway is in a subway or tunnel, passing from King William street, London, under the Thames to Stockwell. The line has been constructed in the form of two circular iron tunnels 10 feet in diameter, driven through the London clay and about 60 feet below the surface. The method of working resembles the sinking of a caisson A steel shield was forced forward while material was excavated. When a sufficient advance had been made a ring of cast iron plates was built up, and a lime grout was forced into the space left by the sides of the shield between the lining plates and the soil. A speed of 16 feet per day was attained. Near the Stockwell terminus an old water course, consisting of gravel with a considerable quantity of water, was encountered. The air-lock principle for which this system is excellently adapted, was employed. The water flow was kept back for weeks upon weeks by the sheer force of volumes of compressed air. After some delay in providing the necessary machinery, which it was hoped might have been unnecessary, the tunnels were satisfactorily completed. These tunnels were made in 400 yards length, 200 yards being driven from each face, and meeting like lengths driven from other faces. The extreme divergence of the junctions amounted in one instance only to seven eighths of an inch, and others not exceeding a quarter of an inch, although the datum levels had to be transferred from the bottom of the shafts, which now contain the lifts, to the centers of the lines of tunnel, as the shafts were all on one side or the other of the line of railway. The rate of excavation was often as much as 16 feet per day, the average of the working days being 13 feet 6 inches advance of heading. At the present time the rails of the road are laid, the platforms erected, and the neatly constructed underground stations, with their walls lined with white glazed tiles, are ready for passengers, and have a cleaner and brighter aspect than any of the other underground stations in London. Moreover, they will not be sullied with smoke and dirt from steam locomotives.

The scheme to work this railway by electricity to avoid the use of steam and its noxious results, or the use of rope traction with slow speed and other disadvantages, was submitted to the City and South London Railway company, by Mather and Platt, engineers, Manchester, and the company accepted the idea. The whole electrical plant has been constructed under the special superintendence of Dr. Edward Hopkinson, who has acted throughout as consulting engineer, with G. A. Grindle as resident engineer.

The following description of a few of the details of the work, from the London *Electrical Review*, will be of interest:

The whole of the machinery for generating the electrical current is situated at Stockwell, the suburban terminus of the line. At this point a complete plant has been erected for the generation of the electrical current. Figs. 1, 2 and 3 are plans and an elevation of the plant. Fig. 4 shows the general design of the engines and method of belting them to the generators. There are three large dynamos of the Edison-Hopkinson type, each worked independently by a vertical compound engine, designed and constructed by John Fowler & Co.

The engines work at a steam pressure of 140 pounds per square inch, and have been built of exceptionally massive proportions. They run at 100 revolutions per minute, giving a piston speed of 450 feet per minute. They are fitted with automatic expansion gear of improved type on both the high and low pressure cylinders, and are controlled

by a powerful governor, which is driven direct from the crank-shaft by cotton ropes, the automatic gear being so arranged as to cut off the steam if necessary in both cylinders from dead cut off to three-quarters of stroke. The engines will indicate up to 375 horse power each. The cylinders are steam jacketed, the high pressure is 17 inches diameter, and the low pressure 27 inches. The valves are specially fitted with multiple ports, which reduces their movement considerably, and still gives a very prompt action. The flywheels are 14 feet diameter and 28 inches

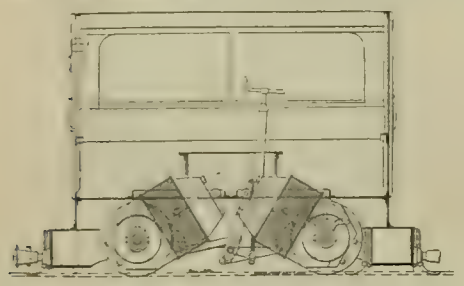


FIG. 7. CITY & SOUTH LONDON RAILWAY.

broad, and drive the dynamos direct by means of leathe chain-belts 26 inches wide.

The engines are supplied with steam from six Lancashire boilers, 7 feet diameter by 28 feet long, which are fitted with mechanical stokers. Two large feed water heaters are also supplied, with brass tubes of ample surface, for receiving the whole of the exhaust steam from the engine without back pressure

Edison Hopkinson dynamos are fitted with bar armatures. The weight of the armature alone is about 2 tons, and the weight of entire machine something over 17 tons. Each machine is capable of generating 450 volts and 450 amperes. The commutators are of hard copper insulated with mica. The magnet limbs are exceedingly massive, each limb, with its pole piece, being over 4 tons, and the yoke of the machine weighs about 3 tons.

The machine can be run as shunt, or compound only, as required. The total weight of copper wire on the magnet of each machine is nearly 1½ tons. The present machines have, it is claimed, an electrical efficiency of 96 per cent,, and the measured efficiency of the engine and dynamo, *i. e.*, ratio of the electric power available outside the dynamo to the indicated horse power of the engine, is over 75 per cent.

Sir William Thomson's multicellular electrostatic voltmeters are used for measuring the electromotive force. The current from the dynamos is conveyed to a general distributing and testing switch-board, fixed in a recess of the engine house.

The site occupied is a plot of about two or three acres on the surface, or ground level, Fig. 1. The access between this depot and the subway is by a curved tunnel descending from above ground by a steep incline of 1 in 3½ feet. Up and down this the trains are brought or lowered by a rope and winding engine. This short bit of tunnel is remarkable. Formed on a horizontal radius of 250 feet and a severe vertical radius, it is marvelous that the junction of the two drivings, one from below and the other

traordinarily high. When the full pressure of 500 volts is on the complete system of working and feeding conductors, the leakage current does not exceed one ampere, so that the total loss by leakage is less than one horse power; this is a small fraction of 1 per cent. of the total power required for working the line to its full capacity. The current is collected from the working conductor by sliding shoes of iron or steel.

Fourteen 10-ton electric locomotives, Figs. 6 and 7, have been supplied by Mather & Platt for working the line, each capable of developing 100 effective horse power and of running up to 25 or 26 miles per hour. The armatures of the locomotives are constructed so that the shaft of the armature is the axle of the locomotive; in this way all intermediate gear and all reciprocating parts are entirely obviated. A motor is fitted on each axle, the axles not being coupled, but working quite independently. The current is conveyed from the collecting shoes through an ampere meter to a regulating switch, then to a reversing switch, thence to the magnets and back through the framework of the locomotive to the rails, so completing the electrical circuit. The locomotives are fitted with a Westinghouse automatic air brake and also a screw hand brake, and they are lighted from the working conductor. The train, when loaded, will weigh 30 tons, and it is intended that ten trains shall be worked on the line at one time. A train consists of an electric locomotive and three passenger carriages, 32 feet in length from end to end of the footboard. The long passenger carriages are pivoted on two 4-wheeled bogies, and the interior, which is divided by a door in the center, contains seats for 34 persons. The inclosed portion is 28 feet in length, the external overhang of the carriage platform being coupled up to the similar

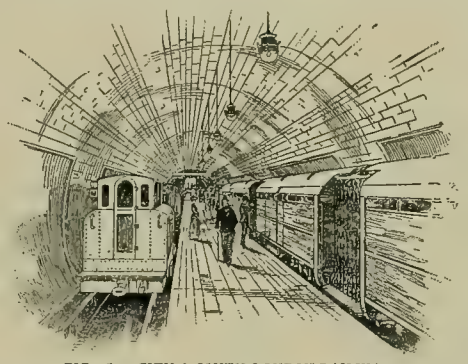


FIG. 5. CITY & SOUTH LONDON RAILWAY.

overhang of the adjoining carriage, and thus forming two open platforms between the three carriages. Upon each of these a guard travels with the train. These guards' platforms are protected at the sides by iron lattice sliding doors. The carriages are lighted by electric light, the current for the lamps being, in like manner, taken off from the conductor.

Each train carries its own reservoir of compressed air, sufficient for 40 stoppages, and as it arrives at the depot station of the line, recharges its air supply. The trains are also fitted with hand brakes, the stopping power being thus

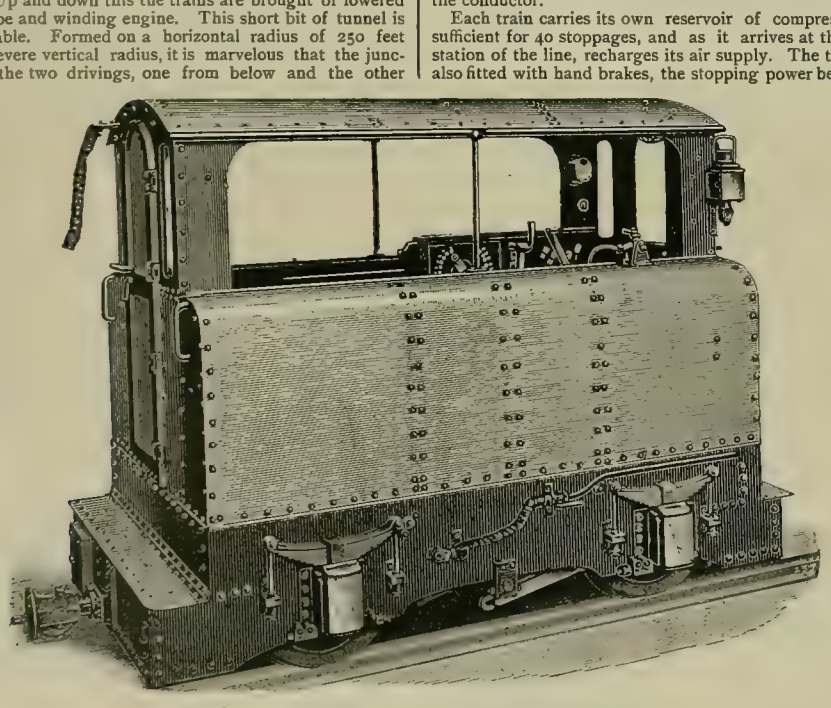


FIG. 6. CITY & SOUTH LONDON RAILWAY—LOCOMOTIVE.

from above, should have met center for center and level for level within an inch or two. At the depot the carriage shed is large enough to contain six trains side by side, The platform at the Stockwell terminus is shown in Fig. 5.

The main cables for the road consist of a copper core of 61 | 14 B. W. G., insulated with Fowler-Waring patent insulating material, and lead-sheathed.

The working conductor is of channel steel, carried on glass insulators. the joints being fished, and also connected with copper strips. The steel employed is of very high conductivity, and has been rolled especially for the purpose. The working conductor is divided into sections for convenience of testing and carrying out repairs on the permanent way. The insulation obtained, it is stated, is ex-

completely independent of the motive power. Block signaling has been adopted. Should, by any failure of the engine at the depot, or any other cause, the train be brought to a standstill, passengers could leave the tunnel safely, as a passage 2 feet wide is provided clear of the rails, and at no point could the distance to be traversed exceed three-eighths of a mile

In the generating house is the hydraulic machinery for supplying power to the lifts at the various stations. The cylinder of the ram is 2 feet in diameter, and the wrought iron flange-jointed pipes, which convey the water at a pressure of 1,200 pounds on the square inch are nearly a foot in external diameter. The engines which pump the water into them act automatically, being put in motion as the accumulator descends by loss of water at the lifts. At the end of this building is a locomotive repairing shop, with special appliances for lifting out or replacing the dynamos on the locomotives.

For the numbers of business men, clerks and employes coming daily into the city it will be a great boon to be conveyed at a speed of at least 12 miles an hour, the journey from Stockwell to King William street occupying 15 minutes, instead of three quarters of an hour as at present by omnibus. Ultimately, the trains will follow each other at three-minute intervals, but at the commencement of the traffic they will start about 7:30 A. M., and run every five minutes. The stations are lighted by gas; and for the water supply of the steam boilers, which is taken from the water company's mains, there are two large tanks, one of 12,000 and the other of 25,000 gallons, as a reserve.

Lighting a Museum Train by Electricity.

Some time ago the W. C. Coup Museum company decided to fit up a train of four cars in which its curiosities might be exhibited en route as the train was hauled from place to place. In order to make the traveling museum as attractive as possible the company recently contracted with the Western Electric company, Chicago, to install on board an electric plant which would brilliantly illuminate the whole train.

The project was an entirely new one, and on this account the plant had to be especially designed. Through the courtesy of E. W. Goldschmidt, who superintended the installation of the electrical apparatus the WESTERN ELECTRICIAN is enabled to give an account of a few of the details of the equipment.

The main portion of the outfit is on the first car of the train. The equipment consists of a 30 horse power engine and boiler, a Western Electric dynamo and a battery of storage cells. In addition there are two tanks which contain a supply of water for the boiler.

To place all of this apparatus together with coal box, pump and other appliances necessary for the successful operation of a complete steam plant, within the space assigned, which was nine feet by about fifteen feet, was quite a problem. The work, however, was done in such a way as to leave convenient passages to all the machinery.

The machinery of the plant is as follows: The engine is of the Beck vertical type and was built by the Taylor Manufacturing company of Chambersburg, Pa. The boiler, it may be mentioned, is fitted with a stack arranged so that it may be dropped when desired upon the top of the car. There is also connected to the boiler a fog horn which is provided for the purpose of awakening every one within a radius of two miles of the place where it is blown. This horn is intended to attract the attention of the curious populace of the towns to the side tracks upon which this train will be exhibited.

The dynamo is compound wound, and has a capacity of 300 16 candle power lamps. The engine and dynamos are belted together. As was stated, water for the boiler is taken from two elongated cylindrical iron tanks which are hung beneath the car. These tanks are each 30 feet long by 24 inches in diameter, and have each a capacity of 100 feet of water. This quantity will be sufficient for any run that the car will be called upon to make.

The accumulator plant is also hung beneath the floor of the car. The battery consists of 60 cells of the Anglo-American Storage Battery company's manufacture. This will be used for lighting the train when the exhibition is not in progress, or during trips between stations.

Each car of the train is lighted by three clusters of lamps, and in addition there are a large number of single lights distributed here and there. The most attractive features, however, are the figures suspended on the sides of the cars and representing respectively a star, an anchor, a sphere, a cube, a horse shoe and other handsome designs. Variously colored lamps are used. Over the main entrance a large horseshoe is placed, producing a very brilliant effect and making it impossible to fail to find the entrance. The wiring is so arranged that the alternate lamp or lamps of each color can be switched out at pleasure, thus enabling the dynamo man to keep up a continuous scintillation in the figures, producing a very peculiar effect.

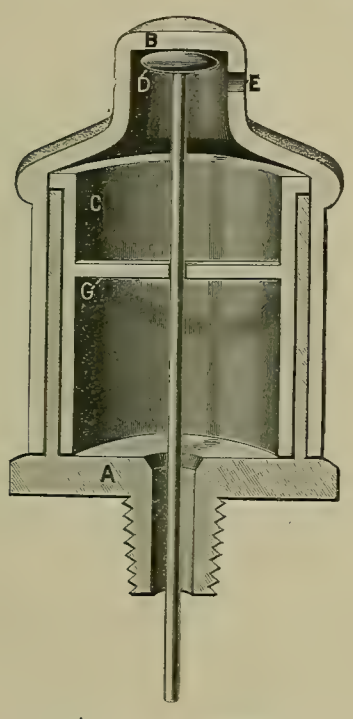
The wiring is arranged in three circuits and so that a constant potential will always be main-

tained, no matter how many lamps are burning, or how many cars are included in the system. The train is fitted up throughout with bells and signals so that employes in the train may be conveniently called without attracting the attention of the public.

A trip through the car is interesting, In the first car is an electric and steam plant, a ticket office, and a Japanese village where a number of almond eyed Japs are offering their wares for sale. The second car is filled with interesting groups of wax figures, mechanical singing birds, automatons and other curiosities, an ossified man, which is about the only living or semi-living object in the car, although everything is in motion, and apparently alive. The greater part of the third car is taken up with an electric organ. It is operated entirely by electricity, the bellows being worked by a small one horse power electric motor, taking current from the mains running through the cars. The organ itself is a very complicated piece of work; the valves are operated by electro-magnets in a very ingenious manner. The music brought out equals in volume and strength that of a brass band of probably 30 or 40 pieces. The organ takes up the entire length of the car. The fourth car is a hotel and sleeping car for the employes on the train.

Powell's Electric Car Grease Cup.

The electric street car motor is located under the car floor and on this account it is of importance that lubrication to the journal bearings



POWELL'S ELECTRIC CAR GREASE CUP.

should be promptly and quickly accomplished. The Powell lubricator is devised to accomplish this without a moment's loss of time and when the car is in motion. The cup is constructed as shown with a removable charging case which may be instantly taken out and replaced when required without the usual annoyance incident upon the old method of refilling.

To fill the cup all that is necessary is to pull off the hood *B*, withdraw the case *C*, by inserting the finger under the guide bar *G*, refill with grease and replace it with its friction rod, and return the cover as before. As the latter slides down the whole length of the chamber *A*, there is no possibility of the cover being lost or shaken off while the car is in motion, and all dirt is rigidly excluded from the bearings *D*. Duplicate charging cases ready filled are sometimes employed to replace the empty cases. This grease cup is applicable to any description of journal lubricator where grease or solid oil is used.

The cup is manufactured by the Wm. Powell company, Cincinnati, O.

J. H. Harris has petitioned the city council of Anniston, Ala., for a franchise for an electric railway.

The Artificial Light of the Future.[1]

By Edward L. Nichols.

The growth of electric lighting forms one of the most brilliant chapters in the history of invention. The record is one of which the electrician has reason to be proud. It is a record of advance following advance in our means of generating current and of transmitting it. It is the record of the evolution of the arc lamp from the first crude forms to the perfectly regulated lamp of to-day. It is the record of the development of the incandescent lamp. Throughout it all we note with wonder that the perfecting of 10,000 details of construction has gone hand-in-hand with ever diminishing cost of production.

As we review the history of the electric light, however, we find that in two respects there is less cause for congratulation. When we come to consider the quality of the light produced and the efficiency of the apparatus as a light-making machine, we find that the incandescent lamp of to-day produces the same quality of light which the earliest examples of its type were capable of giving. We find, however, that its light differs but little from that obtained by burning oil and gas, which, in turn, in spite of all the improvements which have marked the growth of artificial illumination, is almost the same in quality as that which the Eskimo obtains from the crude blubber of the whale, or which the dweller in the log cabin on the frontier may get from his home-made tallow dip.

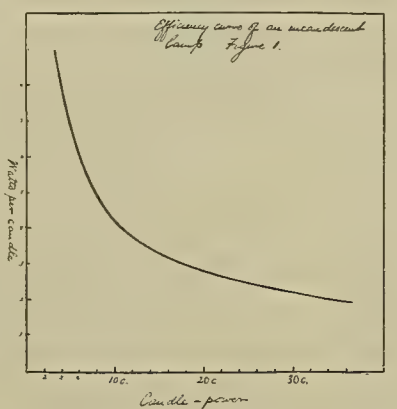


FIG. 1.

FIG. 2.

It is true that the efficiency of the incandescent lamp has gradually risen from five to three watts per candle, but those who have had occasion to trace the discouraging life curves of such lamps, know how little real progress the change implies. We start a well manufactured lamp at any temperature we please, provided that we do not pass a certain limit, beyond which the life of the lamp would be too seriously curtailed. The initial efficiency may be made as large as we please, within that limit; but it is only a question of a few days or hours when the lamp will have dropped to the dead level of mediocrity, the five-watt level which seems to mark the confines of permanency in the case of incandescent carbon.

When we take a lamp and raise its electromotive force step by step, measuring the current, voltage and candle power at each stage of the experiment, and plot the curve which expresses the relation between the energy required and the light produced, we are gratified at the marked rise in efficiency which follows each slight increase in the temperature of the filament, Fig. 1. That rise of temperature, however, means shortening of the life of the carbon, is well known. Unfortunately, rise of temperature means much more than that. I will venture to show you a few life curves recently obtained in the laboratory of Cornell University. These curves enable us to see at a glance what happens during the curtailed existence of a lamp which is forced to undue brilliancy.

In the first instance a lamp was started at the candle power indicated by the maker, and was held at constant voltage by means of the current from a storage battery. The initial candle power was 16, which was obtained at the expenditure of 3.015 watts per candle. Measurements of electromotive force and current were made at intervals of about ten hours, during the 800 hours that the lamp lasted. The candle power was redetermined at intervals of about 100 hours. The voltage never rose more than 65 volt above its initial value, and then only for a short time. The average electromotive force of the entire run was .40 volt below the initial value. The record of this lamp is contained in Fig. 2. It represents an individual case and not the average obtained from many lamps, but it is typical of the results which have been obtained with many. The characteristic features are rapid, followed by slower falling off in candle power, the decrement amounting finally to more than 50 per cent., and rapid, followed by slower falling of efficiency, to a final value of 5 75 watts per candle. These changes were accompanied by continuous and marked increase in the resistance of the filament.

If it be asked whether this individual case represents a state of affairs common to all incandescent lamps, I can only say that in my experience, which is certainly much less extensive than that of some others, I have known of no class of lamps, the performance of which did not agree approximately with that indicated by these curves.

This falling off in candle power exhibited by lamps maintained at constant voltage can be met by a procedure not easily applicable perhaps in commercial work, but readily carried out where the object in view is simply to study the behavior of the lamp under usual conditions. The method consists in raising the electromotive force at short intervals of time by amounts sufficient to restore the candle power to its normal value.

The results of such an experiment performed upon a lamp precisely similar to that from which the curves in Fig. 2 had been obtained, are depicted graphically in Fig. 3. Under this treatment the life of the lamp in question was not quite 100 hours. The total rise in electromotive force during the test amounted to about 9 volts; the efficiency decreased from 3.118 watts per candle to 3.468 watts per candle. The resistance of the filament rose from 221.6 to 234.8 ohms. During the first fifty hours the changes were slight; then occurred a sudden increase of resistance accompanied by marked rise in electromotive force and in amount of energy consumed.

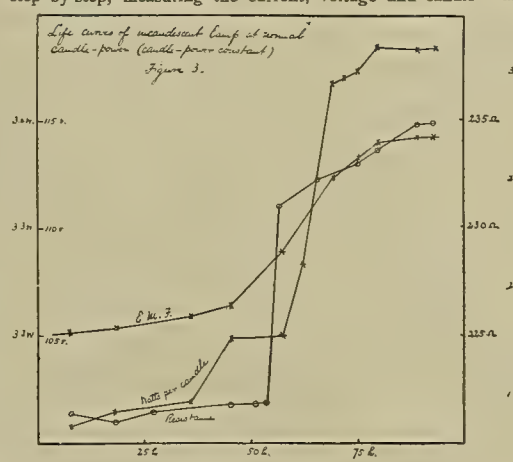


FIG. 3.

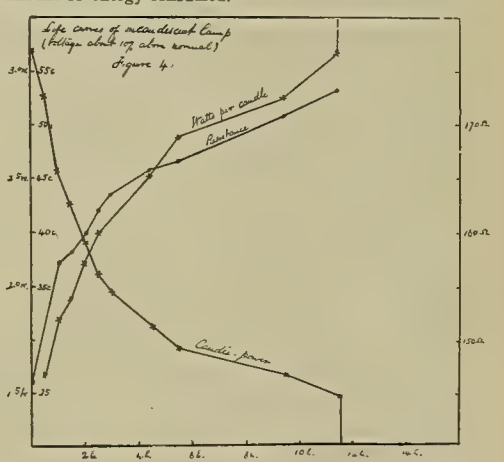


FIG. 4.

The life history of the incandescent lamp at still higher temperature does not differ essentially from that which we have just been considering, but the changes in question go on much more rapidly.

In Figs. 4 and 5 are recorded the performances of two lamps which were similar to those from which the curves in Figs. 2 and 3 had been obtained. The first of these (see Fig. 4) was started at 57 candles. It was maintained at constant voltage for 11 hours and 30 minutes, when it went out. During its brief life the candle power fell to 24.6c. and the watts per candle increased from 1.58 to 3.09. The loss of candle power during the experiment was 55 per cent., an amount which corresponds very closely with the loss suffered by the first lamp tested during the 800 hours that it lasted. In the case of the other lamp (see Fig. 5), the initial candle power (64 candles) was maintained throughout. Its life under these circumstances was 140 minutes, during which short period it had been found necessary

1 Abstract of a lecture before the New York Electric Club, November 20, 1890.

to raise the electromotive force from 114.08 volts to 129.53 volts. The efficiency of the lamp fell, meantime, from an initial value of 1.33 watts to 1 677 watts at the end of the first hour; then more and more rapidly to 1.945 watts at the end of the test.

The conclusion to be reached from these data and from the great mass of experimental results which has accumulated since the incandescent lamp has become an object of investigation, is only too evident. The efficiency of an illuminant in which carbon is the glowing material, is a function of the temperature. It appears that the incandescent lamp is fairly stable only at temperatures for which its efficiency does not exceed about five watts per candle. We have just seen what occurs when one attempts to maintain lamps at degrees of incandescence corresponding to a much higher temperature. It is, perhaps, not possible to point out with perfect definiteness all the causes that are at work to reduce the candle power. The black coating which

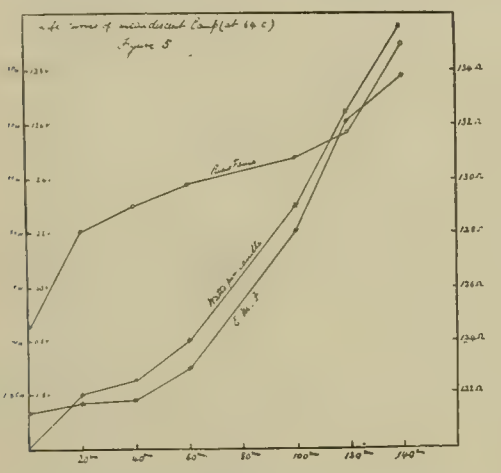


FIG. 5.

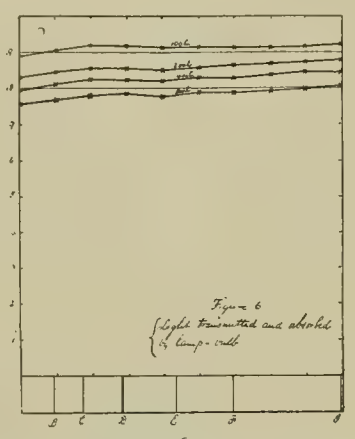


FIG. 6.

gradually forms on the interior of the lamp bulb intercepts more and more of the light from the filament as the age of the lamp increases. The growth of this film and its power of absorbing light have recently been carefully studied by two of my advanced students, B. E. Moore and C. J. Ling.

The life curves which I have just shown you were made by them as a necessary part of their investigation of the loss of light due to the opaque film, and I will venture to take from their work, as yet unpublished, the results which they have obtained in the case of the lamp to which the curves in Fig. 2 refer. These results are given graphically in Fig. 6. They show the amount of light of each wave length of the visible spectrum which the coating on the interior of the bulb absorbed. The measurements were made after the lamp had been in operation 100 hours, 200 hours, 400 hours and 800 hours. In the diagram abscissæ are wave lengths and ordinates show the amount of light transmitted by the lamp bulb at the above mentioned times, in terms of the amount which the bulb allowed to pass before

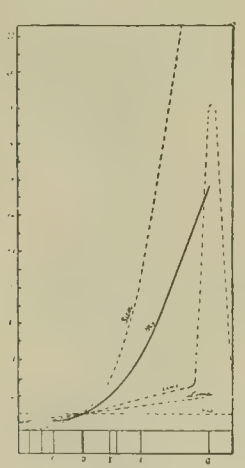


FIG. 7.

FIG. 8.

the coating began to form. You will see by a glance at these curves that the absorbing power of the film was very nearly uniform throughout the spectrum, so that the blackening of the lamp had no appreciable effect upon the light which it emitted; also that the absorption at the end of 200 hours was considerably more than half as great as that at the end of 800 hours, and that the total loss of candle power due to blackening was about 22 per cent.

These measurements enable us to account for rather more than one-third of the loss of candle power suffered by the lamp. We are not, with our present knowledge, in position to speak so definitely concerning the other two-thirds, but the increase in the resistance in the carbon indicates another source of diminution. That gradual failure of the vacuum which the use of spark-coil would unquestionably have enabled the observers to detect, may well be answerable for the rest. Now, the temperature of an incandescent lamp filament at five watts per candle is very nearly the same as that of the carbon in the light-giving flames produced by the combustion of oils and gas, and it appears that the attempt to pass this temperature introduces difficulties of such a nature as to lead to the serious question whether we have not reached a dennite limit, beyond which incandescent carbon ceases to be permanent.

At that limit the efficiency of the lamp is very small indeed, 95 per cent. or more of the radiant energy emitted being of wave lengths too long to afford light.

As to the arc light no more encouraging report can be made. On the contrary it is perfectly well established that the quality of the light, instead of increasing, has fallen off, in the course of the development of the lamp from the clockwork regulators of Dubosc and Foucault, with their slender carbons, to the commercial lamps of to-day.

The researches of Nakano,[2] Marks,[3] and others, show that the efficiency of the arc is a definite function of the current density at the terminals of the carbons, increasing nearly in inverse ratio to the cross-section of the pencil. When the maximum current capacity of the latter has been reached, the efficiency is in the neighborhood of 10 per cent., a value which is not likely to be greatly exceeded by any of the methods in vogue at the present day.

As Edward Weston[4] says in his discussion of Nakano's paper on the efficiency of the arc lamp: "The small amount of luminous energy, compared to the total energy employed, is a sad thing always."

In the vast accumulation of experience which the past years have witnessed, nothing has come to general knowledge which looks to the raising of the barrier which blocks our progress. It seems only too probable that the limiting temperature at which carbon can be used for the production of light has been reached, and with it the maximum efficiency of artificial illumination.

As time goes on, however, the question of the efficiency of illuminants will increase in practical importance. No one of us, I take it, is of the opinion that the world will always be content with the present extravagant methods of obtaining light. Now, if you will permit me, I will turn toward the future and consider the properties of some other sources of light, with the view of inquiring whether they may not have a part to play in the artificial lighting of days to come.

What is to be the light of the future? From the standpoint of the engineer I will frankly say that I cannot answer that question, but abandoning the directly practical point of view, there is something to be said. I need offer no apology here for presenting facts, the application of which is at best remote, and the present importance of which is therefore rather scientific than utilitarian.

The number of elements and of compounds capable of sustaining a high temperature without dissociation or change of state is very large. Carbon is the only one of these, the capabilities of which as a source of light, can be said to have been fully tested; and yet all the others, when heated to a proper point, emit light giving radiation. Take for example the metallic oxides. We heat the oxide of calcium in our magic lanterns and it gives a light of great intensity, and but little inferior to the arc light in whiteness. The exceeding clumsiness of our method of rendering it incandescent, however, has prevented its adoption excepting for certain special purposes. We burn magnesium in fire works and for photographic flash lights, and occasionally we indulge in the luxury of igniting a bit of the ribbon and admiring, for instance, the intense brilliancy of its flame. Now magnesium is one of the most abundant elements on the face of our planet. It is a rather costly metal at present, being quoted at 50 cents an ounce in this country and at about half that price on the continent of Europe. Even under the limited demand for it which exists at present, it has fallen to about one-tenth of its price of a few years ago and I feel sure that it lies within the power of the electrician to greatly further reduce the cost of production. Among artificial illuminants, magnesium has in one respect no equal. W. H. Pickering, who studied its spectrum in 1880, found it to approach sunlight in quality even more closely than the electric arc light does.

The precise character of the magnesium light is shown in Fig. 7. The abscissæ of the curves are wave lengths, and ordinates indicate the brightness of each portion of the spectrum of the magnesium flame in terms of that of the corresponding regions in the spectrum of gas light. The accompanying curves for the arc light, and lime light, introduced for convenience of comparison, are from measurements by Mr. W. S. Franklin and myself. These curves all refer to lights of the same candle power. It will be seen that the magnesium flame is about ten times brighter in the violet than a gas flame of the same power, and but little more than half as strong in the red. It will be seen, also, that it surpasses the electric arc everywhere beyond the yellow, save in a very limited region of the extreme violet. In order to appreciate fully the significance of these curves, one must have had occasion to compare the various lights to which they refer, placing then side by side and noting the effects. You are all aware that the magnesium light is very white and very powerful, but unless you have happened to see it in direct competition with our ordinary illuminants, you will be but dimly conscious of the difference between hem.

I have here a single magnesium lamp of European manufacture. By means of a simple arrangement of clockwork it feeds a thin magnesium ribbon at a rate just sufficient to maintain a flame between 40 and 50 candle power. Turn your attention for a moment to the screen just behind us. It gives you the impression of a nearly uniform white surface, which is well lighted by the incandescent lamps with which this hall is so abundantly supplied. Its whiteness, now, however, is a very different thing from that which it will take on under the rays of the magnesium light. I light the little clockwork lamp, placing it so that it illuminates a portion of the screen. That part which is shaded from the lamp is just as well lighted as it was before, and its tint is in no way changed; but no one would be likely to describe it as a white surface under the present circumstances. It has sunken by comparison into a rather weak chocolate brown. Let us turn the lamp so that you can see the burning magnesium, and place beside it, to emphasize the contrast, this lighted candle. How dull and sickly the candle flame appears, and yet, though old fashioned and rather out of date among our modern glow lamps, the candle does not suffer greatly, so far as quality of light goes, by comparison with them.

This lamp consumes 168 milligrammes of magnesium per minute. I found the light to average slightly more than 40-candle power. Assuming 40 candles to be the correct value, we have 4.2 milligrammes of magnesium consumed per minute per candle. Now to maintain one-candle power of gas light one minute with an average quality of illuminating gas, 157 milligrammes of gas must be consumed. With gas at $1 per 1,000 cubic feet and magnesium at $10 per kilogramme, a price which is in excess of the present European rate, the magnesium light would cost candle for candle, about 6.72 times as much as gas. With magnesium at $1 49 per kilogramme, or about 67 cents a pound, the cost of the two illuminants would be the same. Looking at the matter from a slightly different point of view, we may say, that since 4.2 milligrammes of magnesium will give as much light as 137 milligrammes of gas, their relative productiveness as illuminants is as 32.1 to 1. The true relation between their values is, however, expressed by a larger ratio than that since candle power for candle power, the real worth of a source of light increases with its temperature. The total luminosity of the arc light, for instance, may be considered fully 25 per cent. greater than that of gas. Two candle power of sunlight is the equivalent of three candles of gas light. The luminosity of the magnesium light lies between these two values.

Taking the very low estimate of 7,000 gramme calories per minute for gas, *we find the gross efficiency of the magnesium flame to be about* 40 *times that of gas light.*

We have seen that, weight for weight, magnesium affords more than 30 times the light obtained from gas, with the development of much less heat. The quality of the light is such that merely from the standpoint of illuminating power to say nothing of the additional æsthetic value of a light which approachs sunlight in whiteness, each unit of it must be regarded as the equivalent of rather more than 1.25 units of gas light.

The character of the light corresponds to a temperature much above that of the electric arc, but the flame does not seem to be very hot. I have not as yet succeeded in obtaining a satisfactory measurement of the flame temperature, but a preliminary test made at my request, gave approximately 1,400° C. This value, which is presented subject to correction, enables us to classify the magnesium flame, at least placing it among those the temperature of which is far below the melting point of platinum. Its temperature, probably, does not differ widely from that of the luminous gas flame.[5]

[2] Hatsune Nakano: Am. Institute of E. Engineers, vol. vi, p. 308.
[3] Louis B. Marks: Am. Institute of E. Engineers, vol. vii, p. 175.
[4] Edward Weston: Am. Institute of E. Engineers, vol. vi, p. 20.

[5] Rossetti (Beiblaetter zu den Annalen der Physik 2, p. 333), gives as the temperature of the gas flame, 1340 degrees; of the positive carbon of the arc, at the hottest point, 3,900 degrees; of the negative carbon, 2,150 degrees.

The large candle power of the magnesium flame is due to its peculiar structure. A gas flame consists of a column of heated gases, the particles of which are rising rapidly from the jet of the burner. These carry off with them, by convection, 80 per cent., or more, of the heat of combustion. The flame owes its luminosity entirely to the fact that near the base of the column a few particles of carbon, as yet unoxidized, are heated to incandescence. The total radiating surface of these particles is very insignificant compared with the apparent superficial area of the flame; it is indeed, not very different in extent from the radiating surface of the filament of an ordinary incandescent lamp of the same candle power. The constitution of the magnesium flame is very different. The product of combustion is the oxide of magnesium, a white, amorphous solid of considerable density; it is, indeed, fully twice as heavy as the metal itself. The oxide remains, for the most part, in the place where it was first formed. It becomes intensely

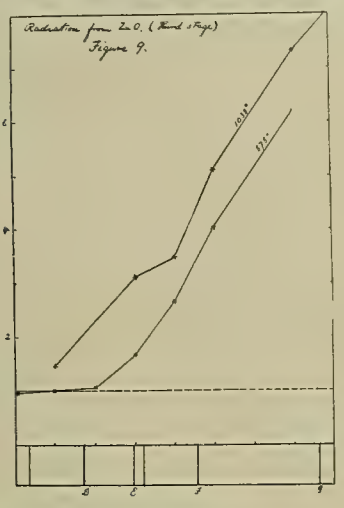


FIG. 9.

incandescent, and having large radiating surface, it affords a large amount of light. Under such conditions, convection plays a minor part, and that which is the chief source of loss in the production of light by direct combustion of gaseous fuels is avoided. The gross efficiency is, therefore, very large.

I am not in position to state positively that the glow of magnesium oxide is due to luminescent vibrations, but I am of the opinion that such will be found to be the case.

You are all acquainted with the beautiful greenish-yellow light which the oxide of zinc emits under the flame of the blowpipe. It is entirely different from the light of the incandescent charcoal on which it lies, although the two cannot differ widely in temperature. The zinc oxide is luminescent, the carbon is simply incandescent, in the usual sense of the word. This is a case which lends itself readily to study, since the temperature at which the abnormal glow appears, is a comparatively moderate one. Last summer I took the matter up, with the efficient co-operation of Mr. B. W. Snow, instructor in physics in Cornell University. We made a systematic comparison of the radiation from zinc oxide and from platinum, at temperatures between the red heat and 1000°C., measuring temperatures and studying spectra by methods which I cannot dwell upon here. Since the results which we obtained are of a character to illus-

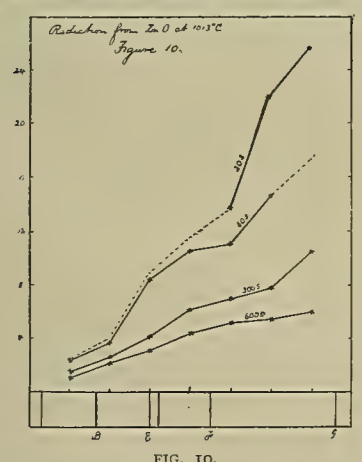


FIG. 10.

trate the points which seem to me most significant, in this question of the radiation of the metallic oxides, I will indicate them graphically.

Zinc oxide is a rather brilliant white pigment. Its radiating power, therefore, according to the theory of exchanges, should be very small At temperatures below 700° C. we found it to be very much lower than that from platinum throughout the spectrum, and the light from the oxide to be of a duller red. Fig. 8 shows the results of the comparison. In this and the subsequent curves, platinum is taken as the standard. The curves show how the oxide of zinc compares with platinum in strength of radiation. The law according to which the visible radiation of platinum rises from zero at the extreme red heat, as the temperature rises, varies with the wave length. It had to be specially determined for the purposes of our investigation in each region of the spectrum to which our measurements were extended.

At about 700° a sudden change occurs in the character of the light from the oxide. It becomes brighter than the platinum of the same temperature, the increase showing itself principally at the ends of the spectrum. In Fig. 8 (707° and 739°) we have curves which represent this second phase The emanations are selective to a marked degree, the yellow being relatively very weak. Measurements of fresh films of the oxide at still higher temperatures revealed the further development of the abnormal radiation of this substance. Fig. 9, which gives curves for 878° and 1,034°, shows the transition into a third, and, apparently, a final stage. The red end of the spectrum loses its prominence, and the curve seems to be developing into a straight line, the trend of which is such as to indicate that zinc oxide, as we pass from the longer to the shorter wave lengths of its spectrum, increases in superiority over platinum at the same temperature.

It soon became evident, from the character of our results, that the radiation at temperatures above about 800° were of a very evanescent sort, falling off in intensity and changing in quality from the first instant in which the oxide was heated. To follow these rapid changes proved a trying task. By taking a great many fresh films of the oxide and watching the time changes of one portion of the spectrum after another, however, we were able to obtain data from which the curves in Fig. 10 were drawn. These show the intensity of radiation and its character, relative again to that of platinum, after the oxide had been maintained 1,013° for a period of 30 seconds, of 60 seconds, of 300 seconds, and of 600 seconds. At the end of the ten minutes, the changes, although not entirely completed, were very slow.

The evidence of the existence of luminescence afforded by these measurements seems to be nearly conclusive. Extension of the investigation to other of the metallic oxides and to wider ranges of temperature, would, doubtless, lead to results more striking.

The application of all this to the problem of the light of the future is as follows: The fundamental question is that of efficiency. High efficiency at low temperature means selected radiation, which appears to be a characteristic of luminescence and not of ordinary incandescence. The study of the radiation of the metallic oxides above the red heat reveals the existence of properties which lead us to regard them as being luminescent "by heat." It is from such bodies that radiation of high efficiency is to be looked for. We have in magnesium oxide a member of this particular class, and we have seen that when it is heated in the process of formation it gives us a light the efficiency of which is unapproached by that of other artificial illuminants.

The problem is easily stated. (1) We need a body which is rendered vividly luminescent by heat. The metallic oxides would seem to offer us many such. (2) The material is to be brought to the temperature at which its luminescence is most marked. Does it not seem probable that the best method, as in the case of carbon, will not be that of direct combustion, but of heating through the agency of the electric current? (3) The material must be restored from time to time. Whether rejuvenation is to be secured through electrical, chemical, actinic or mechanical means, remains to be determined.

Luminescence "by heat" offers, however, only a partial solution of the problem of the highest efficiency. However great the efficiency of the luminescent itself, it is accompanied by incandescence of the ordinary kind. The ultimate solution is to be sought for along other lines. Incandescence is too expensive a means of exciting luminescence. There are many other ways in which it may be generated; friction, chemical action, the impact of light waves, electrical excitation, certain vital processes, are known to result in the production of light. The physics of these phenomena, are, for the most part, undeveloped. I know of but two attempts to determine the efficiency of this "light without heat," as it has sometimes been called. The intensity is, as a rule, very small, and the heat has doubtless been regarded as quite below the range of even our most sensitive apparatus. One of these two cases is of especial interest to the electrician. It is that of the spark discharge in vacuo. Professor S. P. Langley and F. W. Very, in a recent remarkable paper, entitled, "The Cheapest Form of Light," speak of the heat generated in the Geissler tube as so minute as to seem to defy direct investigation. It has, however, been successfully measured by Dr. Staab of the University of Zurich, by means of one of the most delicate instruments for the measurement of heat—the Bunsen ice calorimeter.[6]

In Staab's experiments the vacuum tube was smoked with lampblack and inserted in the ice calorimeter. The ice melted in a given time afforded a measure of the total heat generated by the electric discharge through the tube. A repetition of the determination with the unsmoked tube, under which conditions the light giving rays would escape, gave the energy of the non-luminous radiation. The efficiency was found to be 3 268 per cent. The extremely small candle power of the light derived from the electric discharge in vacuo may seem to preclude all questions of its utilization in practical illumination. The result is one, however, which should not be lost sight of. It suggests a field of investigation which may prove unexpectedly fruitful.

The Geissler tube effect was not the source to which Langley and Very applied the term "the cheapest form of light." The subject of their research was the light of a Cuban firefly. Their work cannot fail to excite the highest admiration of every one who is able to appreciate the difficulties of such an investigation. The exploration of the heat spectrum of so insignificant a source of light is a task which very few physicists would, I think, have considered practicable, but it has been carried through by these investigators to complete success.

When we study the curve of distribution of energy in the spectrum of the firefly thus obtained, and compare it with the corresponding curves of gas light, the arc light and sun light, we find the expression, "the cheapest form of light," which is applied to the light of the firefly by Langley and Very, to be fully justified. All the energy of its spectrum is massed within the narrow limits of the visible spectrum, and what is more, by far the greatest part of it is in the form of rays, which are especially important for the purposes of radiation, the particular rays which give us yellow and green light. The non-luminous radiation which accompanies the light of the firefly seems to be so insignificant that it was with difficulty that it could be estimated, even with the almost inconceivably delicate apparatus used by Langley and Very. They give the efficiency as about 400 times as great as that of a gas flame. It cannot fall appreciably below 100 per cent.

In what I have said this evening, I fear that I have fallen far short of what might have been expected of a lecturer on the artificial light of the future. I have endeavored to show that the efficiency of our present methods is too low to meet the demands of the future for economical illumination, and that whether we ever succeed in approaching the perfect economy of nature's light-making processes, as exemplified in the firefly, or not, there are many sources of light which promise high efficiency. If I have succeeded in indicating even vaguely, some of the conditions of the problem of the utilization of these, and in pointing out some of the lines of investigation which are to be followed in the development of new methods of lighting, my mission has been fulfilled.

[6] G. Staab: Inaugural Dissertation, Zurich, 1890. (See the *Beiblatter zu den Annalen der Physik*, 14; p. 538.)

Chelsea Storage Battery Electric Light Plant.

Hobert Musgrove, engineer of the Foreign & Colonial Electrical Power Storage company of London, writes to the Accumulator company as follows in regard to the Chelsea storage battery electric light plant.

I have pleasure in informing you that the central station in Chelsea is not only giving every satisfaction to the mechanical staff, but what is more important is being highly appreciated by the consumers in the neighborhood. The point I presume that will be of most interest to you is the question of the life of the storage batteries in use. These are all of the L 31 type and you will be happy to learn that no general renewal of the positive or negative plates has taken place with any of the batteries even to the oldest which was brought into operation about twenty months ago. Very little deposit has accumulated at the bottom of the cells although some of the batteries have done very heavy work and we are in hopes that no considerable renewal of positive plates will arise for, at any rate, eighteen months or two years. The method of charging the batteries in series proves to be an exceptionally good one because every cell is always in the same condition as its neighbor and this advantage is further accentuated by the fact that all the cells of the main batteries are worked to the same extent, and for the purpose of regulation, counter electromotive force cells are only employed.

Book Table.

WORLD'S FAIRS FROM LONDON, 1851, TO CHICAGO, 1893. By C. B. Norton. Published by Milton Weston company, Chicago, Ill.

The title of this book explains very thoroughly the nature of the work. The several international expositions which have been held since 1851 are described, and illustrations are presented giving views of buildings and grounds at these fairs. The book then takes up the fair of 1893, presenting a somewhat extended sketch of Chicago, giving the organization of the corporations which will manage the great exposition, with portraits of several of the officers.

To Be Executed by Electricity.

A dispatch from Washington, Nov. 24th, says: "In the Jugigo case the Supreme Court of the United States to-day affirmed the decision of the New York court that Jugigo must be executed by electricity."

It will be remembered that Jugigo was condemned to death after the Kemmler execution, and many hoped that the revolting spectacle would not be repeated. There was a demand that the bill providing for the change in the mode of execution be revoked. In view of this expression of public sentiment, it was thought that Jugigo would escape the extreme penalty of his crime, and even now the governor may reprieve the sentence.

During the month of November the shipments of the Westinghouse Electric & Manufacturing company have amounted to 40 alternating current incandescent dynamos, aggregating a total capacity of 30,000 16-candle power lamps. To this must be added 1200 alternate current meters. The demand for this measuring device has for months been particularly pressing, and the detail department at the Garrison alley shops, where the meters are manufactured, is taxed to its utmost capacity. The same remark holds good in regard to the Westinghouse converters. The company states that during the entire time in which it has manufactured converters not one has ever been returned for fault of construction or inefficiency.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

New Target Board at the Chicago Telephone Exchange. Illustrated 287
Wisconsin Electric Club 287
Ceiling Cut-out. Illustrated 288
The Rice Lightning Arrester. Illustrated 288
Claims a Name 288
Automatic Filament-Flashing Apparatus. Illustrated 288
Electrical Apparatus for Determining Melting Points. Illustrated 288, 289
Storage Battery Car in Chicago 289
The City and South London Railway, London, England. Illustrated 289, 290
Lighting a Museum Train by Electricity 290, 291
Powell's Electric Car Grease Cup. Illustrated 291
Paris Telephone System 291
The Artificial Light of the Future. Illustrated. (New York Electric Club) 291, 292, 293
Chelsea Storage Battery Electric Light Plant 293
The Book Table 293
To be Executed by Electricity 293
Editorial 294
Underground Wires. By Herbert Laws Webb 295
Low Speed Multipolar Dynamos and Motors for Continuous Currents. By Frank A. Perret. Illustrated 295, 296
Theory of Compound Winding for Constant Potential. By Dr. Louis Bell. Illustrated. (American Institute of Electrical Engineers) 296, 297
Ohio State Tramway Association Convention 297, 298, 299
Electric Railways. Discussion of Theo. P. Bailey's Paper by Members of the Chicago Electric Club 299, 300, 301

DEPARTMENTS.

Correspondence 301, 302
The Electric Light 302
The Electric Motor 302

AFTER the presentation of Theo. P. Bailey's paper on "Electric Railways," at the last meeting of the Chicago Electric Club, an interesting discussion took place, which is reproduced in this issue. The topic which attracted the most attention was that of the efficiency of insulation on overhead lines.

THE case of Jugigo, the Japanese sailor condemned to death under the electrical execution law in New York, came before the United States Supreme Court last Monday. The prisoner's counsel held that the experiment in the Kemmler case proved that electrical execution was cruel and unusual and therefore unconstitutional. The court held that the law was not unconstitutional in the legal sense, and the murderer will be put to death by means of electricity, unless the sentence is commuted by Gov. Hill.

AT the last meeting of the New York Electric Club an exhaustive paper was read by Prof. Edward L. Nichols on "The Artificial Light of the Future." The article is presented elsewhere in this issue. The professor's conclusion is expressed in the following sentence: "I have endeavored to show that the efficiency of our present methods is too low to meet the demands of the future for economical illumination, and that whether we ever succeed in approaching the perfect economy of nature's light-making processes, as exemplified in the firefly, or not, there are many sources of light which promise high efficiency."

AN article on "Underground Electrical Work" by Herbert Laws Webb, which appears in this issue, will be read with especial interest by members of the Chicago Electric club. Mr. Webb is "nothing if not critical." His article refers to F. E. Degenhardt's paper read at the club and to the discussion, which followed it. Mr. Webb's criticism is most comprehensive and radical. He challenges statement after statement, and does not hesitate to call in question the statistical information presented by the author of the paper. Those to whom the strictures apply, will probably be inclined to reply to his sweeping criticisms, and their contributions on the subject will be read with interest.

THE ninth annual convention of the Ohio State Tramway association was held at Columbus last week. The attendance was not as large as had been expected, and there was much disappointment owing to the fact that no specially prepared papers had been secured for presentation. The light attendance was explained by the fact that a number of the companies were involved in litigation and the representatives were engaged in other important business. Unfortunately the men thus detained were those who are generally depended upon to contribute to this feature of the proceedings. The presence of representatives of the electric companies rescued the convention from the predicament which appeared when the meeting convened. Much interest was manifested in the electric systems described. The experience of the meeting just closed, will have, it is hoped, the effect of impressing on the officers of the association, the necessity of preparing a regular programme for the next convention. The president announced that strenuous efforts would be made to secure papers by men of reputation. It is gratifying to note that the representatives of electrical propulsion occupied the most conspicuous position in the convention. At the next meeting it is to be hoped that several good papers on electric railways will be presented.

IN the last number of the WESTERN ELECTRICIAN was presented an extract from a remarkable document just published by the executive committee of the National Electric Light association. In the extract in question the well-known dispute between M. J. Francisco and Prof. J. P. Barrett, city electrician of Chicago, in regard to municipal lighting was referred to, and the latter gentleman was criticised in the most unsparing fashion. We stated at the time that, without regard to the merits of the controversy, we deemed it extraordinary for the committee to take a decided stand on a question in dispute between two of the members of the association. When Prof. Barrett stated at the last convention of the National Electric Light association, that he would prepare a statement to accompany Mr. Francisco's paper which criticised the former's figures so unsparingly, he did so on the understanding that the Francisco paper was to be suppressed until his article was ready. He promised to have the matter in readiness within a month. There may have been a misunderstanding between Prof. Barrett and the officers of the convention as to what suppression meant. The latter may have had in mind the official report which is not yet published. Certainly Prof. Barrett assumed that the paper was not to be given to the public in any form until the thirty days expired. Mr. Francisco's paper was published broadcast, and the professor thought he was shabbily treated. He came to the conclusion that it would not be worth his while to prepare any reply. The article published last week in the WESTERN ELECTRICIAN has stirred up Prof. Barrett's friends most decidedly. It is now announced that the professor will prepare a reply in which, it is predicted, he will take up the criticisms of his opponents in vigorous fashion. It is an interesting fact in this connection that opposition to Prof. Barrett's candidacy for electrician-in-chief of the World's Columbian Exposition, is said to have been one of the results of this controversy. It is only fair to add, however, that the professor's friends say this opposition would cease to exist were the facts in the case thoroughly understood.

FROM present reports, it seems as though the Electrical Appliance Building of the World's Fair would be located in Jackson Park, and not on the Lake Front as was at first strongly urged. There is, it was stated, no objection to an electric light exhibit on the Lake Front, but the Appliance Building will, judging from the present outlook, be placed elsewhere. The wisdom of such a decision will not, we think, be questioned by any one at all familiar with heavy electrical work. In the last issue of the WESTERN ELECTRICIAN attention was called to what seemed would be a great mistake on the part of the directory. Had the Appliance Building been located on the Lake Front as was proposed, one of the most attractive departments of the exposition would undoubtedly have been seriously handicapped. With this building in one of the parks there will be no chance of any lack of room, and power houses may be put up and there will be no complaints of nuisance caused by smoke stacks. The directory is to be congratulated on not having chosen the Lake Front for the main portion of the electrical exhibit. We feel sure that as the work progresses and the management begins to receive calls for space, there will be an awakening as to the magnitude of the so called "infant industry."

IN the United States an electric road is not so much of a novelty as it once was, but in England, a different state of affairs exists. The people on the other side of the water are gradually awakening to a realization that they are far behind the times, and we now find English engineers pushing the electric system to the front. In this issue a general description is given of a subterranean road in London which has been equipped with the electric system. This is the first electrical railway of any importance in England. The building of the road is looked upon as quite a feat of engineering The line, which as was before stated, is underground, is about three miles long. The cars travel in a tunnel which is nothing more than two cast-iron tubes, one for the up and one for the down line. The method of building the tunnel was ingenious. A shaft was sunk from which the part designed to pass under the river Thames could be worked. A short length of steel tube, like an enormous cheese tester, was then forced forward by hydraulic presses. This tube was slightly larger than the tunnel, so that the cast-iron tube could be built up in eighteen-inch lengths. The annular space left outside the cast iron when the shield went forward was filled in with grout forced in under pressure through holes specially left in the sections of the tube. Fourteen 100-horse power electric locomotives, it is stated, have been supplied for working the line, and a speed of twenty-five miles an hour is to be attained. A voltage of 500 is to be employed. A feature of the locomotive is that the armature shaft is arranged so that it constitutes an axle of the locomotive. All intermediate gearing is thus eliminated. It is to be regretted that we have at our command no information other than that which is of the most general character. Our English contemporaries in describing this road, have apparently pursued the plan often followed by country newspapers in America. Valuable space which might have been covered with sketches or reading matter pertaining to the strictly novel features of the equipment, is filled with the names of the grand gentlemen who honored the occasion with their presence during the opening trip. It is to be hoped, now that the Prince of Wales has turned on the current "with a gold key," and has referred to the road "in most appropriate and happy terms," that we shall learn something more of the way in which the electrical details were worked out.

Underground Wires.

By Herbert Laws Webb.

I have read with interest the paper entitled "Underground Electrical Work" by F. E. Degenhardt and the discussion which followed that contribution to our knowledge of underground wires, as printed in recent issues of the Western Electrician, and I would like to offer a few remarks on this subject, which nowadays, as in earlier times, excites so much interest wherever it is discussed.

That Charles Augustin Coulomb "discovered that most essential necessity of modern electrical work, insulation," is no doubt true, but we scarcely expected to be reminded of it in a paper on modern underground electrical work. Moveover, history is not nearly so silent as to the first attempts at insulating wires as Mr. Degenhardt seems to imagine. If he had taken any pains to be accurate in the presentation of the historical part of his paper, he would have found that history speaks of many underground lines, laid and working long before the august McCormicks ordered the offending overhead wires underground in front of their aristocratic North side mansions. History also speaks of underground wires being used many years before even Prof. Morse's experiments in that line.

In 1808, or it might have been in 1807, Professor Sœmmering, of St. Petersburg, constructed an underground line about one mile long. He brought his work to the attention of the Russian emperor and to him the professor exhibited the capabilities of his subterranean wires. The emperor was told to take two wires in his hand, and was informed that on making them touch, a charge of powder placed at the further extremity of the line, more than a mile distant, would explode. The wires were touched together and the mine exploded. This led to a number of experiments. In 1815, when the generals of the allied forces were assembled in Paris, Prof. Sœmmering was there with his insulated wires, and he used to entertain the English and Prussian officers by laying a line across the Seine and firing charges of powder on the opposite bank. In 1818 the professor had a telegraph at work, and so confident was he of success with it even with wires laid under the sea, that a submarine cable was ordered to connect Cronstadt with St. Petersburg.

Mr. Degenhardt says that "Professor Morse adopted the underground plan without experiment, not knowing the disastrous results that have followed like attempts in England." This is scarcely the right way to put it as all underground work in those days was looked upon as an experiment, just as much of it is to-day. The date of this work was given as 1832 and the first underground line laid in England was in 1837, for the trial of Cooke and Wheatstone's telegraph in London. This line consisted of five wires which were insulated with cotton soaked in resin; the wires were laid in grooves cut in a piece of wood shaped like the lower part of the letter A, and boards were fastened over the wires to keep them in place. This was the first underground telegraph line in existence; it worked for some time but the insulation fell and it was afterward replaced by an overhead line. Parts of the original underground line are now in possession of the post-office officia s who call it the "fossil telegraph."

Numerous other examples may be cited of underground work in the early days of the telegraph, and much of the work then carried out was on very similar lines to that being done to-day, as Mr. Degenhardt remarked. A curious instance of this can be found in the cables designed by C. F. Varley for the Electric Telegraph company early in the forties. The wires were covered with a double winding of cotton, made up into cables and drawn into a leaden tube; into this tube was forced a hot mixture of resin, pitch, beeswax and other materials. This description applies pretty closely to various types of cable made in this country to-day.

I might fill columns of the Western Electrician in describing the early history of underground electrical work, which is so silent to Mr. Degenhardt, but will pass to other points in the paper and discussion.

Mr. Degenhardt says: "It is safe to say that underground work slumbered for a period of twenty years from the date of Professor Morse's first experiments," and then goes on to quote the epoch-marking event of the removal of an objectionable pole line in Chicago, and the substitution of an underground line some eight hundred feet long. Professor Barrett (who did the work) places the date of this remarkable event as 1876, which would make it some forty years after Professor Morse's experiments, and in either case it is by no means safe to say that underground work slumbered during the interval.

On the contrary, it had been proceeded with most actively in Europe, especially in England, France and Germany. In 1876 when Chicago made a start with 800 feet of underground wire, London alone had over 3,500 miles, and underground wires were in use in all the principal cities of the United Kingdom and between the different cities. The system in use in England is practically the same as that adopted here; the ducts are of iron pipe, 3 or 4 inches in diameter, and the wires can be drawn in or out. In France and Germany the same plan has been adopted, and in both countries, but more especially in Germany, whose underground telegraph system is unrivaled, the work has been carried on continuously during the past forty years. The improvements that have taken place have been principally in the manufacture of the wire, methods of jointing and testing, and minor mechanical details of the work, but the iron pipe system remains as being the safest and simplest method of burying wires yet devised.

The rest of the paper being made up of fragmentary paragraphs which skip from one subject to another and back to the first in such a bewildering manner that it is difficult to criticise one portion without condemning the whole. Perhaps that part which most calls the attention in a paper read to a technical audience, is the portion devoted to advertising. Surely the Chicago Electric Club does not meet to be told that wire manufacturers can make cables to meet specifications, and that "twenty bright and active workers stand ready to take your orders and deliver the results you desire." How often the bright and active workers take your orders and "deliver results" that you do not desire, is well known. In connection with these unscientific remarks it is said that "electrical currents of infinitesimal potential are not more easily conducted than are those electrical giants of four or five thousand volts." As a matter of fact electric currents of "infinitesimal potential" are certainly both more easily conducted and more easily insulated than the "electrical giants" of four or five thousand volts, and the "electrical giants" are more troublesome to manage in every way.

Although, as it appears to me, the paper in question has little value from a practical standpoint or as a contribution to the history of underground work, still it served as a peg for a long and interesting discussion, and this has been the principal merit of many another scientific paper read before an assemblage of practical men.

The discussion turned on the question of cables and insulation rather than on underground construction generally, and in this respect some very curious views were emitted. Mr. Sunny found it difficult to believe that an insulation of 500 megohms per mile was attainable with underground cables. In New York there are many cables in the subways having an insulation resistance of more than twice that figure. In England the mains generally used for electric lighting have an insulation of 5,000 megohms per mile at 60° Fahr. This class of wire costs $1275 per mile, and is used very extensively. Central stations in England and on the Continent have had considerable amounts of it in use for years without finding any deterioration in the insulation.

The discussion then turned on measuring the insulation resistance of electric light circuits with converters, lamps, switches, etc, in circuit. Of course the resistance is then greatly diminished owing to the surface leakage over the apparatus connected, and the low insulation of branch wires and leads. One megohm per mile for an arc light circuit with a large number of lamps is by no means a low figure.

Mr. Degenhardt speaking of the causes which lower the insulation of cables, says that "the moment a cable is exposed to atmospheric action and moisture allowed to enter along the copper, there is a perceptible drop in insulation." That is true only of cables insulated with fibrous materials (and throughout Mr. Degenhardt speaks as if there were no other cables made), which absorb moisture very rapidly. A wire insulated with rubber, gutta-percha, or any of the numerous rubber compounds does not suffer a perceptible drop in insulation the moment it is exposed to atmospheric action.

Factory tests on a reel are next spoken of. This is the height of absurdity, as unless the cable was absolutely bad it would naturally show a high insulation when tested on a dry reel. A factory test on a cable insulated with fibrous material has little value in any case, as the cable is then without joints, and the insulation depends entirely on the soundness of the lead covering. The factory test can only show whether the cable has been properly handled in manufacture or otherwise, and has but little bearing on what the cable will show when laid in the subways and jointed. With rubber and gutta percha covered cables it is different as they are, or should be, tested under water at a certain temperature, and the quality of the insulation can be accurately determined.

"The ordinary galvanometer in use does not show anything above one or two megohms, perhaps, and the result is that 500 megohms are not necessarily practical for the reason that they are without the necessary apparatus to make the test with." In the whole discussion there is not a more nonsensical sentence. There are so many different kinds of galvanometers that what is meant by an "ordinary" one, I am at loss to imagine, but underground electrical work must still be in a very backward stage in Chicago if cables specified to have an insulation resistance of 500 megohms, a mile are tested with "ordinary" galvanometers that will not "show" anything above one or two megohms.

In discussing the question of insulation of telephone cables it was suggested that some wires would run up to 1700 megohms and others be as low as 50, and that the cause might be careless handling in "putting up" the wires. If a telephone cable showed so wide a variation in insulation it would undoubtedly be defective, probably the lead pipe being unsound, but as a general rule the wires are laid up by machinery and not "put up" by hand.

Mention was made of a test on a telephone cable made on ten conductors only, showing a variation from five megohms to 100,000 ohms. "That cable certainly was very far gone, evidently suffering from moisture." It may safely be taken for granted that if a telephone cable shows great variation in the insulation of different conductors, some falling far below the average, that it is defective and will eventually fail altogether.

With regard to telephone service by underground cables, I gather from the discussion that the telephone cables in Chicago are of the pattern known as "straightaway" *i. e.*, the conductors are not twisted in pairs. With straight-away cables the interference from induction is of course very great, and that would fully account for the bad service. In New York I believe the service has been greatly improved since the adoption of the underground system. There is, by the way, since statistics were included in the paper, nearly three times the mileage of telephone conductors underground in New York as compared with Chicago.

Mr. Day's contribution to the discussion was not particularly fortunate. He referred to an article by his friend Sir William Thomson in a recent number of the *North American Review*, stating that Sir William went so far as to say, "Cables in the air, may they long remain there." Sir William Thomson said nothing so flippant. What he did say was this: "The telephone wires alone remain in the air. Long may they hold their place there; they are perfectly harmless to the general public, and they are enormously less expensive where they are than they could be if placed underground." This is perfectly true, but Sir William has already disposed of the cables, *i. e.*, for electric light and power underground. If, as Mr. Degenhardt erroneously states, telephone companies were able to say that they want a cable which will show an electrostatic capacity of so much, and could get it, there would not be so much trouble about underground telephone wires. A cable would be demanded that should have a capacity of about .01 microfarad per mile, and retardation would not be the bugbear that it is. In the present state of the art a mile of underground cable is the equivalent of about 15 miles of overhead wire, and underground wires must be regarded as the deadly enemy of long distance telephony.

There are many other points in the discussion open to criticism; perhaps the presumption noticeable throughout, of considering Chicago as the home and center of underground electrical work is sufficiently groundless not to need correction. Mr. Day, however, who made some very sweeping remarks, is evidently very slightly acquainted with the underground work that has been, and is being, done in England, and although the statement quoted by Mr. Sunny was of course an exaggeration still it is by no means true that "the pole system remains in Europe."

Low-Speed Multipolar Dynamos and Motors for Continuous Currents.

By Frank A Perret.

The many practical advantages of a lower rate of speed in dynamo electric machinery have long been recognized, yet until recently few attempts have been made to secure it. The widespread use of the electric motor has, however, rendered low speed a feature of great importance, in that it so greatly simplifies the application of the machine to all classes of work in most cases obviating the necessity of counter-shafting or similar speed-reducing mechanism.

The writer is aware of the prevailing opinion that serious difficulties are encountered in the attempts to manufacture this class of machines on a commercial basis, but believing the difficulties to be surmountable he devoted several years to a careful study of the subject, with the result that he designed a type of machine in which he believes the desired end is attained without the introduction of any element of danger or the sacrifice of a single feature essential to a thoroughly practical machine.

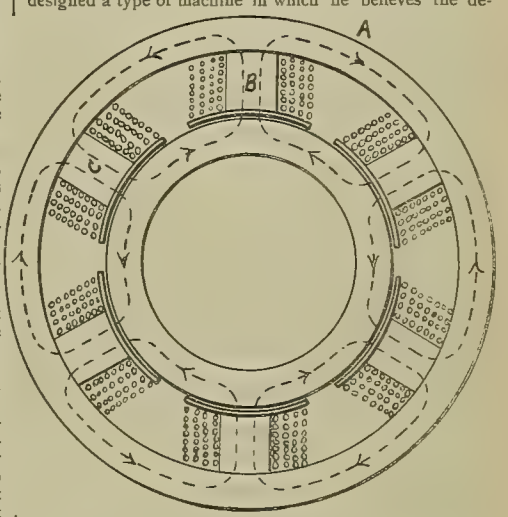


FIG. I.

In the light of this experience it is proposed to consider briefly some of the principles which govern the action of multipolar machines, and to demonstrate that the obstacles which have heretofore stood in the way of low speed may be and have been overcome.

The prime function of an armature conductor is the generation of an electromotive force, the value of which is proportionate to the number of magnetic lines of force cut by it in a given time. Now the number of lines cut per second is dependent upon two factors—(1) the total number of lines of force in the magnetic circuit, and (2) the number of times they are cut per second. As our aim is to generate a given e. m. f. at a *lower* speed than is usual it is evident that the quantities in either or both of the above factors must be increased. In the case of the first we are limited by the saturation point of iron which prevents our indefinitely increasing the strength of the magnetic circuit without adding abnormally to the weight and size of the machine, and even were it possible to do this an increased exciting current would be required, which would detract directly from the total efficiency. We then turn to the second factor and, paradoxical as it appears at first, it is here we find the solution of the problem. How are we to cause an armature conductor to cut a given number of lines of force a greater number of times per second without increasing the speed? In the ordinary two-pole machine the armature conductor crosses the magnetic circuit and cuts all the lines of force twice during a complete revolution, viz , where they enter the armature core at one pole and where they leave it at the other. Now, if we so dispose the magnetic circuit as to cause the lines of force to enter the armature core at one point, to leave it at another, to *enter it again at a third point and to leave it at a fourth* it is obvious that the conductor will cut all the lines at four points in each revolution, and that it will, therefore, generate the same e. m. f. at one-half the original speed. If we increase the number of poles to six we shall obtain the same effect at one-third the speed, etc., etc. This, then, is the principle of construction by which we secure low speed.

It should be noted that we do not increase the number

of lines of force in the magnetic circuit; we do not add to the turns of wire in series on the armature; we do not increase the amount of either copper or iron in the entire machine, but we simply cause the armature conductor to cross the magnetic circuit as often in one revolution as it ordinarily does in two or three revolutions, as the case may be. The writer wishes to emphasize the points, as there seems to be some misunderstanding in regard to them. We do not [illegible] armature to run slowly, but we design the machine for low speed. The resistance of our armature is no higher than that of a high speed machine of the same power; its current capacity is not reduced; in fact, as we shall see later, it is increased. The efficiency is no lower, the regulation no less perfect, and the weight and bulk no greater. We see then that in theory the multipolar machine is perfect; consequently, if any difficulties have been encountered in its practical operation, they must be due to some faults of construction, to a consideration of which the attention of the reader is now invited.

If we take as an example a motor having a six-pole field, and imagine the same in action, we see that the distribution of potential is such as to form the equivalent of three ordinary armature windings on the one ring and connected to the commutator, which has three times as many segments as that of a two-pole machine. Each of these windings, i. e., the wire lying under one pair of poles, has exactly the same number of turns as an armature of a two-pole machine but of smaller wire, and carries but one-third of the total current, the three acting together in multiple. This being the case any relative difference in the strength of the field magnet poles will cause an unequal distribution of potential and current in the armature. This is, in my opinion, the most important point to be considered in designing such machines, as any inequality is sure to cause trouble.

In a bi-polar machine there is but one path for the lines of force, which circumstance insures equal poles, but in the multipolar type, as ordinarily constructed, a variation in the magnetic conductivity of any part of the circuit will cause an inequality.

Fig. 1 represents a form commonly given to multipolar fields It will be seen that an internal blow-hole or hard

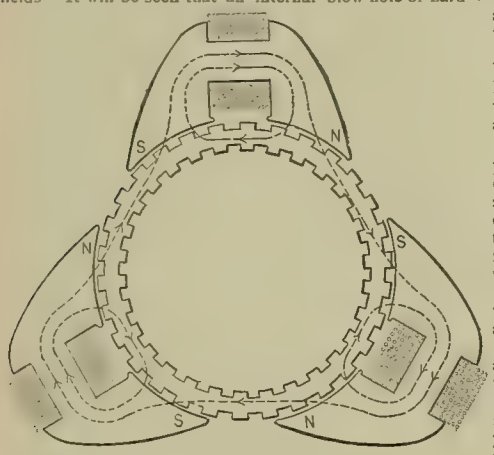


FIG. 2.

spot or other imperfection in the casting at *A* would choke some of the lines proceeding from *B*, and they would, therefore, flow through *C* and cause a difference in the strength of the poles Cast iron should, therefore, be excluded from the magnetic circuit. There should be no joints, and the number of magnetizing coils should be as small as possible.

Fig. 2 is a diagram of the magnetic circuit of the machine designed by the writer. In this construction there are but three magnets, each being isolated magnetically from the others excepting through the medium of the armature core, and completely isolated from the frame work of the machine. They are formed of plates of soft sheet iron, which are punched to the required shape and strung together on non-magnetic bolts, by which they are secured to their supports. A single magnetizing coil forms two salient poles, and as each magnet is built of a large number of plates a uniform magnetic conductivity is secured. By this method of construction all danger of any inequality in the strength of the poles is avoided, and a magnetic circuit without joints and of the lowest possible resistance is secured. It is understood, of course, that in all cases the number of ampere-turns on each magnet must be equal.

In proportion as we decrease the "feet per minute" we increase the "pounds raised," or, in other words, the mechanical effort or torque is greater in a low speed than in a high-speed machine. Extra pains should, therefore, be taken to secure a substantial mechanical mounting for the armature upon the shaft, and also for the wires upon the core. The armature is, therefore, built up on eight insulated steel bolts, the ends of which are secured to non-magnetic spiders, which, in turn, are keyed to the shaft. The wires are wound in longitudinal channels on the periphery of the armature core, which holds the coils rigidly in place and entirely prevents that minute shifting of the wires, which certainly is the case of so many "break-downs" and "burn-outs" in armatures. The driving force in a motor and the resisting force in a dynamo is exerted by the armature conductors, and we should always provide a positive mechanical connection between them and the core; friction does not suffice. The importance of this point is fully understood by Kapp, who writes: "In many machines the friction produced by the binding-hoops is alone relied on to carry the wires through the field;" but experience has shown this to be insufficient.

"Even if the wires are not bodily torn off the armature by the magnetic resistance of the field, they shift and work on the surface of the core; and it is only a question of time when the insulation will be destroyed, and the machine break down."

We have a choice of two methods of coupling the armature circuits together in multiple, one of which is by the use of six brushes distributed around the commutator 60° apart, three negative and three positive, and the other consists of a system of cross connections in the armature or commutator which connects those coils which are simultaneously undergoing the same induction; these in a six-pole machine are situated 120° apart. By this means a single pair of brushes suffices, and these bear on the commutator at points diametrically opposite, exactly as in a two-pole machine. This method is preferred when copper brushes are used, and I have in use a simple system of cross connections at the back of the commutator, in which all danger of short-circuiting is avoided; but the carbon brush is so peculiarly adapted to the method first described that it forms one of the simplest and most reliable means of commutation that can be devised. The high resistance of the carbon brush, as ordinarily constructed, has prevented its universal adoption, but the construction of this machine permits the use of three pairs of brushes, each pair carrying but one third of the total current, and the resistance is greatly reduced by reason of the increased contact surface.

In a two-pole machine the armature current is divided equally between two circuits, while that of a six-pole machine splits into six. This the writer considers in most cases an advantage, as the current carrying capacity is increased by reason of the greater surface exposed to radiation, and the machine will consequently bear a greater overload without injury while the wire is not so large as to be unmanageable. In many machines of the two pole type a stranded armature conductor must be used because a single wire would be too stiff and would heat too much; in a multipolar machine these troubles are avoided.

A great deal has been said and written in respect to the difference of potential that should be allowed to exist between adjacent commutator segments, some writers having advanced erroneous opinions on this point to the disparagement of multipoler machines. One tells us that 10 volts should be the limit because "10 volts will just form an arc," while another puts the limit at 19 volts and gives the same reason. Now an arc has to be started or "drawn" and the only time this can happen is when the brush connects two adjacent bars as they pass underit. But this only takes place at the so-called neutral points where the difference of potential between adjacent bars is almost nothing.

Theoretically this difference of potential is simply the product of half the total current and the resistance of the coil connected to the two bars We see therefore that we should not take for a basis of calculation the *average* difference of potential between adjacent bars, for the reason that the e. m. f. of each coil is continually varying from zero to maximum and down to zero again. A very clear description of this action will be found in the fourth chapter of S. F. Thomson's "Dynamo Electric Machinery," together with the methods used in determining it, and I commend a perusal of this to the writers referred to.

In a machine wound for 220 volts and having 22 coils acting in series, we do not find a uniform difference of potential of 10 volts between adjacent commutator bars, but those coils which are passing the poles are generating 15 or 20 volts, while those in the neutral zone are generating practically nothing. In some of the most widely used closed coiled machines in this country the average difference of potential between adjacent segments is far greater than the limits given by the above mentioned writers. In one of these it is 27 volts, in another 50 volts, and in others it is still higher, yet these machines give no trouble whatever. Let me not be understood to favor the use of a small number of commutator sections; I simply wish to show that no one is limited to 10 or 19 volts, average potential difference between adjacent bars.

In the machines of my own design, which I have partially described, the number of sections in the commutator is 96, of which 16 act in series. At an e. m. f. of 220 volts they average therefore 13¾ volts each, and at 500 volts total e. m. f., they will average 31¼ volts.

As bearing upon some of the statements which I have made, I present the following details of my 10 and 20 horse-power machines which fairly represent them all: 10 horse-power, 220 volt motor: Speed 600 revolutions per minute; weight, 900 pounds; resistance of armature, .19 ohm; resistance of shunt, 175 ohms; 20 horse-power, 110 volt dynamo (Compound): Speed, 600 revolutions per minute; weight, 1,300 pounds; resistance of armature, .029 ohm; resistance of shunt, 26 ohms; resistance of series coil, .007 ohm.

It will be seen that a low speed multipolar machine is not necessarily a heavy one, but that on the contrary it may be made very light. The writer has recently built several 25 horse-power series wound motors which weighed 1,300 pounds each, and run at a speed of 500 revolutions per minute. If one of these were so wound as to run at 1,000 revolutions per minute, it would develop 50 horse-power and weigh only 26 pounds per horse-power. For traction purposes these motors are designed to run as slow as 450 revolutions per minute, and weigh about 70 pounds per horse-power.

In regard to their practical operation, I will simply say that the first machines which were constructed a year ago have been in constant and satisfactory use ever since, and they have proved themselves to be in every respect the equals of the high speed machine.

The Houston, Tex., City Street railway and the Bayou City Street railway have been purchased by capitalists, who have organized a company with E. A. Allen, president; H. F. McGregor, vice-president; and C. A. McKinney, secretary. The company intends to equip both roads with electric power at once, and expects to expend about $350,000 on improvements.

The Theory of Compound Winding for Constant Potential.[1]

By Dr. Louis Bell.

I wish to preface this paper by stating that there is in it nothing revolutionary, nor any radically novel attempt to treat a problem that has already been handled by more skillful hands than mine. It is simply an effort to bring the theory of compound winding to a practical basis, indulging in no complicated formulæ and introducing no constants that cannot be conveniently determined in practice. To this end I shall consider the subject synthetically rather than analytically, starting from the plain shunt winding and considering those terms which must be introduced to take account of the failure of shunt winding to give constant potential. I do not think that compound winding should be considered as anything more than a method of improving a shunt machine already well designed; it should certainly never be called upon to avoid the evil effects of bad design.

For the systematic treatment of the subject I would introduce the following notation, which differs slightly from that most often employed, but is convenient for the purpose in hand.

Let C_x represent the current on the line;
- C_s, the current on the shunt coils;
- R, the resistance of shunt coils;
- r, the resistance of armature and series coils combined;
- E, the e. m. f. of the machine running light;
- e, the fall of potential due to armature resistance;
- N, the number of convolutions in shunt coils;
- n, the number of convolutions in series coils;
- m, the number of convolutions on armature;
- a, b, c, the three terms of n;
- l, the angle of lead;
- q, the magnetic resistance of machine on open circuit;
- q_x, the magnetic resistance of machine at full load, and
- p, the value of q_x divided by q.

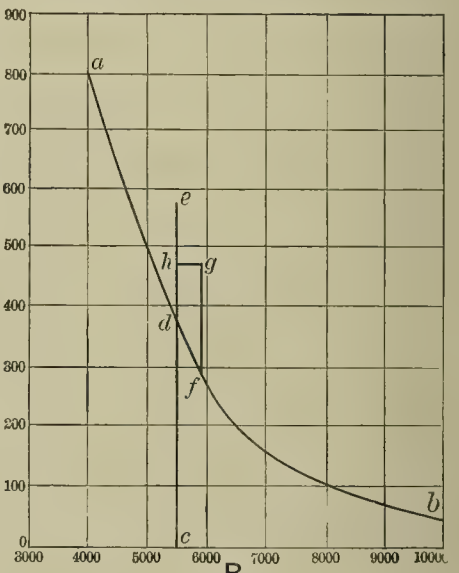


Plate 1.

I shall consider especially the long shunt arrangement, though, as will be seen later, the short shunt leads to practically the same results.

The first and obvious cause of fall of potential at the terminals of the machine is due to the fact that the armature has a resistance, as the current increases a certain amount of potential is absorbed in the armature, and consequently the available e. m. f. at the terminals falls. The amount of decrease is evidently proportional to the resistance in the armature and the current through it

$$e = r C_x$$

To compensate this loss we must furnish an increase of induction sufficient to produce e additional e. m. f. If the field magnets and the armature core were quite unsaturated, that is, if we could neglect to change in permeability, we should simply increase the total ampere-turns to an amount sufficient to compensate the fall in potential. Let a be the series turns capable of producing this at full load, neglecting change in permeability, then

$$a = \frac{Nr}{R}$$

But the permeability decreases as we put on this additional induction. The magnetic resistance, q at the start, will have increased to a certain other value q_x. We must therefore increase the number of series turns to take account of this added resistance, and we have

$$a = \frac{Nr}{R} p$$

It will be observed that this quantity does not have to be multiplied by the coefficient of leakage because we have simply reduced the shunt turns to equivalent series turns, and consequently have already included it. This formula will be at once recognized as practically equivalent to that given by Thomson in his well-known book, and at this point Thomson drops the investigation, merely mention-

[1] Read at the fifty-first meeting of the American Institute of Electrical Engineers, New York, Nov. 18, 1890.

ing incidentally some of the other causes which necessitate compounding. Thomson's formula:

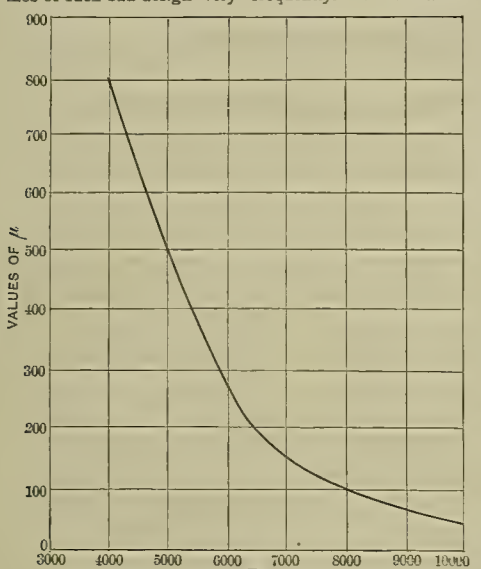
$$\frac{Z}{S} = \frac{r_s}{r_a + r_m} \frac{q_1}{q_0}$$

is not quite the same as mine for the reason that while his q_0 is proportional to the permeability when there is no external current, his q_1 is proportional not to the permeability at maximum current, but to the mean permeability between no load and full load. Hence if Z is taken as the number of shunt turns required to give the desired potential on open circuit. Thomson's formula will inevitably give too few series turns for the reason just mentioned, if for no other. But since by adding series turns the magnetic resistance is increased the shunt winding which produces E volts on open circuit will not do so at full load. Additional series turns must then be employed to compensate for this and since the change in shunt ampere-turns must be from NC to NCp, the number of series turns to be added to compensate for the decreased effect of the shunt will be

$$b = \frac{NE}{R}(p - 1)$$

This term also includes C_x coefficient of leakage for the same reason as before.

It will be noticed that both a and b include the quantity p, and here is met the principal difficulty in effecting the compounding. It is my purpose to show that this quantity p can be obtained from known data with sufficient accuracy for the purpose in hand. It will evidently be a quantity little in excess of unity and in practical machines may range from 1.05 to 1 50, although in certain cases it may even exceed the latter figure. Thomson gives the case of a certain Siemens compound machine in which p would be over three. This, however, must have had a very insufficient amount of iron in the magnets or the armature core, or both. We fortunately do not have to deal with dynamos of such bad design very frequently. Provided we



B

Plate 2.

have known enough about the iron to be used in a given machine to design the shunt winding intelligently, we shall also know enough to design the compound winding. If we have at hand the characteristic curve of a similar shunt machine p can be determined very easily from it. I give herewith the data for the Manchester machine described by Dr. Hopkinson. I have simply taken the apparent permeability from his characteristic curve.

When magnetizing force equals	induction / magnetizing force	equals
1,000,		470
2,000		465
3,000		460
4,000		460
5,000		460
6,000		451
7,000		443
8,000		425
9,000		400
10,000		377
11,000		353
12,000		333

If the permeability curve of the iron is known even approximately we can obtain p from it quite readily. In Fig. 1, let $a\ b$ be the permeability curve. The permeability at no load corresponds to the point d, that at full load to the point f. Now lay off the ordinate $d\ e$ so that the ratio between $d\ e$ and $c\ d$ equals the ratio between the iron resistance and the air resistance of the proposed machine; then lay off from the point f the ordinate $f\ g$ equal to $d\ e$, and draw $g\ h$. Then the ratio of the lengths $h\ c$ and $e\ c$ corresponds to the quantity p required. Fig 2, drawn from Hopkinson's figures, gives numerically the change in permeability for cast iron. The figures relating to the Manchester machine were, of course, for wrought iron cores and cast iron poles. It is thus evident that a rather close approximation to the value of p can be made if we know anything about the iron that we are going to use. Now as we shall see later, and as is indeed evident at the start, a and b are of about the same order of magnitude. I do not think that b will ever be negligible in a practical machine unless a is also negligible, and there is, therefore, little need for compounding. When the magnets are anywhere near saturation b will be much larger than a, but both a and b combined will not give the proper number of series turns for constant potential unless the armature is run with no load, and therefore produces no demagnetizing effect. The approximate demagnetizing effect of the armature has been investigated by Hopkinson and is as follows:

$$4\pi C \frac{m}{2} \frac{2l}{\pi} = 4\, l\, m\, C.$$

In other words, it is due to the convolutions included in twice the angle of lead. For constant potential we must add then c turns in series equal

$$v\, m \frac{l}{\pi}$$

It is evident at once that a change in lead will affect the compounding; an increased load will cause the machine to under-compound, a decreased load to over-compound. As, however, the amount of distortion in the field depends largely on the shape of the extremities of the pole pieces, the above uncertain factor in compounding can often be gotten rid of by a little care in designing the poles.

It is obvious that the term c is to include the coefficient of leakage. Uniting now, the three terms, a, b and c, we have finally, as the completed formula for compound winding, the following:

$$n = p \frac{Nr}{R} + \frac{\frac{NE}{R}(p-1)}{C_x} + v\, m \frac{l}{\pi}$$

It may be interesting to see how well this formula applies to practical machines. I regret to say that I have been unable to get full details of any machine which gave exact compounding, but I have obtained an assortment sufficiently large to show in a general way the applications of the formula.

Machine No. 1, 110 volts, 8 amperes, over-compounded 2 volts. For this small machine take p equal to 1.2. Applying the formula, a equals 14, b equals 44, c equals 15; total series turns by formula, 73; actual number, 90.

Machine No, 2 110 volts, 3 amperes, over compounded 3 to 5 volts. a equals 2, b equals 7, c equals 7; total series turns by formula, 16; actual number, 28.

Machine No. 3 500 volts, 20 amperes. p equal to 1.1, a equals 3, b equals 15, c equals 14; total turns by formula, 33, actual number, 60. Machine over-compounded 3 to 5 volts.

Machine No. 4, 110 volts, 200 amperes, over-compounded 5 volts; p equals 1.05; lead rather large; a equals 2, b equals 2, c equals 5; total turns required, 9; actual number 12.

Machine No. 5, 500 volts, 60 amperes. p equals 1.05, over-compounded about 7 per cent. a equals 3, b equals 5, c equals 4; total 12; actual number, 32.

Machine No. 6, 500 volts, 90 amperes. p equals 1.05; a equals 3, b equals 4, c equals 4; total turns should be 11; actual number 19. Machine over-compounded like the former.

Machine No. 7, 500 volts, 150 amperes; p equals 1.05; over-compounded 7 per cent. a equals 3, b equals 3, c equals 3, total 9; actual number of turns, 28.

Machine No. 8, 100 volts, 30 amperes. p equals 1.1, a equals 13, b equals 46, c equals 25; total 84; actual turns, 56. Machine over compounded about 2 volts, and the shunt winding did not bring the potential up to the 100 volts intended.

These are merely rough figures obtained without the use of even the permeability curve of the iron—simply by estimation from permeability curves at hand. It will be seen, however, that all the over-compounded machines got from the formula too few series turns, while the under-compounded machines gave too many. I think that the discrepancy is of about the right order of magnitude, although we cannot verify it accurately without the curve of the iron.

It remains to consider some few further points regarding compounding. If the winding is designed to give the potential at practically no load and at full load, it necessarily follows that at some point between the potential will rise; for, while the magnetizing force changes along a line, the magnetic resistance changes along the corresponding curve between the same points.

An approximate idea of the amount of irregularity in potential may be gained from Fig. 1. Connect in this diagram d and f by a straight line. From its middle point drop an ordinate upon the axis. The length intercepted between the straight line and the permeability curve then gives the error in compounding, by comparison with the total change of magnetic resistance.

It should be noted that the formula I have given determines the compound winding for a given assumed potential produced by a shunt coil alone; therefore, if the machine is to be run at a slightly different speed from that at first intended to produce this given voltage, the compounding is still correct, for it pertains to the voltage rather than to the speed. If the speed of a correctly compounded machine be raised and the current in the shunt kept constant, it will tend to over compound. If the current in the shunt is allowed to increase, the change in resistance will decrease the relative power of the series coils, and the machine will under-compound.

It now only remains to glance at some of the formulæ heretofore given. That of Thomson I have already incidentally discussed. That of Frœlich (perhaps the best we have had) should receive mention here. Frœlich takes account of the change in permeability by introducing a quantity f. Like Thomson, his formulæ involve two points of saturation. It should be said here that there is no special black magic about the half saturation point of a dynamo, any more than about the three-seventh or the seven-thirteenth saturation point. In very many cases it happens to be about the point at which the machine is used. Kapp, in his well-known and excellent book, takes account of the change in permeability with a fair degree of approximation, by the use of his tangent function.

All these attempts at the proper theory of compounding depend, like the one which I have just presented, on forming some sort of an estimate on the change in magnetic resistance of a dynamo, due to adding a certain amount of induction. Without some approximate method of finding this quantity, the problem is indeterminate, and the special thing which I have endeavored to show is that from the data already at hand about iron, we can form a sufficiently close estimate of the value of the coefficient p, without either knowing the characteristic of the machine, or indulging in endless approximations. I hope that some practical designer will look into the values that p takes in his machines, and I believe that it can be readily enough obtained to permit of quite accurate compounding, by the use of the formula I have given. The introduction of the terms b and c I regard as important. Their existence has been well known, but I do not think they have received the attention that I have endeavored to show they deserve.

Dr. Bell has added the following paragraph to the paper since its presentation:

I am much indebted to J. B. Entz for calling attention, in course of the discussion, to an apparent increase in the magnetic resistance of the air gap as the load increased. I say apparent increase because it is hard to separate increase of magnetic resistance from counter magneto motive force, supposed by some to be caused even while the armature is running without lead. In applying a formula similar to my own and like it including change in permeability and armature reaction as well as armature resistance, Mr. Entz found that his formula gave only about 80% of the series turns actually required. This was in the case of Edison machines and while not knowing the exact character of his formula I am unable to compare it fully with my own, I am inclined to agree with him that the observed discrepancy is probably due to increase of the resistance of the air space, rather than to counter magneto motive force. It has been before this pointed out that while the dynamo is running the lines of force do not pass radial increase of the air space, but are skewed by the magnetism of the armature so that the actual path must be somewhat greater than the apparent one. I am surprised, however, that the difference should reach the amount observed. It certainly would not do so in machines like the Wenstrom, having a very small air space. The total effect on the magnetic resistance of the machine would be of course proportional to the ratio between the magnetic resistance of the iron and of the air gaps and would increase while the relative value of the latter increased. The amount of increase of air resistance due to increased lead probably varies quite systematically with the ratio of armature ampere turns to fields ampere-turns, but the exact amount of this variation, disturbed as it is by the effect of the poles, is a subject for further investigation. If the lines of force were skewed 45 or even 30 degrees from a radial direction there would certainly be a very perceptible effect on the magnetic resistance of the dynamo. In any case, however, if the amount of skewing can be even roughly estimated this added magnetic resistance can very readily be taken care of in the formula I have proposed. To do this would only be necessary to take account of the change in laying out the line fg in Fig. 1. On drawing gh we should then have a value of p including the change in resistance due to the cause mentioned. I shall take up this question in detail, for a sufficiently simple and convenient method of estimation can probably be found that will enable the correction to be introduced into my formula by the above very easy method, so as to give a result sufficiently exact for all practical purposes.

Ohio State Tramway Association Convention.

The Ninth annual meeting of the Ohio State Tramway association was held in the Hayden Bank Block, Columbus, Ohio, Nov. 19. The meeting was called to order at 10 o'clock by the vice-president, John N. Stewart of Ashtabula, in the absence of the president, William B. Hayden. Chairman Stewart stated that in the absence of Secretary Lang of Toledo, Treasurer J. B. Hanna of Cleveland would act as secretary.

The delegates present and companies represented by them, were as follows:

List of Delegates.

Chapman, W. D., president Akron Street Railway company.....Akron.
Metlin, J. E., superintendent Akron Street Railway company.....Akron.
Stewart, John N., president Ashtabula Street Railway company.....Ashtabula.
Everett, Dr. A., president East Cleveland Street Railroad company.....Cleveland.
Blee, B., general manager Woodland Avenue & West Side Street Railroad company.....Cleveland.
Hanna, J. B., secretary Woodland Avenue & West Side Street Railroad company.....Cleveland.
Rodgers, A. D., president Columbus Consolidated Street Railroad company.....Columbus.
Sheldon, R. E., vice-president Columbus Consolidated Street Railroad company.....Columbus.
Stewart, E. K., secretary and treasurer Columbus Consolidated Street Railroad company.....Columbus.
Rickley, R. R., vice-president Glenwood & Green Lawn Street Railroad company.....Columbus.
Ferdening, C. J., president Dayton Street Railroad company.....Dayton.
Rodgers, G. W., vice-president Dayton Street Railroad company.....Dayton
Clegg, C. B., president Oakwood Street Railroad company.....Oakwood.

The following named gentlemen were also present: R. M. Johnson, Northern Car company, Minneapolis, Minn.; C. C. Curtiss, Short Electric Railway company, Cleveland, Ohio; Ernest L. Clark, secretary Illinois Electric Material company, Chicago, Ill.; A. H. England, secretary and treasurer Electric Merchandise company, Chicago, Ill.; S.

J. Collins Meaker Manufacturing company; H. F. Probert, Sheffield Velocipede company, Three Rivers, Mich.; C. A. Benton, Detroit Electrical Works; John I. Beggs, district manager, Alexander H. Lewis, special agent, and William Hand, railway department, Edison General Electric company, Chicago, Ill.; C. K. Harding, president Harding Electric Railway company, Atlantic, Iowa; A. W. Brickwood, president Russell Street Carette company, Chicago, Ill; W. J. Cooke, vice-president McGuire Manufacturing company, Chicago, Ill.; F. B. Brownell, Brownell Car company, St. Louis, Mo.; W. S. Wills, Wills Elastic Wheel company, Charlottesville, Va.; Gilbert M. Smith, Ansonia Brass and Copper company, Chicago, Ill.; E. V. Cavell and S. L. K. Monroe, *Street Railway Gazette*, Chicago, Ill.; C. B. Fairchild and F. L. Kenfield, *Street Railway Journal;* W. Forman Collins, *Electrical Engineer*, Chicago, Ill.; John B. O'Hara, WESTERN ELECTRICIAN, Chicago, Ill.; John N. Reynolds, *Motor Car and Locomotive Builder*, New York; D. B. Dean, *Electrical Review*, Chicago, Ill.

President's Address.

In the address of the chairman attention was called to the fact that electricity was being largely introduced in street railway work in Ohio. Representatives of several systems were present, he said, and they would describe to the members the special features and advantages claimed for each.

At the conclusion of the president's address the convention adjourned until 2 P. M.

Afternoon Session.

The afternoon session was called to order by the vice-president at 2:30 o'clock. He introduced Charles K. Harding, president of the Harding Electric Railway company, Atlantic, Iowa.

MR. HARDING: The great interest shown in electric traction, and recently in underground systems of distribution, may serve as an excuse for calling your attention to a new American closed conduit system. It seems strange that we have thus far allowed foreigners to lead in the important branch which must at no distant date be an essential feature of electric railways in cities. The many desirable features of electric railways are too well known to make it necessary to mention them. Still, many great advantages, such as its flexibility, its variable speed and the facility with which it may be handled in crowded thoroughfares, are not generally known. This is due largely to the fact that there has been no practical system up to the present time admissible in the larger cities, which have the greatest need for a system of rapid transit embodying its general features, by which the cars can be operated on the main and branch lines with the same power, admitting the crossing of drawbridges, etc., and permitting the use of a number of outlets from the crowded portions of cities. Its variable speed renders progress safer on the crowded portions of the road, and a higher speed possible where the way is clear. The economy in the operation of a road where the larger part of the business is done at certain hours, as occurs in most cities, must be greater where electricity is used than with any other system of propulsion.

In looking for the weak point of our present systems, we should certainly find it in the transmitting line, which must be an essential part of any practical system and its office is the direct transmission of the current from the station to the moving car. Its objections are the unsightliness of the overhead wires and poles, danger to other wires, inductive interference with telephones, liability to damage from lightning, and the fact that defective insulation and the demands of safety require the use of a much lower voltage than is desirable for the greatest economy in operation and efficiency of distribution over large areas.

With these objections removed most of the others can be readily overcome. A system making the use of a current of higher voltage safe, would render practical the use of a more efficient slow speed motor with direct gearing, thus avoiding the noisy and sometimes expensive gearing necessary with high speed motors now in use, and would facilitate the use of a free running armature and clutch arrangement, which would overcome to a great extent the shock and severe strains on the motor in starting, which cause nearly all the break-downs and burn-outs at present, except those from lightning.

It was to avoid some of these difficulties that I devised the conduit system to which I desire to call your attention. Heretofore the word "conduit" has been almost inseparably connected with some slotted arrangement. It should be understood that to preserve insulation you must exclude water, and to do that the conduit must be entirely closed, without slot or other opening through which the current is taken. In order to accomplish this result I employ a tubular iron casing, in the top of which is a channel or flanged portion in which are insulated and supported the sections of the working conductor. These sections may be from four to six feet long and extend an eighth of an inch above the surface, and are normally insulated from each other, the casing and the main conductor, which extends through the lower tubular part, and is entirely surrounded and embedded in the insulating material.

In the end of each section of the casing or conduit there is an enlargement of the lower tube, which forms a junction box in which is located a small electro-magnetic contact, making a device which, when operated, connects its conductor section with the main or supply conductor. One end of the winding on the magnets of these contact devices is connected through a simple switch to the adjacent working conductor section, and the other end directly to the conductor section on the other side by means of this arrangement, and a second brush on the car. I employ a very small portion of the current to operate automatically the contact device, and bring the exposed sections of working conductor separately and successively into connection with the main insulated supply conductor when these sections are immediately under the car, and protected by it.

In other words, I get the current to the car through the series of insulated exposed sections which are fed from the main conductor as the car passes along, and are at all other times completely insulated from the wire carrying the current. By employing a derived circuit in multiple arc with the motor circuit, I am enabled to use a very small portion of the main current for the operation of the contact devices, and to make the magnets of small size and wind them with iron wire, thus making the construction of the contact-making devices a comparatively simple matter, and permitting them to be placed in a small closed cavity in the ends of the sections where they will be readily accessible and interchangeable.

It will be readily seen that the short exposed sections of working conductor will have very high insulation and prevent all but the least appreciable amount of leakage when it is taken into consideration that under no possible combination of circumstances can any section except those immediately under the car be brought into or maintained in connection with the supplying current.

The placing of the wire underground will remove the possibility of any trouble from lightning, and the position of the wire and the fact that the return current passes through the track rails and the conduit casing near to and parallel with the supply current, precludes the possibility of inductive interference with telephones.

The chairman next introduced Robert Blee, general manager of the East Cleveland Street Railroad company, who said he had heretofore given his attention to steam railroading, but finding that electricity was the predominating factor in street railroads to-day he had begun the study of that means of propulsion, and hoped soon to be able to add to the general store of information on that subject.

President Stewart introduced Mr. Curtiss of Cleveland, representing the Short electric system.

MR. CURTISS, of the Short Electric Railway company: I am glad to hear Mr. Blee refer to this meeting as an electric street railway convention. He speaks as though he had left steam railroading and had adopted electric railroading; that is, that the horse and the mule have been abandoned and that cables have been abandoned, and that now the electric railway is synonymous with street railway. The largest contract ever let in this country by disinterested parties was given by a syndicate of Philadelphia gentlemen for equipping the street railway system of Rochester, N. Y., to our company. This contract called for the equipment of 100 cars. The greatest objection to electric railroading in its practical operation has been the one item of repairs. I see gentlemen here who know very well how much this has amounted to. In one town, I am told by a gentleman connected with the road, that the repairs last year amounted to as high as $1,100 per car. When I went into the Short company it had a road running in Muskegon, Mich That road has been running for six months, commencing with five cars and increasing to nine at the end of the six months. The total repairs on that road have not exceeded $100 on all the electrical equipment. You can appreciate the advancements which we have made.

C. A. BENTON, of the Detroit Electrical Works: I represent the only single motor that I believe is in successful operation. The peculiar feature of our motor over that of other systems is that it is geared to both axles, a construction which permits the use of large wearing parts, slow speed of armature shaft, and therefore reduced friction and long life; it secures perfect insulation between the motor and the truck, eliminating all electrical strain and making burn-outs from this cause impossible.

Reference has been made to the economy of electrical street railroading and the cost of repairs. It has been said that six cars running for six months at Muskegon, Mich., required repairs entailing an expenditure of $1,000. We have twenty-one cars running at Saginaw, Mich., which have been in operation for eleven months, and the cost of repairs on the entire equipment has not reached the sum of $50.

Some people think we are a little bit new in this business, but we are not. Several years ago, in fact, six years ago, Mr. Rae first built an electric motor, and during the time which has elapsed between that time and this he has been busily engaged in perfecting it. We have during the last few months closed many important contracts.

MR. CLEGG: What is the weight of your motor as compared with others?

MR. BENTON: It varies but little from the Sprague or the Short. I think it is a little lighter than the Thomson-Houston.

MR. CLEGG: It struck me that it was much lighter.

MR. BENTON: There is but very little difference. The weight, of course, would vary some for this reason: We weigh the motors on the trucks and sometimes we have heavy wheels on the truck and sometimes lighter wheels.

The president called upon F. B. Brownell of the Brownell Car company, St. Louis.

MR. BROWNELL: The leading subject now among street railroad people, I think, is the subject of electricity as a motive power; but it has always appeared to me that the proper amount of thought has not been given to the mechanical construction and operation of the car. Electricity itself is a matter that I know very little about, in fact almost nothing, but the prevailing methods of transmitting the current to the car axles through mechanical appliances is, in my judgment, far from being perfect. We have a very large electric road in St. Louis now that has been in operation only a very short time. In conversation with the superintendent a few days ago, he told me that the defects in the electric trucks were very many, and that it seemed to him, and to me also, that the people jumped at the construction of the electric truck without giving the matter proper consideration. In most of the electric trucks that I know of the motors are located very close to the ground. The movement is very rapid, and the tendency to draw in foreign substances from the street is very great, and I do not believe that we are going to get an economical car until some change is made in the location of your motor. The thought has occurred to me that the present electric car in general use is much finer and larger and better finished inside than the horse car, but the motors are located on the trucks underneath this car. Now if there is anything the matter with your car to prevent its running, it will be most likely in the trucks. The result is that you have to run this expensive car into your car shed, throw up the trap doors and let the mechanics get in with their soiled clothes and greasy hands, and throw tools and traps up on the cushions in their effort to repair the truck. The car is very apt to be damaged. It would seem to me that the better mode would be the use of cars in trains, a motor car with a passenger coach as elaborate as you see fit to use, the more elaborate the better for the car builder. Have the motor car made small, and strong and plain so that the liability to injury by the handling of tools and parts of the mechanism of the car would not be much. The motor car should not be used for conveying passengers.

I have thought also that the motors instead of being horizontal and close to the ground, should be located vertically and so arranged that every part could be easily gotten out for repairs or removals or renewal, or whatever might be necessary to do with them, thus changing the whole system of construction to something practical and desirable.

Then again there is another subject which I think should be considered in connection with the operation of these electric and cable roads, and that is the fearful liability to accident. You can scarcely pick up a daily paper but what you will find an account of some one killed on an electric road in some part of the country. I find that nearly all the electric cars, and nearly all the cable cars, have got a fender or so-called life preserver constructed somewhat after the principle of a locomotive pilot. Apparently the parties who first built an electric car, saw the necessity of something, and without stopping to think, they concluded that the locomotive pilot was just what they needed. Now the locomotive pilot is not destined to preserve the life of anything that may be on the track. The engineer of a locomotive, if he sees a man or an animal on the track, will try to stop his locomotive; if he sees that he cannot do it then he will open the throttle and give the engine all the steam she will take and he will knock that object sky high and get it out of the road and thus prevent the derailment of his locomotive and the possible wrecking of his train, and great loss of life. Nearly all the switch engines around the yard, where the movement is slow and the liability to obstruction is great, are provided with a sort of platform on which a man could jump and be carried along with the locomotive until it can be stopped, thus preserving life as well as preventing the derailment of the engine. There are cases on record where lives have been saved by this style of a fender, and there are many cases where lives have been lost on account of having other styles of fenders.

DR. EVERETT of Cleveland, said he was perfectly satisfied with electricity. He continued: "All I have to say to you is to come and see me. We will show you the Edison system in practical operation, the Sprague system, the Short system, the Westinghouse system, the Rae system, and very soon, within two weeks, we will show you another system from Baltimore."

W. J COOKE, vice-president of the McGuire Manufacturing company: "I commenced building trucks several years ago when cables first came in. When electricity was introduced we had a truck which we thought was peculiarly adapted for electricity. I found out from the electric people that they had designed that the standard should be 30-horse power. When I had completed my truck, my electrical friends said I was wild, simply crazy; that I had 1,500 pounds more than I should have. I insisted that my figures were right. The result was I did not sell any trucks for electric motors, for six months; they thought I had too much strain. In the last year, however, I could not make trucks enough; I am making them heavier than ever and do not now think that they are heavy enough. They have been figuring the standard on the other side from the basis of a 2-horse team and came down, while I started from 30-horse power and went up. We are not quite reconciled yet. I do not believe in connecting the motor and truck according to the present method. You are now getting the motor down in the mud and the dust and the dirt, and this of course creates friction in the gearing and that cuts and consequently requires repair. I do not know how the remedy is to be accomplished, but I have an idea that we will have to get up on top with our motive power. We are at the mercy of the electrical and street railway people. We want to build whatever they want. We have gotten out what we believe is pretty near the requirements of to-day, but we are ready to adopt any new device or make any modification that the demands of the street railway people may require.

We have recently gotten up a frame made of pressed steel, consisting of only four pieces. Noise has been a disagreeable feature to some extent in the electric motor. Some motors are very noisy, and some trucks are very noisy. We have made a truck of very few pieces, less than half the number, I believe, used in any other truck constructed to-day. We had it on exhibition at Buffalo; a pair of trucks under a double truck car. We believe that that solved the question of the expense as to wear and tear of truck and motor. Until very recently we have not had the matter taken up. We have now under contract 200 pairs of trucks for three lines in Pittsburg; double trucks also for Sioux City, Salt Lake City, Los Angeles and Oakland and several other places, where they have recently adopted the double truck car, 24 to 30 feet in length. We are of the opinion that that is the coming car for street car service—one long car instead of a trailer. It makes less expense on the cars; the friction will be practically nothing, and it makes a saving of flange wear on the tire.

MR. CLEGG: What will be the wheel base?

MR. COOKE: Four feet 6 inches on the long car; just enough to let the motor in. The electrical people wanted us to make it longer, but we are trying to get the wheel base as near the gauge of the car as possible, and we have adopted a standard of 4 feet 6, and arrange it so that we can get all of the present motors in that wheel-base.

Mr. Rice of Pittsburg, who has used these short wheel

based trucks for a good many years under his cable cars, is of the opinion that it is the most economical style of truck to use, both as to rail wear and wheel wear and motor wear. On our double truck we extend the spring base 3 feet wider, thus doing away practically with oscillation of the car, which is also very hard on the rail, wheel and motor.

SECRETARY HANNA: Can you tell the gentlemen present anything about the new electric heater we were talking of this morning?

MR COOKE: Yes, just a little. The gentlemen representing the heater expected to be here. It was invented in Minneapolis. I have one in my house in the laundry. I take off the lamp in the house and connect the wire and my laundress irons all day by means of this heater. The iron only gets so hot; it can't get any hotter.

He has arranged a heater for a street car. I am sorry he is not here to explain it himself. It is merely a ribbon that runs along under the edge of the seat, I think, about 6 or 8 inches wide and possibly a half or three-quarters of an inch thick; and with the current from the trolley, he heats the car perfectly to any degree of heat that is necessary. There is a button at the motor man's hand, so that he can give the car quarter heat, half heat, three-quarters heat or full heat, just as the demands of the weather may require.

I merely make this statement in behalf of my friend, who has just recently taken hold of it, and who expected to be here to-day and give you an exhibition of it.

WILLIAM M. HAND of the Edison General Electric company said he had just completed the installation of the Glenwood & Green Lawn Street Railway of Columbus, extending about four miles west from High street. Five cars were operated with the Edison system. The road has been in operation over two months, and the repairs on the cars during that time have not amounted to one dollar; nor has there been an armature taken out of any of the cars.

PRESIDENT STEWART: I wish to say that at the next meeting of our association, on the second Wednesday in November, at Akron, Ohio, I have no doubt but that every street railroad man in the state of Ohio will be present. Just at this time there is so much going on in every city and village almost towards improving the systems and changing the systems that they have had in use from horses to electric or cable, that it seemed to be necessary for the street railway people to attend to their business at home instead of coming to this convention, although we were in receipt of a communication from almost every road in the state of Ohio that some of their representatives would be here, Litigation of an important character in Toledo has called a number there, trouble in Cleveland is keeping a number there, and so on all through the state. There is no doubt whatever that the Akron meeting will be a very interesting one for the reason that there will be papers prepared upon all of the subjects that will be of interest to the fraternity in the state, as well as to the fraternity at large, and I hope that all who can find it agreeable will be at Akron, and I feel safe in saying that every road in the state of Ohio will be represented at Akron by one or more delegates.

Officers for the ensuing year were elected as follows: President, John N. Stewart, Ashtabula; secretary, J. B. Hanna, Cleveland; chairman executive committee. E. K Stewart, Columbus. The next meeting will be held at Akron on the second Wednesday of November.

CONVENTION NOTES.

Gilbert M. Smith, Western manager of the Ansonia Brass and Copper company, was in attendance at the convention.

A. H. England represented the Electric Merchandise company of Chicago. He had a number of switches on exhibition.

The Chicago delegation to the convention adopted resolutions of thanks to the Chicago & Atlantic Railroad company and its employes for the favors extended during the trip.

Many of the visitors to Columbus were interested in the examination of the features of the Minott electric motor, manufactured in that city. Several motors, operating all kinds of machinery, were shown.

President Stewart of the association says there are operated in Ohio at the present time 200 miles of electric street railway lines. The total mileage of the state is 555, of which only 55 are operated by cable.

During the convention it was reported that a consolidation of several electric railway companies had been consummated, but the representatives of these systems denied the rumors at the meetings of the association.

Ernest R. Clark of the Illinois Electric Material company, Chicago, exhibited a switch for overhead electric railroads. Each delegate and visitor was presented a souvenir in the form of a pencil by Mr. Clark.

The J. G. Brill Company of Philadelphia was represented by Payson K. Andrews, its Chicago manager. Mr Andrews entertained the attendants at the convention with an elucidation of the meritorious features of the Brill truck.

The McGuire Manufacturing company of Chicago was represented by W. J. Cooke. He appeared before the convention and gave the visitors the result of his experience in building trucks. He predicted that in a few years street railway men would order heavier trucks than those now in use. Mr. Cooke's experience in this line certainly should give him authority to speak.

The delegates and visitors examined the Glenwood and Green Lawn Electric railway line. W. M. Hand, of the Edison General Electric company, and Superintendent Abbott received the visitors and showed them the features of the system. The company is operating five cars equipped with the Edison system. There are four and a half miles of track constructed at present and extensions are being made. The power plant consists of a 125 horse-power McIntosh & Seymour engine and 110 horse power Edison railway generator. Arrangements have been made for enlarging the plant. It is expected that three additional dynamos shall be added to the plant.

H. T. Probert, representing the Sheffield Velocipede Car company of Three Rivers, Mich., took occasion to explain to the delegates and visitors the advantages of the Three Rivers electric truck and described its leading features.

Mr. Brickwood said that he hoped to soon have carettes operated by storage batteries. The Russell Street Carette company of Chicago, of which he is general manager and secretary, is now experimenting with several systems and is building several carettes to be operated by electric motors.

A special car carried the Chicago delegates to the convention. The party was entertained in a most hospitable manner by Messrs. Monroe and Cavell of the *Street Railway Gazette*, Chicago, who had charge of the excursion. Resolutions of thanks for the courtesies extended were adopted.

There were no papers presented to the convention. At the meeting of 1889 it was decided to extend a general invitation to the members to present papers on such subjects as they might see fit. As a result no one responded at the convention just closed. This induced the members to instruct the secretary to prepare a list of papers and select members to read them at the next convention.

A. W. Brickwood of Chicago, was greatly disappointed by the railroad company in not getting a carette to Columbus. It was shipped from Chicago, Saturday, but failed to arrive in time to exhibit it to the delegates. The electric railway men were not slow to use these incidents to impress the delegates with the fact that the much boasted reliability of the steam railroads was not all that was claimed.

There were very few exhibits at the convention, but the electrical supply and construction companies were well represented and little attention was given to any other form of propulsion. Animal power was not considered, and the prevailing opinion among the representatives of the street railways seemed to be that it would not be many years before the street railway conventions would become purely electrical conventions.

C. A. Benton of the Detroit Electrical Works exhibited a model of a Rae motor for street car propulsion, and explained the working of the system. Mr. Benton was disappointed in not being able to show the delegates a Rae car operating on one of the local railway company's lines. The car had been shipped but the railroad company had failed to deliver it at Columbus. This was not the only instance illustrating the unreliability of the steam railroad service.

The proceedings of the meeting were terminated with a banquet at the Columbus club. An elaborate spread was provided, the banqueting hall and the reception rooms were handsomely decorated; and under the guidance of President Stewart the affair was conducted in a most admirable manner. Speeches were made by many of the visitors, and all expressed themselves as more than pleased with the hospitable entertainment afforded them during their sojourn in the city.

D. Forsythe Morris had a Milliken pole on exhibition, and many representatives of companies considering the introduction of electricity on their lines examined it. Mr. Morris had a miniature pole erected in the center of the table at the banquet Wednesday evening and when called upon for a speech calmly pointed to the pole. He said its merits had already been fully recognized and needed no praise from him. The Milliken pole was recently illustrated and described in the WESTERN ELECTRICIAN.

Electric Railways.

At the last meeting of the Chicago Electric club Theo. P. Bailey read a paper on "Electric Railways." The article appeared in the last number of the WESTERN ELECTRICIAN. After the reading of the paper the following discussion took place:

THE VICE-PRESIDENT, ALEX. KEMPT: Mr. Pfatischer of the Accumulator Company, New York, is with us to-night, and we would be glad to hear from him.

MR. PFATISCHER: I was pleased to hear Mr. Bailey's paper, but in one particular I was disappointed. He mentioned the conduit system, but left the storage battery out of the question altogether. Now, as I am a storage battery man, I of course would like to have heard something said about it. I am perfectly satisfied that the working of street cars operated by storage batteries will assume very large dimensions in the near future. The batteries have been very much improved in the last few years, and the cost of maintenance is quite reasonable. Companies are willing to give the same guaranty that the overhead companies have done, and I think the near future will see the equipment of many storage battery roads. Of course there are a good many of our friends in the electrical business who are rather skeptical about the storage battery, because it was not a great success some years ago, but time has changed things. As Mr. Bailey stated, the overhead system has been introduced inside of two years, and such a development is quite possible with the storage battery.

MR. DEGENHARDT: Mr. Bailey touched a very tender spot when he spoke of the conduit system, as I have been working on the conduit scheme for the last two or three months in connection with some other gentlemen. I should like to ask Mr. Bailey if he would tell us to what he believes failure is to be attributed and also, if he has no objections, to say what experiments are now being made in that direction.

MR. BAILEY: I desire to say that the reason my paper did not touch upon the subject of storage batteries is that I had had nothing whatever to do with them officially, and knew nothing about them in a practical way. I have read considerable about the progress storage battery companies are making, and I think they are entitled to a great deal of credit for their energy and persistence.

In reply to my friend Mr. Degenhardt, I will say, the failures that have attended the efforts of the experiments with the conduit system resulted principally from lack of ability to secure proper insulation. The experiments that are now making in quite an extensive way, and referred to in my paper, are at Lynn, Mass., and are instituted by the Thomson-Houston Electric company. They are laying, I think, in the neighborhood of a mile of conduit for the purpose of making an exhaustive test embodying all their latest improvements. While they have hoped for success they are not making mention of the matter in a public way.

PROF. BARRETT: I would like to ask Mr. Pfatischer if he has any figures showing the comparative expense for maintaining the accumulator and the overhead trolley system.

MR. PFATISCHER: I did not bring any figures with me, but the company is willing to guarantee the batteries I understand, for 20 per cent. of the first cost. In other words, the maintenance per car mile for the accumulators alone would be from 1½ to 2 cents. I am satisfied that in the case of a good many roads, where there are not excessive grades, the storage battery system can be operated just as cheaply as the overhead system. The reason in the first place is that the motors work at a much lower potential, and both poles are insulated; and any electrician knows that a motor working at a low potential and having both poles insulated will not burn out as quickly as one which has one pole grounded. Of course it is only a question of comparative cost of maintenance. The coal consumption is not greater with the storage battery system, for different reasons. One of them is that the engine always works up to its full power, and consequently at its highest efficiency. Seeing is believing and I think we will see in the near future that the storage battery road can be operated just as cheaply as the overhead, where, as I say, grades are not excessive.

MR. BAILEY: I would like to ask Mr. Pfatischer this question. While it may be somewhat leading, he is at liberty to refuse to answer if he desires: There are roads scattered through the country here and there with one, two or three storage battery cars; but there are no roads that I know of that are equipped exclusively with storage battery cars, and there are a number of places where the conditions are very favorable to that sort of a system. I would like to ask the gentleman what explanation the storage battery company or companies have for their failure to secure a more rapid introduction of that system; whether it is for the reason that the system is incomplete as yet, or whether it is the result of other conditions.

MR. PFATISCHER: The reason that there are at the present day not many roads in operation is in my opinion mainly due to the fact that the company which, I think, has the best battery, has not been exploiting in the field. You gentlemen all know that there has been a great amount of litigation in the storage battery field, whereas in the overhead system anybody can build a motor, and two strong companies took hold of it. You know well that as long as there is patent litigation companies do not care to invest a great deal of money. I think that is the principal reason, and there are a few others.

MR. DEGENHARDT. I would like to inquire what standard of insulation is demanded, or what standard of insulation is obtained when the weather is absolutely dry, and everything is in perfect condition. To what degree can you stand a leak, as for instance, on a rainy, muggy day, when perforce there must be some leak over metallic surfaces?

MR. BAILEY: That is purely an engineering question, and one that I would prefer to have answered by some of our scientific friends. Professor Badt can give you an answer to that question.

PROF. BADT: I do not know that that can be answered very easily; quite a number of things are to be considered. The construction of the electric railways as practiced by the different companies is not identical by any means. In an electric railway, for instance, without the proper return wires, as Mr. Bailey spoke of, but with a good metallic return by means of the rails, it might happen that less energy would be developed to give a certain number of horse power for the operation of the cars in rainy weather than in dry weather, for the simple reason, that in rainy weather the moisture of the earth adds to the conductivity of the rail. Thus what you might possibly lose by leakage in the overhead line, you might gain by the additional earth return in wet weather. In the practical operation of certain electric railways, when a break has occurred somewhere in the connection, and there was not time to repair it at once, it has been sometimes found that the cars would go over that break very sluggishly indeed. After they passed it on the last part of the road, they would hardly move at all. When it commenced to rain, the earth made a good return and the cars move over it as if there was no break at all. I think leakage in railway construction, if the work is done as it ought to be, does not occur to any great extent. If iron poles are used, insulators are always employed on the poles, and insulators are located between the ends of the span wire and the pole. The trolleys are insulated, and every trolley is insulated by span wires again; and as Mr. Bailey explained, the trolley wire insulator is so constructed that the inside is always dry, as in our glass insulator. I do not think the loss of energy by leakage, even in rainy weather, in a well-constructed overhead railway line, amounts to anything to speak of. Feeder wires are used by some companies, I think by Mr. Bailey's company, and a good many cars run over the tracks, requiring the same good insulation as any current of 500 volts would require. They are put up in the usual way.

MR. DEGENHARDT: The fact still remains that there is leakage. I asked a question to find out to what extent this seepage could be permitted to continue without

material interference with the system. I asked the question basing it on the assumption that everything is in first-class order. I have inferred from conversation with gentlemen operating the lines that there is a material seepage at times in wet weather. Is there a point with a thoroughly insulated overhead line, where rain will interfere with the operation of the motors?

PROF. BARRETT: As with the electric light system, overhead, there is seepage always.

[illegible] figure it out by electric laws.

MR. DEGENHARDT: That is all right, but does not explain the matter. Mr. Bailey said the trouble with underground conduits was due to their inability to cope with the moisture. There certainly is absolutely inability to keep off moisture from overhead lines entirely, and I was simply asking with a view of finding out how much of a figure this moisture cut.

MR. DOW: I can answer that question to a certain extent, but I will have to go back to the days before electric railways to answer it, and then refer to the first electric railway. Going back before electric railways there was an incandescent lighting system upon which 500 volts were used and the leakage was quite serious. I had a sad time with the circuit. The leakage was grievous to my soul. We were never able to get a decent insulation test. Our rule for that circuit is the rule, I believe, that is applied to-day by electric railway companies. We would not pay any earthly attention to the leakage until the dynamo held up the engine, and then we stopped.

Now I will go back to the first street railway that I know anything about and that was the Baltimore & Hampden road on which a Daft motor of 250 volts was used. I was acquainted with some of the stockholders of that road. I was then in the telegraph service, but I fooled around the road a good deal, as it was of great interest to me. That road worked out the question of rail bonds. They used only fish plates at first. The circuit became very bad—it was especially bad, because it used a third rail, an ordinary iron rail, as an outward conductor. They used two regular rails as a return. The outward rail was, from the beginning, if I remember right, fitted with bonds as is the usual practice now. The return rails were not at first fitted, but were afterward, in the summer time. They were bonded with small pieces of cable. The motor men on the road alleged, the engineer alleged, and every one I got hold of alleged, although they never could show it by proper tests, that the road pulled a great deal easier in wet weather. I fully believe that it did. There must have been a heavy leakage, because the insulation from the central rail to the earth was a sheet of rubber packing. Notwithstanding that, I have seen those cars hurry along through a hollow pulling a heavy load—every passenger that could hold on to them—with the track six inches deep in water, and with the bottom of the feed rail wet. As I said there were two regular rails, and they were actually under the water, and the bottom of the feed rail was fairly in the water, and under those conditions that road still pulled and pulled well. The motor men said it was always run better in a heavy rain than in dry weather. They always ran until the generators held up the engines.

MR. DEGENHARDT: I wanted to find out whether they did know anything about the amount of seepage that took place. It is apparent that they do not seem to know whether there is a leak going on or not until the engine is stopped. That is just what I wanted to get at. As Mr. Dow explains it, it is possible to run through water. Prof Badt admitted practically that with a broken bonded rail they were able to run. He did not explain as Mr. Dow has, that there was seepage, and that this thing was known and that they did not pay any attention to it. The thing I wanted to find out was as to how much seepage they can stand.

MR. DOW: I have not been working on street railway work, but I have had a great deal of experience with overhead electrical wires, and for the last year and a half I have been handling high tension alternating currents. I have found that under certain conditions high insulation is a positive nuisance. In certain states of the atmosphere I cannot hold a screw driver to the line without the line spitting at me. I can get a static discharge from every corner and angle, just such a discharge as I get from a belt. When that condition obtains, I switch in my ground detector and leave it in until the air gets damp again. I positively start a leak on that line.

PROF. BADT: I would like to say something concerning the remarks made by Mr. Dow. A 500 volt series incandescent system cannot very well be compared with a 500 volt railway system for sufficient reasons. I had the pleasure, if I may call it so, of putting up these 500 volt systems myself, and I believe I was the pioneer in putting them up, with the alternating system and I know just exactly what they are. There we have a multiplicity of small wires running into houses and everywhere cleated. The two wires were covered with the famous underwriters' insulation. In going into houses holes were bored downward from the outside so that the water could flow easily through the beautiful construction Miles and miles of small wires were exposed in that manner. In street railway work we generally have one wire well insulated, not by one insulator, but by a series of insulators against leakage, all in plain view. If anything happens to that insulation we can see it in a minute and find the place to be repaired. And as to static effects, I am confident enough to say I do not believe we will experience any real difficulty in the system spoken of simply for the reason that we discharge through our motors to the ground.

Mr. Degenhardt seemed to think because I could not tell exactly what insulation we wanted, in an overhead railway system, we did not care at all how much of the expensive current escaped to earth But I wish to state that overhead systems of electric railways are put up so well that we do not trouble ourselves to find out how well because we know it is well enough. Because we know that so little current escapes, we do not care how much. There is a trolley wire insulated, and the trolley wire insulator suspended by an insulated wire again to cast iron poles.

MR. DOW: The whole thing soaking wet, professor?

PROF. BADT: Supposing it is, it is only a small leakage; 500 volts is not a very high current. Supposing it is very wet weather and the insulation on such a line goes down to 500 ohms; it certainly will not go below that; as the current is equal to the electromotive force divided by resistance, there is one ampere lost in a 500 volt system. Take a big railway system using 500-horse power, the loss is nothing to be talked about as a factor.

MR. DEGENHARDT: I am glad to hear the professor stir this thing up. He has certainly reached the halcyon days we are all looking for; he has a perfected state of insulation, and I am glad we have met him to-night in this controversy. He is the first gentleman I have ever met who has had the temerity to stand up and openly say that he has reached the perfection of the art.

MR. GRIER: I have observed several railways, and in regard to this question of insulation, which Mr. Degenhardt has brought up, I remember a system in Allegheny where the resistance probably got down very low. That is an underground system, and we would have water running in the conduit and the place spitting fire in the winter time. Prof. Badt spoke about the small leakage; if we have a 500-horse power engine we would have about one-fifth of one per cent. or one horse power, and really the leak doesn't have any effect until we get pretty near a dead short circuit. Then we must stop; that is all.

I think Mr. Degenhardt's idea is to ascertain what insulation resistance they would like to have between the return wire of an underground conduit, and the wire that comes to the motor; or what loss of insulation resistance would be safe in the case of an underground system if all the connections to the motors were open. I should say if we have a 500 volt system, even if we get as low down as 500 ohms, safety to life and machinery would be perfectly assured.

THE CHAIRMAN: Will Mr. Day, of England, say something on this question?

MR. DAY: From what I have learned since I have been in the city, and from what I learn from reports in Europe, there is no doubt in my mind that we are upon the eve of a great modification in the storage battery, by which the dead weight carried will be very much reduced. I do not look upon the present system of the electric railway as permanent by any means. It is quite certain that a system must be developed by which we can serve the traffic of our streets, and travel all over the world. I do not think any city I have ever been in shows such congestion of the streets at certain hours of the day, as this city, and there is no doubt in my mind that all railways must be removed from the streets, for many reasons. It is my conviction that so long as pedestrian traffic is maintained, so long as the ordinary traffic by horses is maintained, there can be no very great speed made by any railway system in the streets on the surface.

I am convinced, as I said before, that however excellent any of the great systems may be they are not of a permanent type. They must give place to something better. The spur gearing which is used must be discarded. The speed of the armature must be reduced, and the system must be made as noiseless as possible, and other alterations have to be introduced.

PROF. BADT: I would like to say something in addition in reply to Mr. Degenhardt. We will assume a railway system one mile in length. I can imagine a case where 100 electric horse power will be transmitted over the wire. What have we in such a system? A single wire one mile long transmitting 100 electrical horse power. Take an incandescent system or an arc light system and transmit 100 electrical horse power and you haven't one wire a mile long, but you have wires about twenty-five miles long over which this power is transmitted. What does that mean? It means twenty-five times or fifty times, whatever the ratio may be, as many points where poor insulation will permit an escape. That is the reason why insulation that may be absolutely worthless for incandescent work will stand excellently for a feeder, for a trolley wire for instance, and the insulation on the trolley line, the insulation of the poles and so on, will be sufficient. It is the old question which came up, about, I think two or three years ago when a committee was appointed by the club to prepare rules for proper insulation. Well, we came to the conclusion that it all depended, first, upon the voltage; secondly, upon the number of miles of wire. If we assume 100,000 ohms as a perfect insulation for 100 incandescent lamps, we should be satisfied with one-tenth that, or 10 000 ohms, for 1,000 incandescent lamps, and with 100 ohms insulation resistance for 10,000 incandescent lamps. So in electric railways it still depends upon the length of the line. As I said before, there are only a few points of support. There is insulation simply at these points; where these are very few in number there is very little leakage, in spite of the fact that the voltage is twice what it usually is in a city system of incandescent lighting.

MR. BROWN: One point occurred to me while listening to Mr. Bailey's very interesting and able paper, was that he did not give to the work done by electric lighting interests sufficient importance in preparing the field for electric street railways. We can imagine what would have been the result if electric railways had been suggested about ten or twelve years ago, before the electric lighting industry became general, and people became educated up to the standard that they have now reached on that subject, both as to apparatus and as to circuits.

There is a point upon which I want some information, and that is, the subject of double trolley systems, which Mr. Bailey, I believe, did not mention in his paper. I have heard that double trolley systems have been in use I have seen affidavits by gentlemen now in the club that the double trolley systems were perfectly practicable, and I presume I could find a copy of such affidavits.

PROF. BADT: I don't know about that.

MR. BROWN: One great advantage of the double trolley system that was brought to my attention, is the avoidance of interference with the telephone lines. Now, the telephone was here before the electric street railway, and I believe that an unprejudiced man would say that our talking rights are just as valuable as our riding rights, and the telephone is entitled to consideration. Now, it is said, of course, that it is a good deal easier to put metallic circuits on telephone lines than on street railway lines. I believe that it is not certain that even putting metallic circuits on telephone lines will obviate the trouble which comes from the street railway lines, but the one way to absolutely avoid interference between the telephone current and the street railway current is to have a double trolley system, a metallic system, for your street railway lines.

MR NICHOLS: There is one point that has not been touched upon that I think should not be lost sight of, and that is the efficiency of the motor for street railway work, or in any railway work, so far as that is concerned. It is a question that has been discussed in the newspapers for some months, and there seems to be a very great difference of opinion upon the subject. I think that in touching upon that part of the subject, the question of the ground return, or metallic return, could be brought in. For instance, you take it in a case of return through the track, and you notice, as we all know undoubtedly, that there is a great deal of sparking. Where that sparking occurs excessively, I have noticed it particularly on the Milwaukee line, there is undoubtedly a great production of heat from which we lose efficient work. Would not that loss which would occur in the rail occur in the double wire system? I presume that nearly every member of the club read the paper written by an electrical engineer who made a test, I think of the Daft system on the New York Elevated Railway, in which he seems to have come to the conclusion, as a result of his test, that the motor efficiency was very low. It was lower, in fact, than the efficiency of the steam locomotive. There may have been some contradictions of this conclusion written in later papers, but I have never seen them. I think it would be very well to touch upon that subject.

MR. DELAND: There is one point that I think should be touched upon, and that is, the great faith that the early pioneers or projectors of electric railways must have had in that industry. I think there are two members of this club to whom a great deal of credit is due in this respect. They carried this matter along for, I think, two or three years, and they put in one, or possibly two or three roads. Then all at once a great company took it out of their hands. I think the gentleman who looks down upon us from that picture [W. A. Stiles] is entitled to as much credit as anybody for helping the electric railway along. I think the cities in which they have been adopted are indebted to his faith in the final outcome from the fact that he furnished the cash that was necessary for carrying out early experiments, and from which it seemed likely at the time he would get so little return.

I think the gentleman who favored us this evening with such an interesting paper is entitled to a great deal more credit than appeared on the surface.

MR. BLISS: I am interested in one road which has a ten and one half per cent. grade, and have been interested in its operation for some time. While in the incandescent business I remember that the first plants that were sold in this city were sold at about $40 a lamp; and the problem which is before my mind particularly in connection with electric railways, is how are we to get railroads so perfected and cheapened that the future cost will bear the same relation to the present cost as the cost of the incandescent lamps in the first place bears to the price at which they are sold now?

I am very glad to express my convictions to the club that wonderful progress has been made in this electric street railway matter; and our experience with this little road which we are operating is very encouraging for the future of this line of business. I think it has an immense future. I believe that the electrical development in connection with transportation has hardly been begun, and that those who shall live a few years longer are going to see the system superseding other systems to a very considerable extent. There is operating at Topeka on one of the roads a storage battery system against which I have been very much prejudiced, but I have occasion to watch it occasionally from time to time, and I have been surprised at the efficiency with which that apparatus was doing its work, running right straight along from day to day So its field is widening out under various conditions, and it is going to make business for us all, and I think it is going to be a very great benefit in every way

MR. DAY: What is the average efficiency of any one system of motors used on street railways? I made a careful study of the electric railway which has been started in Indianapolis, the first railway that has got a line of poles insulated, and a double line extending across. I noticed on the starting of those cars up a hill there was a tremendous amount of sparking for which I was unprepared from all I had heard about them. I wish to find out from these gentlemen if that is their experience. What is their estimate as to the loss by sparking during the early period of commencing from a stop to getting into a fast motion.

MR. BAILEY: In reply to our friend Mr. Pearson in regard to the fatality of a current of 500 volts used in electric railways, I will give the result of an investigation that was made by a committee of the Senate and House of Representatives of Washington, and I think that perhaps will satisfy him that the current is absolutely safe. One of the companies had begun the installation of an overhead system there, and they were enjoined by property holders and citizens who alleged danger to the lives of the people. The matter was referred to a committee of the House and Senate, and a very careful and rigid examination was made. I believe something like two hundred witnesses were examined and I think about fifty affidavits were presented; and the testimony was overwhelming that the current was absolutely safe so far as fatality was concerned. The injunction was then dissolved and the work was allowed to proceed.

In reference to the remark of Mr. Brown in regard to the double trolley system, I feel at liberty to rehearse the

experience of one of the companies at Cincinnati. They took a contract to put up a double wire system, and they worked on it something like five or six months before they had it in any where near satisfactory working order. The system was very complex from the fact that it was a double track road with numerous curves and some crossings, and they seemed to be unable to put up enough supports to hold the wire in place and to provide for the heavy frogs and switches that have to be used. I think, however, that by wiping out some of the complexities and reducing it practically to a straight double track without any curves or switches, they were able to make it work with fair satisfaction.

In regard to the question of using a double wire system with reference to obviating the objections and troubles which the telephone companies complain of I think that matter has been fully determined by the courts, to whom the telephone companies appeal for relief. I have no doubt the railway companies would be very glad to use the double trolley system if they could, and the telephone companies have tried very hard to compel them to do it. They appeared to be able, however, to demonstrate to the satisfaction of the courts that they could not build a practical and commercial railway system with double wires. Telephone companies seem now to appreciate these conditions and in some cases have adopted the McCluer system and in others are arranging, I believe, for the use of the metallic system. In regard to the distance which electric railways are operated in one direction from the central station, I beg to say that we have some roads ten miles. We have a number of roads with arms or branches six or seven miles long. As for the possible growth of the system to take the place of steam road operations I do not feel quite sanguine enough on the subject just now to predict that that will be done very soon. I do not see any very serious electrical obstacles in the way; it seems to me to be within the range of possibilities, and I think ultimately it will be done.

Regarding the sparking at the wheels, I have seen the installation at Indianapolis to which our friend alluded, and I have noticed that in certain conditions of track there is considerable sparking. I have seen the road in operation at other times when the track was clean, and there was absolutely no sparking at the wheels whatever.

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 22.—Again the electric railway has received the approval of the State Railroad commission in the granting of the Brooklyn City railroad permission to change its motive power from horse and steam to electricity. The Third avenue road from the Brooklyn city line to Fort Hamilton, and an entirely new road to Gravesend Bay will make the total length of the extension about five miles. A few property owners along the lines are said to be indignant at the action of the State Railroad commission, and have drawn up a set of resolutions protesting against the use of overhead electric wires. This action on the part of the property owners is not likely to avail anything, as similar positions have been taken before against the introduction of the electric railway system in other cities, but in every case the people have been led to see the many advantages of the electric system over any other.

An alleged attempt at bribery gave the Newark Passenger Railway company, which owns nearly all the street railways in Newark, as well as the road between Newark and Orange, a very decided set-back. The East Orange township committee was asked to give its permission for an electric system in order to complete the line between Orange and Newark, and not being inclined to move hastily in the matter, openly charges the railroad company with attempt at bribery. The chairman of the committee, Henry E. Jopson, reported that members of the committee had been approached and money bribes offered to them for their votes for franchises, and that the committee therefore considered it due to their dignity and honor that the petitions should be denied. The adoption of a motion to that effect and a vote of thanks to the committee was the outcome of the meeting. It was indignantly denied by the railroad authorities that any one had been authorized to make any offer to any member of the committee.

Another sensational death attributed to electric wires was heralded about town in a most scandalous fashion the early part of the day. The case was that of James Tucker, foreman of the linemen of the East River Electric Light company, who was repairing an overhead wire at Second avenue and Sixty-sixth street, when he was suddenly seized with a fit and fell across the wires. The body was taken down and the ambulance surgeon from the Presbyterian Hospital pronounced him dead. The body showed no signs that the man had sustained an electric shock, and the superintendent of the electric light company said that the current was turned off from the wires at the time Tucker met his death.

The argument in the Supreme Court Chambers to-day upon the application of the electric light companies to continue an injunction restraining the Consolidated Telegraph & Electrical Subway company from interfering with the plaintiffs' access to and use of the subways, was heard by Judge Ingraham. The array of legal talent at the counsel table included Jas. C. Carter, Frederick B. Coudert and Edward Lauterbach for the defendant, while Joseph H. Choate and Paul D. Cravath represented the plaintiff. The argument was opened by Mr. Cravath, who claimed that the subway company demanded exorbitant rates and that there had been favoritism in the use of the subways. The judge reserved his decision.

The Magnetic Club tendered a dinner at Martinelli's to a number of telegraphers and representatives of the electrical press last Wednesday evening. About fifty members of the club were present, and nearly one hundred guests. The banqueting hall was specially decorated with electric light accessories and the brilliant illumination of the varicolored lamps was a feature Among the guests were Dr. Norvin Green, Thomas F. Clark and General Thomas T. Eckert. President W J. Dealy introduced Dr. Green as the speaker of the evening, who in the course of his remarks said: "Telegraphy is an employment that cultivates the mind and improves the condition. Telegraphers as a rule are an intelligent body of men; more so than others. The telegraphic industry has changed the whole character of traffic, and that in a comparatively few years. When I was a young man there was not a man in the United States who could claim to be a millionaire. What would a rich man in those days think of a billionaire nowadays? And could that billionaire have accumulated his wealth without the aid of the telegraph? No." Electricity in general and the future uses of the great power were referred to by the speaker. Songs were sung and recitations given by different members of the club and a most enjoyable and instructive programme was carried out.

A large and attentive audience greeted Dr. S S. Wheeler last evening at the Department of Electricity of the Brooklyn Institute, where he presented a lecture of unusual interest, illustrated by experimental demonstrations on "Some Applications of Electricity."

The Gas Commission met yesterday and empowered Secretary McCormick to advertise for bids for electric lights for the streets for 1891. Altogether, there are 1,386 electric lamps to be lighted. The electric lighting companies will endeavor to get higher prices because of the cost of subway rentals, and the Gas Commission will fight against an increase and threaten to return to gas altogether. In his provisional estimate Commissioner of Public Works Gilroy asked for $826,000 for gas and electric lighting for next year, an increase of $126,000. The increase was asked for to meet the expected increase in the cost of electric lighting. The board of estimate and apportionment, however, cut out this increase and announced that if the electric companies put up their prices, gas would have to be used instead.

A fire occurred to-day in the Western Union Telegraph office at 66 Gold street, caused by some wires crossing each other and igniting the switch-board. The damage was $100.

The city officials have decided to increase the number of lights in City Hall. A row of incandescent lamps will be arranged just underneath the dome. The corridors on the second floor will be brilliantly lighted by electricity.

The reported suicide of Jabez Fearey, manager of the Postal company's New York office, was soon run down last week and proved, as Mr. Fearey's friends had predicted, a canard. Mr. Fearey while engaged in business in Matawan, N. J , fell and hurt the stump of an arm lost in the late war. He was obliged to take to his bed and telegraphed his family. The boy who was sent with the message pocketed the money he received to pay for it and failed to deliver it.

A few weeks ago two Frenchmen appeared among the leather merchants of the Swamp and announced that they were the possessors of a system by which sole leather could be tanned by electricity in ninety six hours. The drums and other machinery necessary for the tests were set up in the factory of T. P. Howell & Co in Newark, N. J., and the experiments were begun. Sixteen hides were put in an ordinary peg drum, liquor was poured in, and the electrical current applied. For ninety-six hours the drum was watched. The result was that when the leather was taken out it was found to be apparently thoroughly tanned. Its fibre was looser than it should be, however, and it lacked the firmness necessary for the best of stock. A second drum was started. This time no electricity was put through the tan fluids, and at the end of ninety-six hours it was declared that the result was as satisfactory as that obtained by the Frenchmen's method. The committee then reported that the leather merchants would decline to invest. Had the test proved satisfactory the Frenchmen would have made fortunes, as there are over 4,000 tanneries that would have probably employed the process, W. H. T.

Pittsburg, Pa.

PITTSBURG, Nov. 22.—The motive power of the Pittsburg Union Passenger Railway company is now being changed from mules to electricity. The work was commenced a few days ago, but since then, one of the stockholders has filed a bill in equity in the Pittsburg courts to restrain the management from proceeding with the work, because the stockholders did not give their consent to the change. The case will come up next week.

The McKeesport Electric Light company has just put in a 50 arc lamp dynamo. With big orders for lamps from the National Tube works, a factory situated there, as well as blast furnaces and municipal buildings, the company is still unable to supply the demand made upon the capacity of the plant and for this reason there will be two additional 50 light arc machines installed in the plant. E. H. H.

Minneapolis, Minn.

MINNEAPOLIS, Nov. 22.—John G. Gluck, representing a number of influential gentlemen who own abutting property on Hennepin boulevard, has procured a temporary injunction and a restraining order which will prevent the construction of that important part of the Minneapolis electric railway system this winter. Hennepin boulevard is one of the principal driveways in the elaborate system of boulevards in this city, and the conformation of the land through which it runs, together with the fact that a populous suburban district lies beyond it, makes it one of the most desirable routes that could be selected for a street car line. Two months ago the Minneapolis Street Railway company was authorized by an ordinance of the city to go ahead and build on the thoroughfare. At that time there was most bitter opposition to the plan. The action of Gluck et al. in procuring the injunction was precipitated by the commencement of work at the east end of the thoroughfare, and a tedious legal controversy seems likely to result. The injunction suit will be heard by the court Dec 9, and in the meantime all further work on the line is prohibited. Nothing more in the way of construction can be done until spring.

The Medicine Lake electric line project is to be undertaken in the spring and a double track is to be completed on Sixth avenue, north to that suburb, touching Golden Valley and Plymouth by July 1, 1891. This decision was reached at a public meeting of property owners interested, C. C. Dunn, A. R. Rieberth, H. O. Nyberg, H. G. Tracy and C. Jensen being the principal movers. At this meeting estimates were presented by several local electrical companies upon the cost of equipping and operating the line, and it seems likely that an independent plant will be put in. The projected line will connect with the Minneapolis company's line at Penn avenue in any event, thus giving a direct and convenient service into the heart of the city.

The agitation of the citizens in southeast Minneapolis over the delay in getting the interurban line into running order, did not result in any public protest before the city council as contemplated, for the good and sufficient reason that before the project materialized, cars were running on that line as far as Prospect Park, giving the public in that populous suburb a splendid service. The company reiterates its promise to have the entire line between St. Paul and Minneapolis in operation by the 10th of December.

It is announced that the steel arch bridge over the Mississippi connecting the east and the west sides of the city at Hennepin and Central avenues will be completed Dec. 1. This is an important announcement to the street railway company, as it will afford them the opportunity of laying permanent tracks and conduits to connect the important lines already completed except at this point. This will undoubtedly enable the company to complete its magnificent system at least a month earlier than was expected.

The St. Paul city council has heard Supt. McMichael of the Western Union Telegraph company upon the subject of burying wires. Mr. McMichael simply rehearsed the well known objection of that company to the underground conduit system, stating that it had unsuccessfully experimented with that idea for the past fifteen years. As a substitute he offered to erect new poles and put their 100 wires on Fourth street into four cables thus abolishing the network of wires now strung there. His proposition did not meet with favor, and the committee on streets recommended the drafting of an ordinance to compel the Western Union to bury its wires. Responding to inquiries, Mr. McMichael made the interesting statement that his company's business in St. Paul paid $9,000 a month, 80 per cent. of which is paid to employes.

A curious and costly accident has cost the Minneapolis Telephone company $5,000. A heavy wired pole was mysteriously relieved of its supporting guy-wire and fell across the stteet, crashing into a store front and injuring a passing teamster.

Building Inspector Hazen has announced that hereafter all electrical companies and the street railway company must secure permits before stringing wires. He derives his authority from a city ordinance which says that every

individual, firm or corporation, before entering upon the erection, construction or alteration or change of any electrical work or wiring in the city of Minneapolis, shall file with the inspector of buildings, plans and specifications showing such work or alteration, and shall obtain a permit from such inspector for such proposed work before proceeding herewith.

W. G. DeCelle of St. Paul, who is the principal stockholder in the Winona Street Railway Company, as weil as a member of the Thomson-Houston Electric company of that city, is the victor in litigation of long standing in the Winona courts, and the company will now be able to go ahead with the electrical lines projected there. The trouble was among the stockholders of the present company, and was adjusted by giving the minority credit for the full amount of their stock should they desire to sell it, or the privilege of continuing it after the motive power is changed to electricity. N. O. Y.

Louisville, Ky.

LOUISVILLE, Nov. 22.—Most of the machinery for the new electric light plant at New Albany has been received and the remainder is daily expected. It is hoped to have the work completed by the middle of December. The company will then be prepared to furnish 250 arc or 3,000 incandescent lights. It is thought there will be no difficulty in getting the general council of that city to pass an ordinance abandoning gas, as that is expensive in that city.

L.

THE ELECTRIC LIGHT.

Franchises have been granted by Hinton and Kingwood, West Va., for electric light plants.

The Fort Wayne Electric company has captured the order from the Louisville, Ky., Gas company for 750 arc lights.

The city council of Waukegan, Ill., and the local electric light company have at last come to an agreement by the terms of which the latter is to furnish sixty-five arc lamps to burn until midnight at $65 per lamp per year.

The electric light plant at Morrison, Ill., was started last week. The station building is 60 feet long by 50 wide. Four Edison dynamos have been installed. There are at present in use 450 lights in stores, 300 in residences, and 86 lamps are used for lighting the streets.

At the last meeting of the Wichita, Kan., City Council the contract with the Wichita Electric Light & Power company, which was referred to the committee, was reported and read. The bill provides for all night service in the territory of that company, the city contracting for forty lights.

The Thomson Houston company reports the following sales: Balatka Bros., Chicago, 20 incandescent light plant; Soldiers' and Sailors' Orphans' Home, Knightstown, Ind., 400-light incandescent plant; Milwaukee Car Wheel & Foundry company, Milwaukee, Wis., 20-arc light plant; Democrat Printing company, Madison, Wis., 100 light incandescent plant; L. E. White, Greenwood, Cal., 30-light arc plant; The order recently placed by the Union Pacific System, for lighting the shops of the Denver Union Railway & Terminal company at Jersey, Colo., with the Western Isolated Lighting Department of the Thomson-Houston Electric company, comprises two 500-light dynamos and other appliances, including wiring necessary to operate 1100 incandescent lamps, also a 600 light generator which will be used in connection with an electric motor for running a transfer table.

THE ELECTRIC MOTOR.

The Glenover Street Railway company is also building with a view to operating by electricity.

The Beaumont, Texas, City Street Car company has been granted a franchise to construct an electrical railroad. It is proposed to commence work at once.

The extension of the lines of the Greenville, Tex., Street Railway company will be commenced at an early date, and it is probable that the company will change to the electric system.

The North Avenue Electric Railway company has applied to the Baltimore, Md., city council for authority to extend its line to the center of the city, using an elevated roadway.

The Asheville, N. C. Loan, Construction & Improvement company will build from one to three miles of electrical road. It is investigating both the storage battery and trolley systems.

J. Q. Burbridge, J. M. Schumacher, F. F. L'Engle and others have organized a company, to be known as the Jacksonville, Fla., electric railway, to build the electric railroad previously mentioned.

The Augusta, Ga. Railway company intends extending its Summerville line to Monte Sano, about one-half mile of double track, and will also build to the exposition grounds. It has ordered additional equipment.

Ground was broken last week for the Lincoln, Neb., Street Railway Electric power house. Without car storage houses the power house proper is to be a brick building 90 by 150 feet wherein will be a machine, construction, paint and blacksmith shops and space for four 125-horse power dynamos and steam boilers capable of evaporating 13,000 pounds of water per hour. It is thought that the building will be completed by January 1, and that the street car system will be running with electric power by April 15.

St. Louis property owners interested in the adoption of electricity on the street car lines have organized to insist upon John C. Scullin performing his contract. They are determined to compel Mr. Scullin to substitute electricity for mules and will not patronize his lines as long as mules drag the cars.

The Beatrice, Neb., Rapid Transit Power company has begun operations looking to the early completion of an electric motor street car line on Sixth street from Court street southward and across the river, the South Beatrice addition. The company promises to have the line in active operation by January 1.

The construction of the electric street railway to the Meso, east of Albuquerque, N. M. is now assured. The projectors of the enterprise are local capitalists, who recently purchased a large tract of land on the Meso, and they are building the electric road for the purpose of bringing their own property into market. Work will be commenced at an early day.

The Leavenworth, Kan., dummy line, operating from Fort Leavenworth to the Soldiers' Home, has been sold to the Leavenworth Electric Railway company, by Newman Erb of the Wyandotte, for a sum approaching $100,000. The line will be extended to Mount Muncie cemetery, south of the Soldiers' Home and spurs connecting the thickly populated outlying additions with the heart of Leavenworth, will be constructed as soon as the franchises may be obtained. The new owners will operate eighteen miles of railway, and the motors have already been ordered. The change of motive power will probably be made in the spring. The company is composed of S. F. Neeley, Leavenworth, president; B. E. Sunny, Chicago, first vice-president; H. L. Newman, St. Louis, second vice-president; D. J. Hoff, Kansas City, secretary and treasurer; W. B. Knight, Kansas City, chief engineer, and John Hannon and Robert Garrett of Leavenworth. The capital stock is $300,000.

A meeting of the stockholders of the Wyatt Park Railway company at St. Joseph, Mo., will be held January 10, 1891, for the purpose of considering a proposition for the consolidation of the Wyatt Park Railway company, with the Union Railway company. Arthur Moulton of New York, secretary and treasurer of the People's Street Railway company, is in the city to attend the meeting of the directors of the Union line and Wyatt Park Street Railway companies. After the consolidation the company will be known as the Union Line Street Railway company The terms of the transfer are already agreed upon and virtually settled, as the directors are nearly the same in both companies and this meeting is to dispose of the matter formally. The recent franchise granted by the city council enables the Wyatt Park line to run to the Union depot over the Union line tracks from Olive street, and further compels the lines to interchange transfers. It will facilitate business with the two lines. When the two companies are consolidated and the mortgages arranged, then the new bonds can be printed and placed on the market. The new company will improve the roads, and by the first of the new year have the railway system of the city completed.

Miscellaneous Notes.

A team of horses was killed in St. Louis last week and the driver thrown to the ground. It is claimed that an electric wire was the cause of the trouble.

The suit of David Brooks, Philadelphia, against the Western Electric company, Chicago, for alleged infringement of patents, was compromised last week by the defendant paying $5,000 damages.

The Morgan Gardner Electric company of Chicago, has been incorporated to manufacture and sell electric mining machinery, etc; capital $100,000. Incorporators: Henry A. Gardner, James P. Gardner and George C. Gardner.

Personal Mention.

David Brooks of Philadelphia was in Chicago last week.

John C. Reilly, general superintendent of the New York & New Jersey Telephone company, New York, was in Chicago last week.

It is reported that Henry Villard sailed for New York, Nov. 20. He had given up the idea of returning to this country immediately but advices from New York convinced him it would be better for him to be on the ground.

W. E. Bell has been appointed superintendent of the Chicago Telephone company, in charge of the American District Telegraph service, vice Assistant Superintendent N. A. Douglas, resigned. Mr. Bell has been connected with the Western Union company for eighteen years.

Charles D. Shain of New York, Eastern district, manager of the Edison General Electric company, was in Chicago this week. He reports business excellent in every department, and says the demand for apparatus is greater at the present time than at any period in the history of the company.

Business Mention.

S. W. Lord & Co. have been awarded the first premium medal for their boiler cleaning compound, at the Piedmont Exposition, Atlanta, Ga.

The Magnolia Anti-Friction Metal company of New York, was awarded a gold medal at the recent electrical exhibition at Edinburgh, Scotland.

The Pittsburg Sheet Metal Tool company has just issued a circular to the trade calling attention to its electrical specialties. This concern is manufactuaing different styles of pushes and is also exploiting Hipwell's ingenious expanding wire guard for incandescent lamps.

The Triumph Compound Engine company, of Cincinnati, O., reports sales of engines last week in Georgia, Tennessee, Virginia, Florida—one each—and two for Alabama.

The Knapp Electrical Works of Chicago have just issued their new catalogue for 1890, which they will be pleased to mail to applicants. The company has just brought out a new annunciator of an improved type.

The Electrical Supply company, 171 Randolph street, Chicago, reports large sales of the celebrated Sunbeam incandescent lamp, in addition to which it has arranged to handle the Edison lamps at Edison prices. The Electrical Supply company expects to dispose of large quantities.

Charles A. Schieren & Co. of New York have just furnished to the Louisville Cotton Mills, Louisville, Ky., eighty-nine feet of 32 three-ply patent perforated electric belt, which is a very heavy belt for a perforated belt. The demand for the firm's patent perforated electric belt is growing constantly; those who have used it have discovered its merit.

The Sebastian-May company of Cincinnati, O., has decided to move, December 1, to Sidney, O., in order to obtain increased manufacturing facilities A large tract of land has been secured at that place, on which have been erected brick and stone buildings. The company writes that with its increased facilities it will be able to fill promptly orders for its lathes and tools.

The artistic lighting of the painting, "The New Ideal of Christ," in Old Christ Church, Fifth avenue and Thirty-fifth street, New York, a private view of which was given on the evening of Nov. 18, is accomplished by an electric light plant of James H. Mason's battery system. The new catalogue of the batteries is just out, which sets forth the advantages of the Mason system of electric lighting and power.

C. C. Martin, chief engineer and superintendent of the New York and Brooklyn Bridge, writes to the Magnolia Anti Friction Metal company, 74 Cortlandt street, New York, that Magnolia metal has been in use "about six months on the crank pin of a 450 horse power Wright engine, and also as packing rings on the piston rod of a locomotive. In both places it has given entire satisfaction, not causing the least trouble."

In order to fill the rapid demand for manufactures of the Westinghouse Electric & Manufacturing company, that corporation has lately been obliged considerably to augment its facilities for shipping goods from the works to the railroad stations in the city of Pittsburg. A number of wagons are constantly engaged in hauling motors and machinery, but as the company's own teams were not sufficient it was necessary to call on some of the local express companies to aid in the work

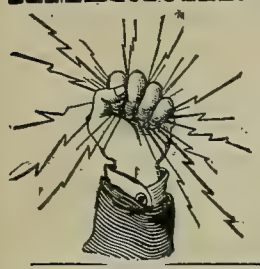
Chas. Wirt, the well known electrical expert, has connected himself with the Electrical Supply company of 171 Randolph street, Chicago. Mr. Wirt has been connected with electrical interests for many years, and is best known to the community at large as an inventor and engineer. The first two instruments which Mr. Wirt has patented, and which are meeting with large sales are the Wirt voltmeter and the Wirt lightning arrester, for both of which instruments remarkable accuracy, simplicity and general durability is claimed.

J. Lang & Co. of Chicago have just completed an order for four main line switches of the well-known "Andrews" pattern, each 1000 amperes, for the Minneapolis Edison company. It is claimed for these switches, of which there is a large number now in use, that the clips and tongues are made of the purest copper attainable, and the body of a composition metal of high conductivity. The blade is hung loose insuring a perfectly parallel contact across its entire face thus insuring ease of manipulation and the reduction of the loss from sparking to a minimum. These switches are made in sizes ranging from 100 to 3,000 amperes and are sold with an iron-clad guarantee Lang & Co. manufacture other switches—one style known as the "Lang"—and in addition they have a large line of electrical specialties bearing their name. The factory is now being run to nearly its full capacity, under the personal supervision of the senior member of the firm, which insures high class, intelligent work.

It is now a little more than two months since the electric street railway in Lansing, Mich., the first road operated by the Westinghouse electric street railway system, was started. Since then the Westinghouse company has completed the equipment for twelve roads, which to day are operating to the utmost satisfaction of the purchasers and the manufacturers. A few days ago the managers of the Lansing road, in a letter to the Westinghouse company, stated that although they had a number of difficulties to surmount in the construction of the road, they were glad to say that all had been overcome, and that they felt positive the Lansing electric railway was to-day the best equipped street railroad in this country. It must not be forgotten, however, that while speaking of difficulties, that term in no wise referred to the motor equipment of the road. In fact, as far as the Westinghouse motor is concerned, it is said that the apparatus runs as smoothly and noiselessly to-day as it did on the first day it ran along Main street, Lansing. The Westinghouse Electric & Manufacturing company has now increased the capacity of the motor department to an extent that the company is able to manufacture and ship 100 motors per month. The company has at the present time 50 new roads under process of construction, and as the facilities and the working capacity of the motor department are constantly increased, it is expected that within a very short time the supply will be equal to the demand.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

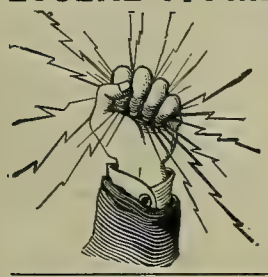
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

—MANUFACTURERS OF—

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS
4 LASALLE AVE
CHICAGO.
MAKE ANYTHING IN BRASS.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union,** under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof,* and *will not deteriorate, oxidize* or *crack,* and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS: W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., { Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

EXPERIMENTAL, MODEL AND ELECTRICAL

Work, Intricate and Special Machinery, and anything that can be done in a first class experimental machine shop, is solicited.

E. D. STIFF, 67 & 69 So. Canal St., Chicago.

Light Manufacturing under Contract.

FOR SALE.

One 8½x10 Armington & Simms Automatic Engine.

One 20-Light Fuller-Wood Arc Light Dynamo and Lamps.

A. L. IDE & SONS,

SPRINGFIELD, ILL.

WATERHOUSE ARC APPARATUS

FOR SALE OR EXCHANGE.

Complete Outfit. - Rare Opportunity.

ADDRESS,

NEWARK ELECTRIC LIGHT and POWER CO.,

Newark, N. J.

Binders

FOR THE Western Electrician

$1.00.

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

—THE—

WRITING TELEGRAPH

instruments and system have been perfected, and also proven by the test of time.

The instruments are adapted for

EXCHANGES,

NEWS REPORTING,

PRIVATE LINES.

It is desired to form Sub-Companies in the different WESTERN STATES to introduce this system of communication, which has its many advantages.

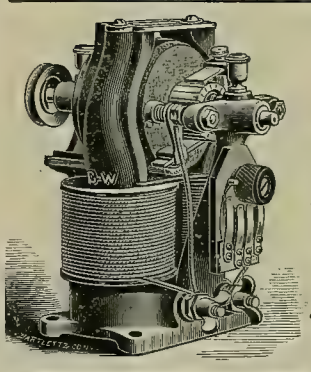
For particulars address WRITING TELEGRAPH CO., P. O. Box 1322, New York, N. Y.

N. B.—The patents of the Writing Telegraph Co. for CANADA, AUSTRALIA and SOUTH AMERICA are for sale, or desirable arrangements will be made with proper parties to operate the instruments in said countries.

Sealed Proposals.

SEALED PROPOSALS will be received by the Common Council of the city of Big Rapids, Michigan, at the City Recorder's office until Monday evening, Dec. 1st next, for lighting said city with twenty-six (26) to thirty-five (35) 2000 candle power electric lights, from January 1st, 1891 to January 1st, 1892. Said bid to state price for lights running from dusk until 12 o'clock, and also price to run from dusk until daylight. Each bid to be accompanied by a bond in the sum of $1000 as a guarantee that the parties tendering such bid will enter into a contract for operating such lights if their bid is accepted. The Common Council reserves the right to reject any and all bids.

S. G. WEBSTER, Recorder.
Big Rapids, Mich., Nov. 5, 1890.



THE CROCKER-WHEELER

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base-Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies o be

THE MOST PERFECT MOTOR MADE.

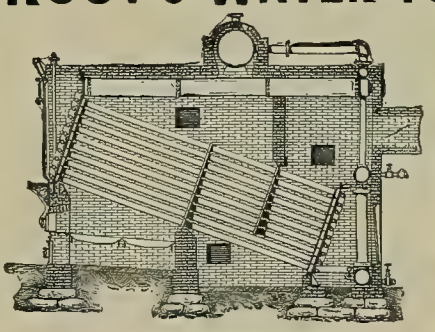
Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Prest.

ROOT'S WATER-TUBE BOILER.



ROOT SECTIONAL SAFETY BOILER.

SAFE. ECONOMICAL. DURABLE

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL OKONITE COMPANY, Limited, - - 13 Park Row, NEW YORK.

BRANCHES Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

EDISON LAMPS REDUCED TO 44 CTS.

16 CANDLE POWER LAMPS.

Lots of 25 to 150 ..... 44 cents each.
Lots of 150 to 500 ..... 42 cents each.
Lots of 500 ..... 40 cents each.

Other sizes in proportion. All sizes in stock, with bases to fit any make of lamps or sockets.

Full Line OKONITE WIRES in Stock. Safest and best wire made.
Full Line of Edison Sockets and Appliances.

STANDARD ELECTRICAL WORKS, CINCINNATI, OHIO.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 10, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed. Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

A MODEL RAILWAY.

The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

FRANK T. BROWN, Late PRINCIPAL EXAMINER ELECTRICITY, U. S. PATENT OFFICE, NOW OF

Butterworth, Hall, Brown & Smith,

Patent Attorneys,

25-26 HONORE BUILDING, - - CHICAGO.

Two complete sets of U. S. Electrical Patents.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

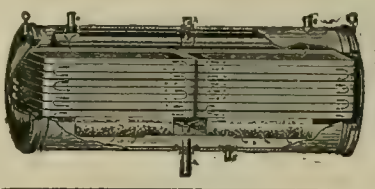
$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

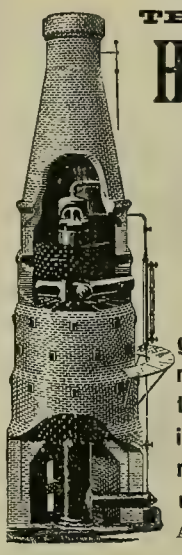
HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.



THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

ALUMINUM Reduced from $2.00 to 75c. per lb. in ALLOY COMPOSITE. 100 lbs. (sample) containing 7½ per cent. Aluminum sent prepaid for only **$7.** We desire to establish an Agency in every large city for our Metal Alloy. For terms and city rights address **THE SCHMIED-BARENGUSS FURNACE CO., Newport, Ky.**

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

Electrically and Mechanically Yours,
JAS. McLAUGHLIN,
Pioneer in Arc Lighting and Electric Railways.
14 YEARS' PRACTICAL EXPERIENCE

Manufacturer of New Parts and Repairs of all Systems of Electric Light, Railway and Power. Electric Specialties. Raising and Lowering Device for Arc Lamps, my patent. Simple Automatic Lightning Arresters (patents applied for). Arc Lamps for all Systems; Arc Lamps for Incandescent Circuits. Consulting Electrical Engineer. **Office and Works: 48, 50 and 52 North Clinton St., Chicago, Ill.**

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

WM. S TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

CARDEW VOLTMETERS.

These are the only standard Voltmeters that can be used on **alternating** as well as **direct circuits.**

DIRECT READING. DEAD BEAT.

CAN BE LEFT IN CIRCUIT CONTINUOUSLY.

Send for Catalogue 1-66 of Electrical Test Instruments.

QUEEN & CO., PHILADELPHIA.

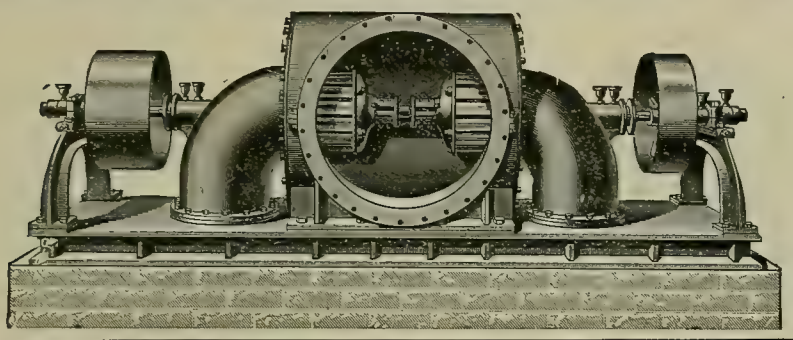
ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators. Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use. we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

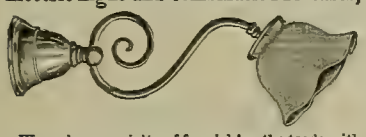
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

JAMES LEFFEL WATER WHEELS

BUILT BY THE

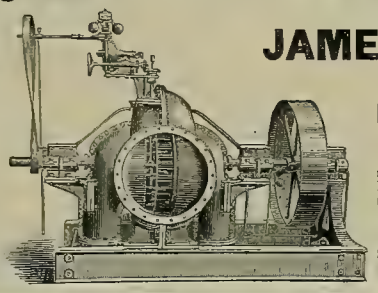
JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING

PLANTS.

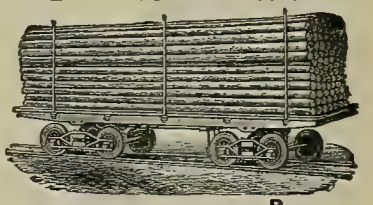


Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS POLES ARMS

C. H. HOLMES & CO.,

Room 410, Com'l Bld'g, St. Louis, Mo.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

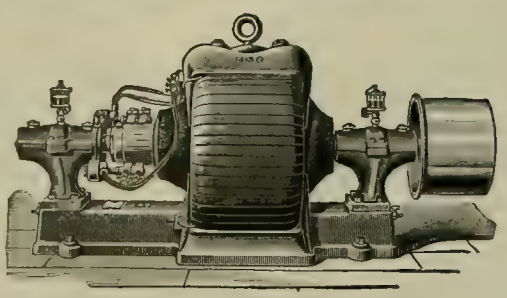
THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

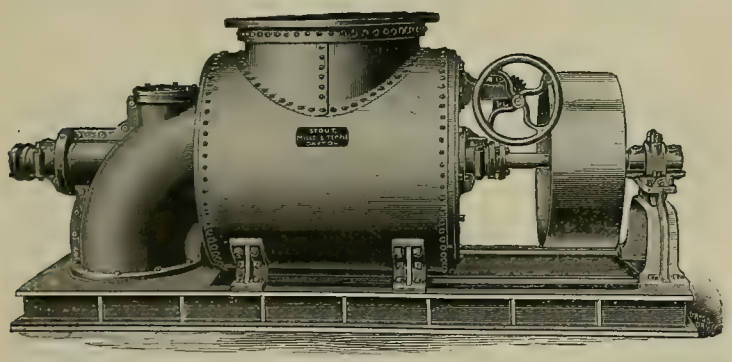
Correspondence regarding Underground and Overhead Cables, Insulated Wires, Electric Lights, Telegraph Instruments, House Goods, and other electrical apparatus solicited. Our new Illustrated General Catalogue will be furnished to the trade on application.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

STANDARD ELECTRICAL WORKS, Agents, CINCINNATI, OHIO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

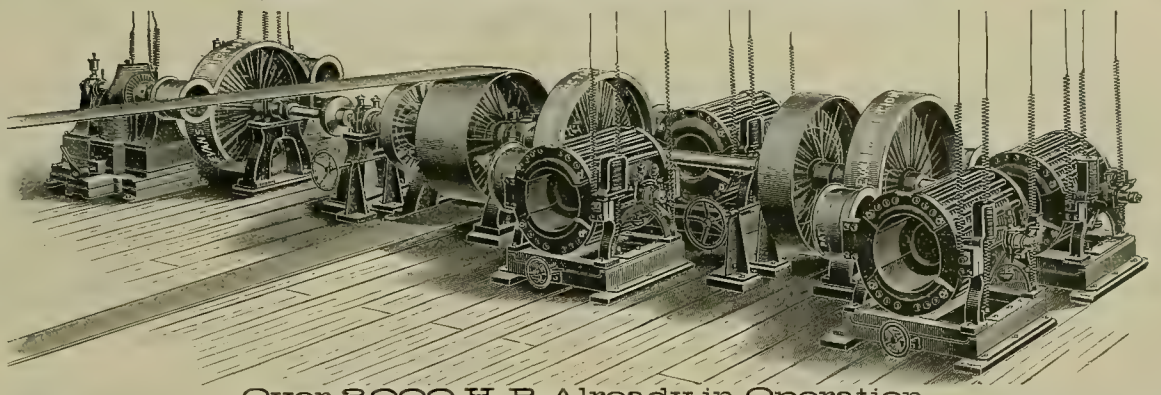
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

(STATION OF THE NORTH ATTLEBORO STEAM AND ELECTRIC CO.)

This Station has been in Successful Operation Since March, 1890.



Write for Full Particulars and List of Parties who are Using.

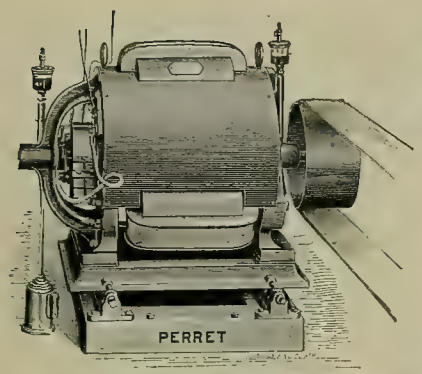
Over 3,000 H. P. Already in Operation.

Send for Catalogue "D" to **THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.**

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—



Perret 20 H. P. Motor, Speed 550, Weight 1,300 lbs.

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY, LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power. Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., C. M. Barclay, 205 Canal St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
BALTIMORE, MD., W. W. Donaldson, 215 N. Calvert St.
ST. PAUL, MINN., F. J. Renz, 327 Minnesota St.
PHILADELPHIA, PA., Cleverly Electrical Works, 1018 Chestnut St.

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

—Manufactured by—

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.
FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

DICTIONARY

—OF—

ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - - CHICAGO, ILLINOIS.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

OKONITE
TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

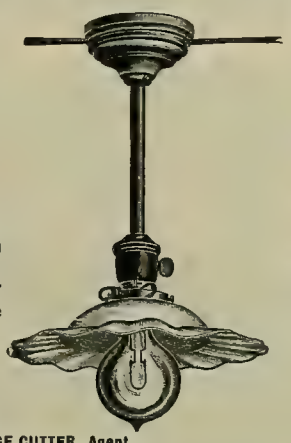
Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.
CHICAGO OFFICE, 190 Fifth Ave., GEORGE CUTTER, Agent.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

BARNES' NEW SENSITIVE DRILL

Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

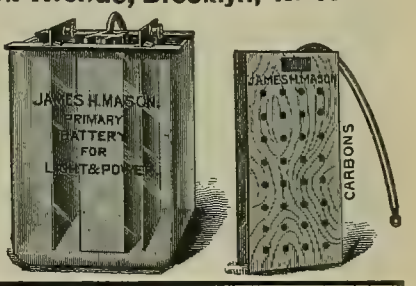
JAMES H. MASON,

MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

COMPLETE PLANTS FOR SMALL STORES.
Office and Domestic Lighting.
GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



PRINCIPAL DEPOT:
Chestnut St., cor. Twelfth, Philadelphia.

BRANCH HOUSES.
Nos. 767 & 769 Broadway, New York.
" 1260 & 1262 Broadway, New York.
" 160 Tremont Street, Boston.
" 151 & 153 Wabash Avenue, Chicago.
" 444 Fulton Street, Brooklyn.

Cable Address: White, Philadelphia.

The S. S. White Dental Manufacturing Co.

Founded by Samuel S White in 1844.

JAMES W WHITE, President. J. CLARENCE WHITE, Secretary
HENRY M. LEWIS, General Manager. SAMUEL T. JONES, Treasurer.

Philadelphia November 4th, 1890.

Edison Mfg. Co.,

Orange, N. J.,

Gentlemen:

Yours of October 16th duly received, and sickness has caused the delay in answering it. As to the Edison Laland Battery, we have been using primary batteries to operate dental electric pluggers and motors since 1875, and am compelled to say that the Edison Laland Battery far excells all other batteries we have ever used.

Yours truly,

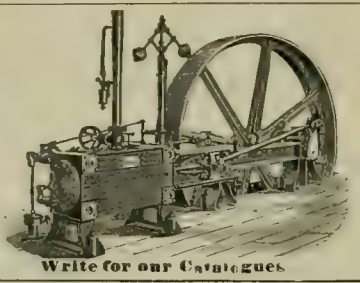
The S. S. White Dental Mfg. Co.

E J Ward

THE REYNOLDS
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues.

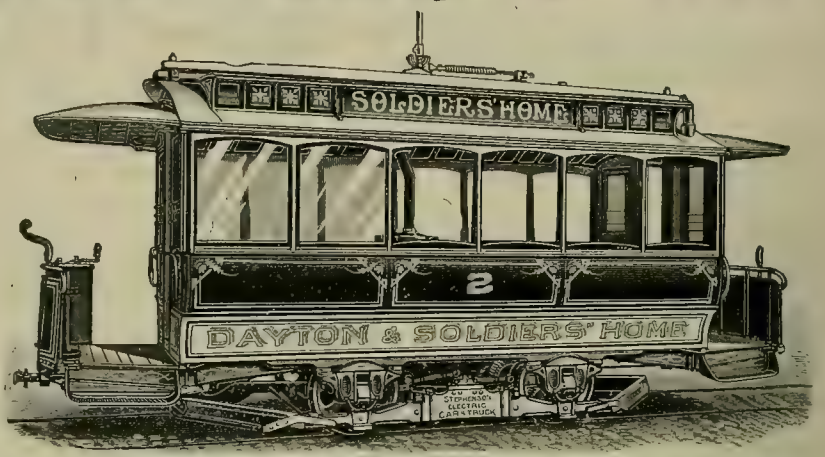
SOLE BUILDERS
EDW. P. ALLIS & CO.,
RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in
Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

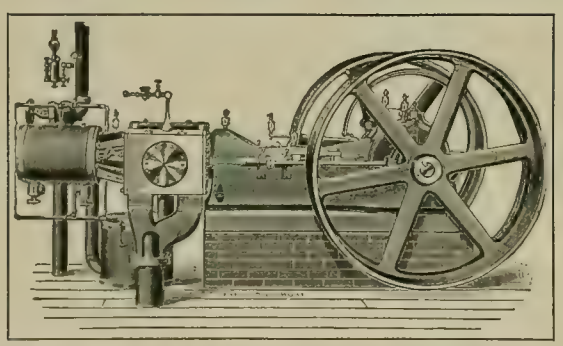
JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.

STREET CARS
—FOR—
ELECTRIC MOTORS
ADAPTED TO ALL SYSTEMS.

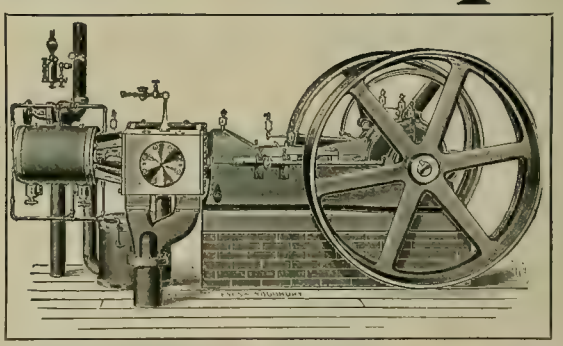


ARMATURES COMMUTATORS
REPAIRED and REWOUND
TRUED OR RENEWED
GENERAL DYNAMO REPAIRING & JOBBING
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

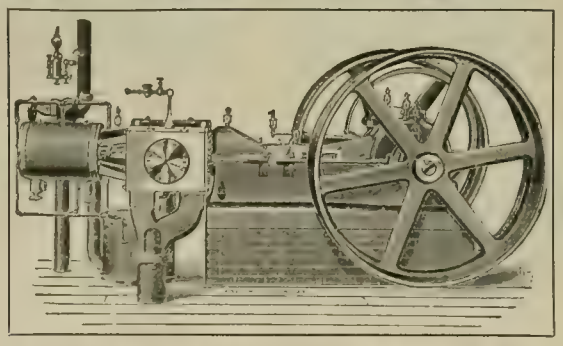
None so Good, None to Equal.



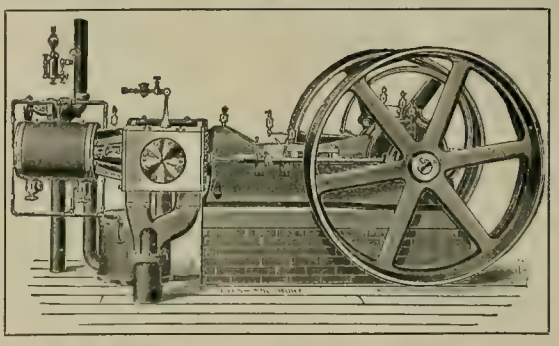
TANDEM



McINTOSH & SEYMOUR.



COMPOUND



WESTERN POWER CONSTRUCTION CO.,
CORRESPONDENCE SOLICITED.
144 ADAMS ST., CHICAGO.

W. N. Hobart, Pres't. L. O. Maddux, Vice-Pres't and Treas. J. H. Eickershoff, Sup't.
J. C. Hobart, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 TO 300 HORSE-POWER. COMPOUND AND VALVELESS.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS. NO ECCENTRICS, NO STUFFING BOXES.
NO PISTON RODS. INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.

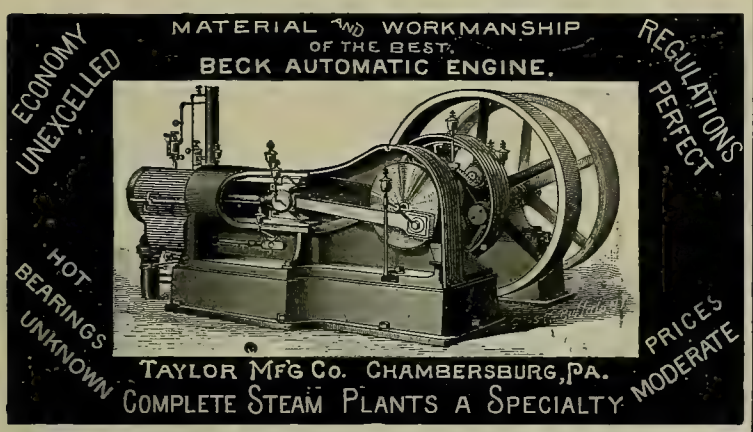
The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

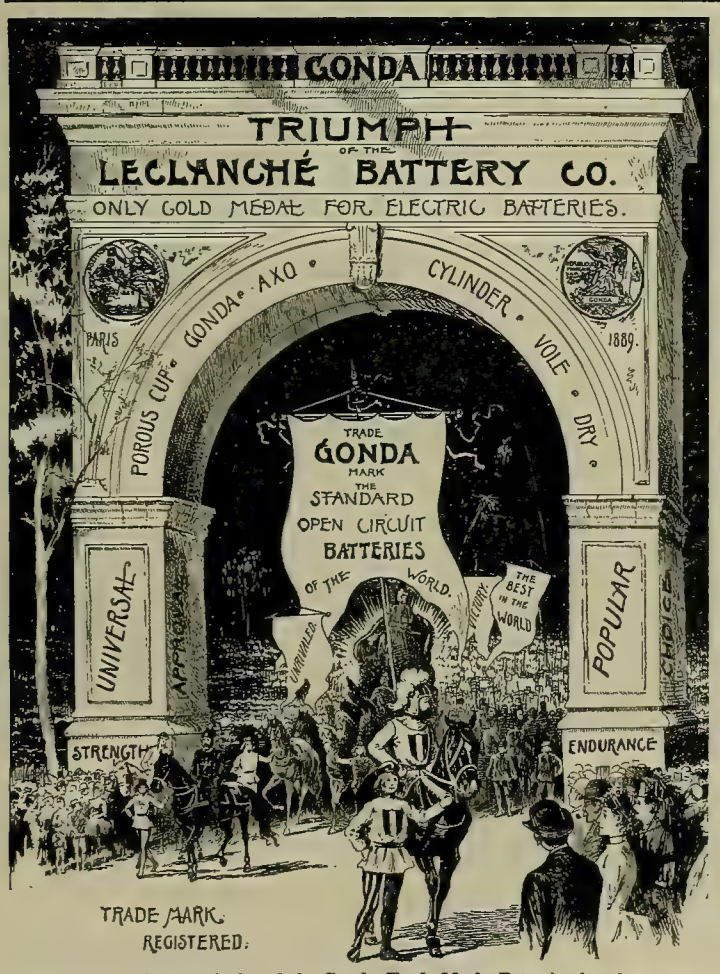
THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.





For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

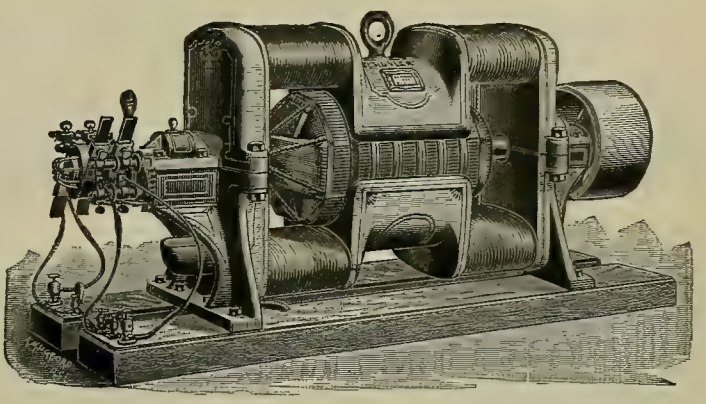
The LECLANCHE BATTERY CO., NEW YORK.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

THE

THOMSON-HOUSTON ELECTRIC CO.'S

RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

Companies desiring Centre Pole Construction should see the Indianapolis Plant, illustrated below. Also Washington, D. C., Rochester and Brooklyn, N. Y.

Citizens' Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON,
620 Atlantic Ave.

CHICAGO,
148 Michigan Ave.

ST. PAUL,
408 Sibley Street.

KNAPP ELECTRICAL WORKS,

GENERAL WESTERN AGENTS

PERKINS ELECTRIC LAMP CO.

To Fit Any Socket, Any Candle Power,
Highest Efficiency.

GRIMSHAW WHITE CORE

Wires, Cables

and Tapes.

ANNUNCIATORS,

BURGLAR ALARM BELLS, BUTTONS, ETC.

PORCELAIN CUT-OUTS,

Main and Branch Cut-Outs, Rosettes and Switches, Underwriters' Weather Proof Wires and Line Supplies.

Write for Prices on these Specialties. Our New Catalogue for 1891 Just Out.

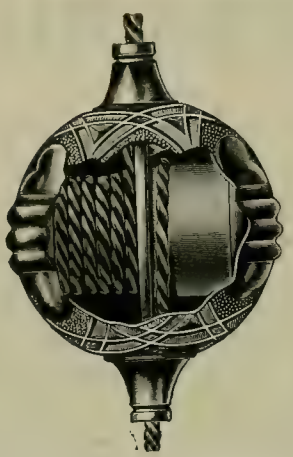
54 & 56 FRANKLIN STREET, CHICAGO.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.

The demand for Bradner Hangers is increasing daily. Every electric lighting station should keep a supply of them on hand; your customers want them.



The secret of the popularity of the Sunbeam Lamp is that it gives light —not an excuse for light, but a good, steady, SUNBEAM light — sixteen candle power to start with — sixteen candle power when its mission is half completed—sixteen candle power at the journey's end.

Oak Pins.

Locust Pins.

Cross-Arms.

Round Cedar Poles.

Octagonal Cedar Poles.

Iron Poles.

Lag Screws.

Pole Steps.

Tools.

Insulators.

"THAT TIRED FEELING"

Would not come on if you used **"SHIELD BRAND"**—the best weather-proof and only moisture-proof line wire. TRY IT.

OUR

Stock of SHIELD BRAND WIRE is equal to any emergency.

WE

Carry a very large stock of TESTING INSTRUMENTS.

Wirt Standard Voltmeters.

Weston Voltmeters.

Ayrton & Perry Voltmeters.

Carpentier Voltmeters.

Cardew Voltmeters.

B. W. Ammeters.

Weston Ammeters.

A. & P. Ammeters.

Testing Sets.

HABIRSHAW

LEADS

As a first-class rubber insulation, and has stood tests where all other insulations failed. Make your orders read

"HABIRSHAW."

OUR CATALOGUE NO. 648

Should be read by all interested in Bells, Batteries, Annunciators, Burglar Alarms, etc.

Purchasing Agents for Telegraph and Telephone Companies will find this catalogue of much service.

OUR CATALOGUE NO. 560

Should be read by all interested in Electric Light or Power Plants.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having *won four distinct infringement suits* in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

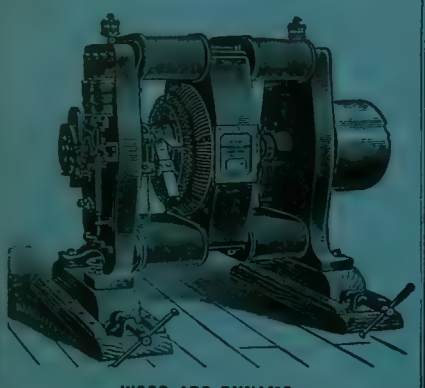
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



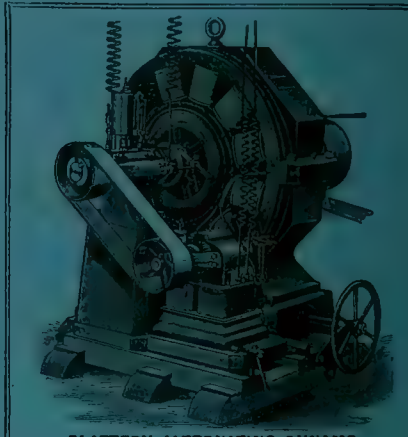
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

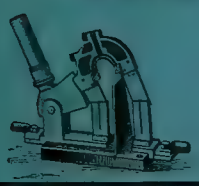
PHŒNIX GLASS CO
OF PITTSBURGH, PA.
MANUFACTURERS OF A FULL LINE OF
ELECTRIC LIGHT
GLOBES SHADES
BOTH ARC AND INCANDESCENT.
RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.
ADAPTED TO ALL SYSTEMS.
729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

Western Electrician.

$8 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, DECEMBER 6, 1890. No. 23

"AJAX SWITCHES"



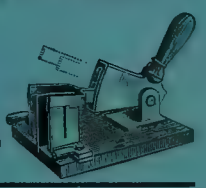
In all Sizes, for any Potential, Single, Double and Treble Pole.

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,

74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin' ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

INDORSED BY THE UNITED STATES AND GERMAN GOVERNMENTS.

NEW YORK AND BROOKLYN BRIDGE, BROOKLYN, Nov. 7, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—This certifies that we have had your metal in use about six months on the crank pin of a four hundred and fifty horse power Wright engine and also as packing rings on the piston rod of a locomotive. In both places it has given entire satisfaction, not causing the least trouble.

Yours very truly, C. C. MARTIN, Chief Engineer and Supt.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.

CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York. / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

THE MILLIKEN PATENT ELECTRIC RAILWAY POLE.

—MANUFACTURED BY—

MILLIKEN BROS.,

No. 55 LIBERTY STREET, NEW YORK. | No. 59 DEARBORN STREET, CHICAGO.

Standard Side, Center and "Put-Off" Poles. Special Attention Given to Insulation. Special Poles of any Required Length, or to Stand any Strain Made to Order.

Adopted by all the Leading Roads and Recommended by the Best Engineers.

In use in the following cities: NEWARK, BUFFALO, JERSEY CITY, PATTERSON, TROY, PITTSBURGH, HAMILTON, O., ETC.

Over 6,000 Ordered in the Last 3 Months.

ORDERS FOR STANDARD POLES FILLED FROM STOCK.

WRITE FOR PARTICULARS.

BRANCHES: { 161 Summer St., Boston, Mass. / 225 Pearl St., New York City. / 129 N. Third St., Philadelphia, Pa. / 60 W. Monroe St., Chicago. } St Louis, Mo.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., BOSTON, MASS.
148 Michigan Ave, CHICAGO, ILL.
115 Broadway, NEW YORK, N. Y.
215 W. 4th St., CINCINNATI, OHIO.
N. Y. Life Ins. Bldg., KANSAS CITY, MO.
115 N. 3d St., ST. LOUIS, MO.
15 First St., SAN FRANCISCO, CAL.

Electric Railway Equipment. Electric Motors.

THE ONWARD MARCH!

Some Facts in Electric Lighting.

No. of Companies using Thomson-Houston Arc Apparatus, Jan. 1, '90	516	
No. of Companies using Thomson-Houston Arc Apparatus, July 1, '90	587	
Increase 6 months, ending July 1, '90		71
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, Jan. 1, '90	68,203	
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, July 1, '90	79,387	
Increase 6 months, ending July 1, '90		11,184
No. of Co.'s using Thomson-Houston Incandescent Apparatus, Jan. 1, '90	337	
No. of Co.'s using Thomson-Houston Incandescent Apparatus, July 1, '90	436	
Increase 6 months, ending July 1, '90		99
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, Jan. 1, '90	281,555	
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, July 1, '90	408,515	
Increase 6 months, ending July 1, '90		126,960

There are also in the United States Isolated Plants using in the aggregate
20,000 Thomson-Houston Arc Lamps,
and over 100,000 Thomson-Houston Incandescent Lamps.

ELECTRIC RAILWAYS.

Roads in Operation, July 1, 1890	80
Number of Motor Cars	1,069
Roads under Construction, July 1, 1890	43
Number of Motor Cars	408

Grand Total.

Number of Roads 123 Number of Motor Cars 1,477
Total Length of Track (in miles) 897

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co..... xx
Abendroth & Root Mfg. Co.. —
Alexander, Barney & Chapin. xii
Allis, E. P. & Co..... xxii
American Electrical Works. . xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co..... vii
Baggot, E..... xvi
Bain, Foree.....xii, xvi
Ball Engine Co..... xxii
Barnes, W. F. & Jno..... xxi
Barton, Geo. P..... —
Baxter Electric Motor Co..... xx
Bernstein Electric Co..... xxi
Bleckert & Nelson..... xvii
Brush Electric Co..... xxvii
Bubier Publishing Co..... xvi
Bunnell & Co., J. H..... —
Butler Hard Rubber Co..... xx
C. B. & Q. R. R..... —
C. & C. Electric Motor Co... xviii
C. & N. W. R. R. Co..... —
Central Electric Co..... xi
Chicago Electric Club..... —
Cleverly Electrical Works... iv
C. M. & St. P. R. R. Co..... —
Colburn & Co., I. W..... xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... ——
Consolidated Electric Storage Co.....xxviii
Continental Dynamo Co..... iv
Cowles Electric Smelting and Aluminum Co..... xvi
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... —
Day's Kerite Insulation..... i
Dayton Globe Iron Works Co. xviii
Delany, P. B..... xv
Eastern Electric Cable Co. xv
Eddy, Henry C..... xv
Edison Mfg. Co..... xxi
Edison General Electric Co.,— Lighting Dept..... viii
Edison General Electric Co.,— Lamp Dept..... i
Electric Construction & Sup. Co iv
Electrician Publishing Comp'y ——
Electrical Supply Co.....xxvi
Elektron Mfg. Co..... xix
Empire City Electric Co.....xviii
Empire China Works..... xvi
Eureka Tempered Copper Co.. xvii
Evans Friction Cone Co..... xix
Fibrone Mfg. Co..... xv
Fletcher & Fletcher Electric Co xvi
Forest City Electric Works.... vii
Fort Wayne Electric Co..... xxviii
Gibson Co., W. D.....iv
Globe Carbon Co..... xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S..... xiv
Harmount, G. A..... vii
Hawkeye Electric Mfg. Co.... iv
Hazelton Tripod Boiler Co... xvi
Heisler Electric Light Co..... xvi
Hill Clutch Works..... xxii
Holmes, Booth & Haydens.....xvii
Holtzer-Cabot Electric Co..... i
Humphrey, H. H..... —
Illinois Electric Material Co.... xiv
India Rubber & Gutta Percha Insulating Co..... i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L..... —
Jewell Belting Co..... xv
Jones Bros. Electric Co..... xxii
Knapp Electrical Works..... xxv
Laminar Fibre Goods Co..... xvii
Law Telephone Co..... xv
Leclanche Battery Co.....xxiii
Leffel & Co., Jas.....xvii
McLaughlin, James.....xvi
Magnolia Anti-Friction Metal Co i
Mason, James H..... xxi
Milliken & Co..... i
Monitor Electric Co..... vii
Munsell & Co., Eug..... xv
Munson Belting Co., Chas..... xiv
National Carbon Co..... iv
National Electric Mfg. Co..... x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T..... xxi
N. Y. Belting & Packing Co... ——
Okonite Co..... xv
Ostrander & Co., W. R. xviii
Page Belting Co..... —
Paiste, H. T..... xiv
Peckham Street-Car Wheel & Axle Co..... vii
Partrick & Carter xx
Phillips Electrical Works, E. F xv
Phoenix Glass Co..... —
Pittsburgh Sheet Metal Tool Co..... xiv
Pond Engineering Co..... xxi
Powell Co., Wm..... —
Queen & Co..... xv
Roeblings' Sons Co., Jno. A.... xix
Sawyer-Man Electric Co..... xii
Schieren & Co., Chas. A..... xiv
Schmiedbarenguss Furnace Co..xvi
Schoverling, A xxii
Schuyler Electric Co.....xxiii
Shultz Belting Co..... i
Southern Electrical Supply Co. xxi
Sperry Electric Co..... xviii
Standard Electrical Works... xv
Standard Paint Co.....xiv
Standard Underground Cable Co. i
Standard Carbon Co..... xx
Stanley & Hall.....xiv
Star Electrix Co..... ix
Stephenson & Co., Jno..... xxii
Stiff, E. D. & Co..... —
Stiles, W. A..... xv
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xvi
Taussig, S..... xvi
Taylor Mfg. Co..... xxiii
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxiv
Triumph Compound Engine Co xxiii
Turner Brass Works..... xv
Union Hardware Co.....xiv
United Electric Traction Co....xxiii
United States Electric Lighting Co..... xiii
Van Nuis C. S..... i
Wanted.....xv
Western Electric Co.....xviii
Westinghouse Electric and Mfg. Co. xiii
Weston Electrical Instrument Co..... xiv
Wollensak, J. F..... iv
Woodbridge & Turner..... xv

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co

Aluminum.
Cowles Electric Smelting & Refining Co.
Schmiedbarenguss Furnace Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
McLaughlin, Jas.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bubier Publishing Co.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanché Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S..
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.

Belting—continued.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
McLaughlin, Jas.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Merchandise Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, C. H. & Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Electrical Supply Co.
Electrical Merchandise Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Ide & Son, A. L
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phoenix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Continued.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Elektron Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Brown, Frank F.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Great Western Electric Supply Co
Holmes C. H. & Co.
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes C. H. & Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Queen & Co.

Springs.
Gibson Co., W. D.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.
Writing Telegraph Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

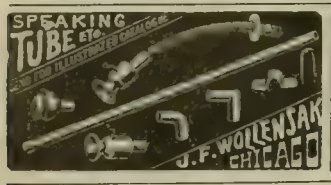
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Electric Merchandise Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

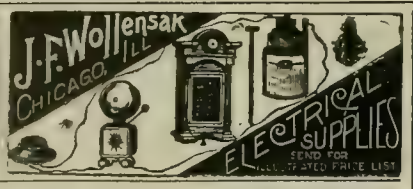
THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.





Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

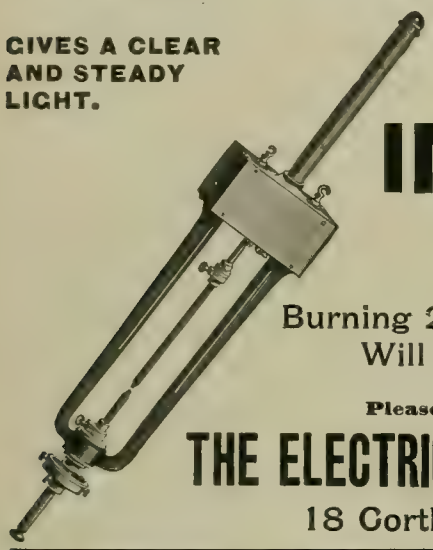
THE WM. D. GIBSON CO.,

NO. 63 NORTH JEFFERSON STREET,

MANUFACTURERS OF SPRINGS.

Springs for Electrical Machinery a Specialty.
Trolley Springs for Electrical Railroads Made to Order.
Also Car Seat Springs.

GIVES A CLEAR AND STEADY LIGHT.



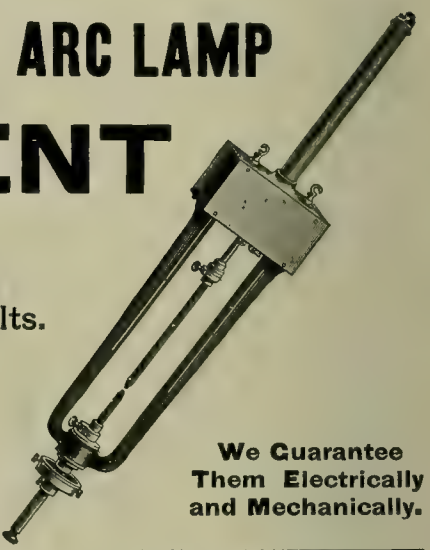
THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.



We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

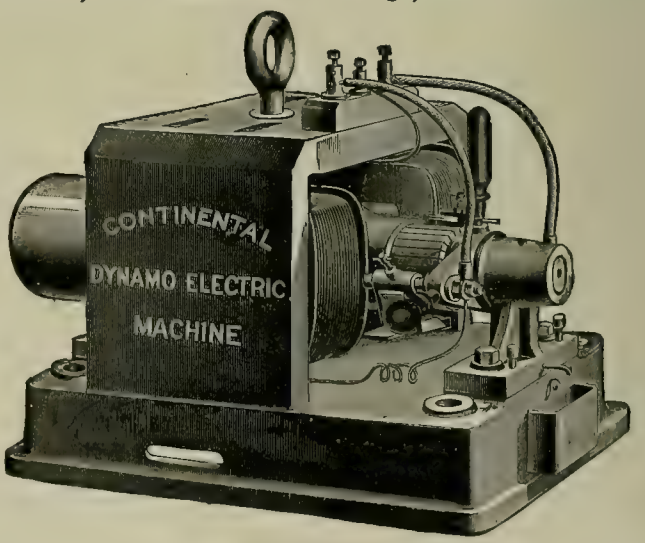
87 and 89 South Fifth Avenue, - - NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 63 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, journals running in oil,** therefore wastes no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192
FIFTH AVE.,
CHICAGO.

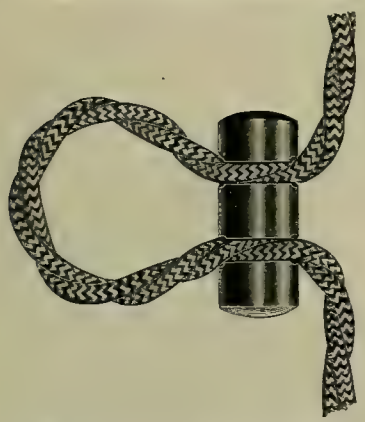
Makers of the Choicest Electrical Supplies.

ELECTRIC SHADES

IN LARGE VARIETY.

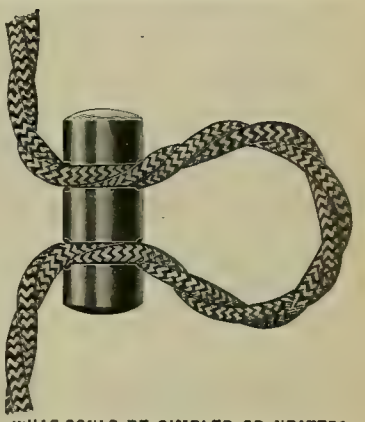
OPAL SHADES,
ETCHED SHADES,
OPALESCENT SHADES,
COLORED SHADES,
AND
CUTTER'S COMBINATION TIN SHADES.

FINE LINE OF
ELECTRIC AND COMBINATION
FIXTURES
—TO SUIT—
ALL ARTISTIC TASTES.



IMPROVED LAMP-CORD ADJUSTER.

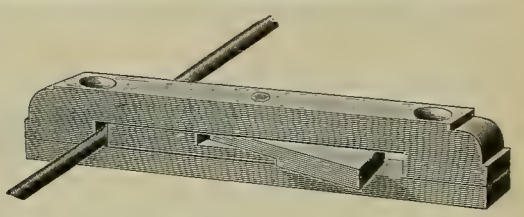
WE HAVE THE MOST RELIABLE
SAFETY DEVICES,
MAIN CUT-OUTS,
BRANCH CUT-OUTS,
WOOD ROSETTES,
HORSESHOE CUT-OUTS,
PORCELAIN ROSETTES,
FUSIBLE PLUGS.
—TRY US ON—
TESTED FUSE WIRE.



WHAT COULD BE SIMPLER OR NEATER?

The Wire that gives
The Highest Line Insulation,
SIMPLEX
The Wire that Pays Best
In the Long Run.
Why not use the Best?
We sell it entirely on its merits.

INSULATORS
Of All Patterns and Sizes in Quantity.
TAPE,
FIBRE,
HARD RUBBER.
GOOD FIGURES ON INSULATORS.



SELF-BINDING CLEAT.

You draw the Wires Taut,
This keeps them so.

DO YOUR CEILINGS BLACKEN?
WHY DON'T YOU USE THE ONLY PRACTICAL CURE:
Cutter's E. L. Insulator,
It keeps your ceilings clean, looks well, and gives high insulation.

INCANDESCENT
LAMP CORD,
—ALL SIZES—
COTTON OR SILK.
SOCKET BUSHINGS
—AND—
RUBBER TUBING.

ALL OF OUR
Specialties
WEAR WELL.
A SINGLE TRIAL WILL PROVE IT TO YOU.

For the Choicest Goods at the Lowest Prices, Remember Our Address.

IMMENSE STOCK!!
BOTTOM PRICES!!

Electrical Supplies

OF ALL KINDS.

NORTHWEST
THOMSON-HOUSTON
ELECTRIC CO.,

403 & 405 SIBLEY ST., · ST. PAUL.

OUR POLICY:

First Class Goods, Small Margins and Quick Delivery.

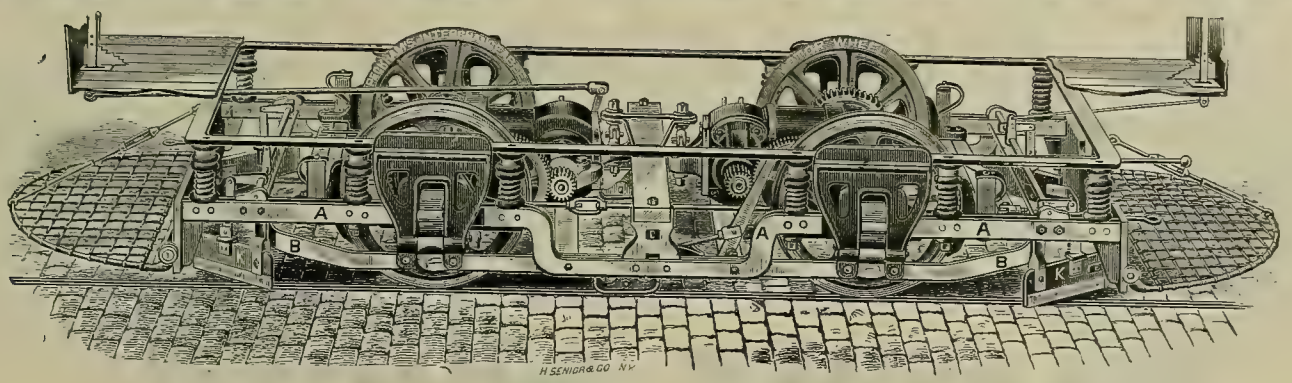
LARGE STOCK OF

Grimshaw White Core,
Holmes, Booth & Hayden's "K. K."
Underwriters' Line Wire & Magnet Wires.

FULL LINE OF PORCELAIN GOODS.

"ELECTRIC BLOCK", 403 & 405 SIBLEY STREET, ST. PAUL, MINN.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

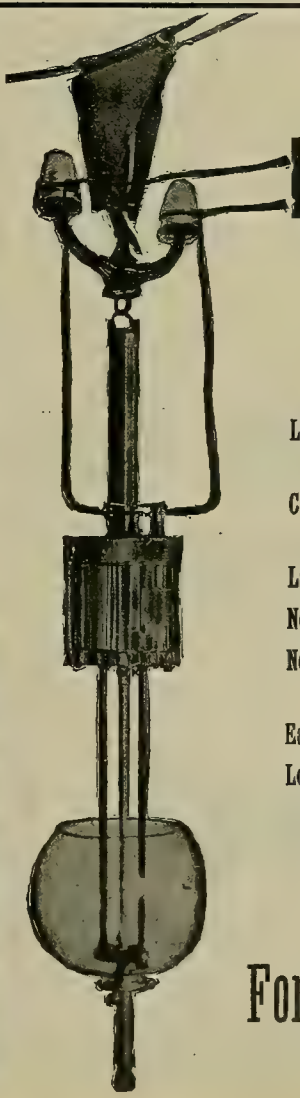
WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.



THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.

EDISON PATENTED APPARATUS.

For Sale to all Parties in U. S.

Except for use in certain localities already exclusively licensed, list of which will be furnished upon application.

SAMPLE PRICES.

GENERATOR.	MOTOR.	RATING.	PRICE TO PURCHASER.
5 light,	*¼ H. P.*	*.250 Kilowatts.*	*$37.84*
10 light,	*½ H. P.*	*.500 "*	*$58.76*
20 light,	*1 H. P.*	*1. "*	*$106.83*
45 light,	*2½ H. P.*	*2.5 "*	*$177.02*
90 light.	*5 H. P.*	*5. "*	*$278.77*

ARTICLES.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.	ARTICLE.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.
Standard Keyless Socket,	*1*	*$0.297*	*Porcelain Ceiling Cut-out,*	*397*	*$0.3575*
Standard Key Socket,	*2*	*$0 627*	*Porcelain Double Pole 10-light Switch,*	*511*	*$1.2925*
Standard Keyless Receptacle on Porcelain Base,	*3*	*$0.275*	*Pendulum Ampere Meter up to 200 Amperes,*	*377*	*$12.10*
Attaching Plug,	*V 69*	*$0.1925*	*Standard Pressure Indicator,*		*$41.25*
Two-Wire Branch Cut-out,	*1935*	*$0.44*	*Ground Detector,*	*152*	*$4.125*
Safety Plugs for Cut-outs, 1 to 30 Lights,	*181*	*$0.0715*			

16 C. P. LAMPS {in lots of 25} 44 CENTS EACH.

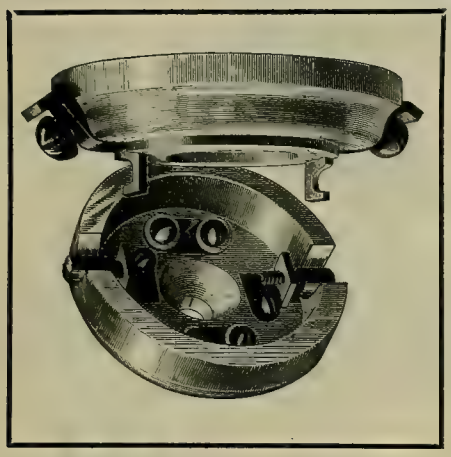
Write to nearest district office, or any Electrical Supply House, or Electrical Engineering Concern.

EDISON GENERAL ELECTRIC COMPANY.

MAIN DISTRICT OFFICES:

Canadian District, Bank of Commerce Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 38 Pearl Street, Boston, Mass.
Rocky Mountain District, Masonic Building, Denver, Colo.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Southern District, Cotton Exchange Bldg., New Orleans, La.

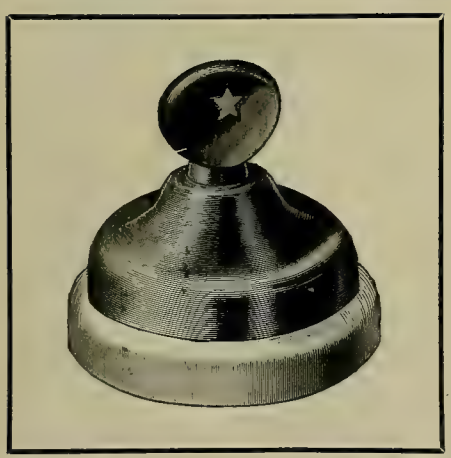
ELECTRIX!



This week we add to our line of Specialties a ceiling cut-out. The "ELECTRIX" ceiling cut-out is pronounced by all who have used it, to be the best thing of its class up to date.

ARTISTICALLY DESIGNED,
EASILY WIRED,
SATISFACTORY IN OPERATION.

The Wiremen like them. Architects specify "ELECTRIX" for fine work. Dealers say they sell like hot cakes.
Send for Samples.



"ELECTRIX" Switches need no further introduction; they are now on sale by dealers from the Atlantic to the Pacific.

Correspondence Invited.

THE STAR ELECTRIX COMPANY,

1320 Wallace St., PHILADELPHIA, PA.

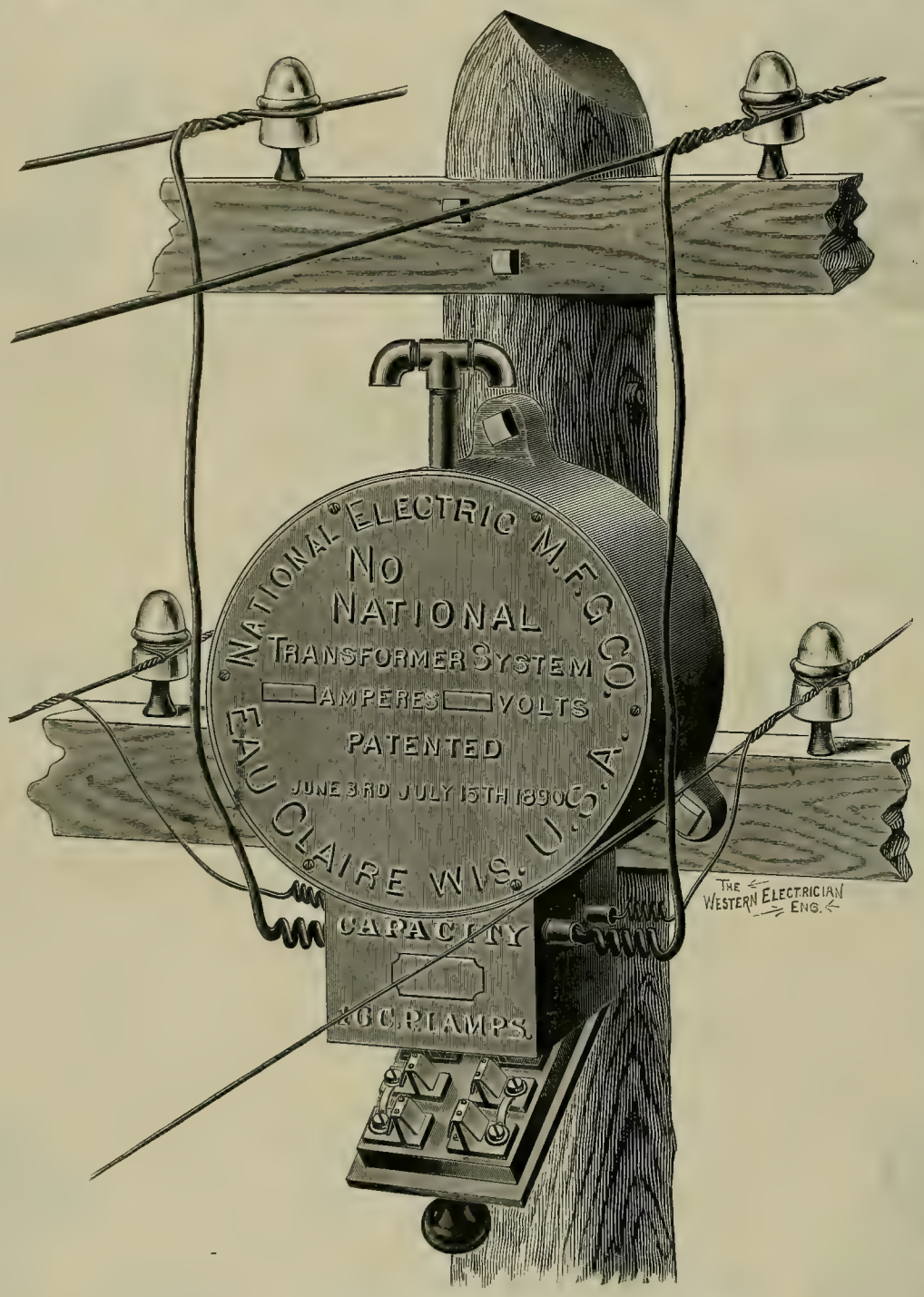
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



Transformer on Pole Showing National Safety Fuse Box.

No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., - - - - - - Seattle, Washington.	W. N. GRAY, Special Agt., - - Room 12, Chamber of Commerce, Cincinnati, O
THOMAS WOLFE, Southwestern Agt. - - Union Depot Hotel, Kansas City. Mo.	NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Bldg, 50 Broadway, N. Y. City.
LITTLE, McDONALD & CO., Gen'l Agts., - - 141 East Seneca St., Buffalo, N. Y.	NATIONAL ELECTRIC DEVELOPMENT CO., History Bldg., 723 Market St., San Francisco, Cal.
METCALF, REED & CO, Western Agts., - - - 1517 Larimer St., Denver, Colo.	SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Agts., - Winnipeg, Manitoba.
CHAS. M. BLANCHARD, Agt., - - - - Girard Building, Philadelphia, Pa	A. IRVINE, Agt., - - - - - - - Emilie Building, St. Louis, Mo.
L. N. COX, Agt., - - - - - - - 16 Fifth St., S. E., Washington, D. C.	

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

"Like Hot Cakes"

IS THE WAY IN WHICH OUR LAMPS ARE SELLING.

The Lamps, however, do not get HOT
When put in Circuit.
They give a soft, white light for
The term of their natural lives.
They fit any Socket;—
Any Candle Power,—
Any Voltage.

TRADE A.B.C. MARK

ALEXANDER, BARNEY & CHAPIN.

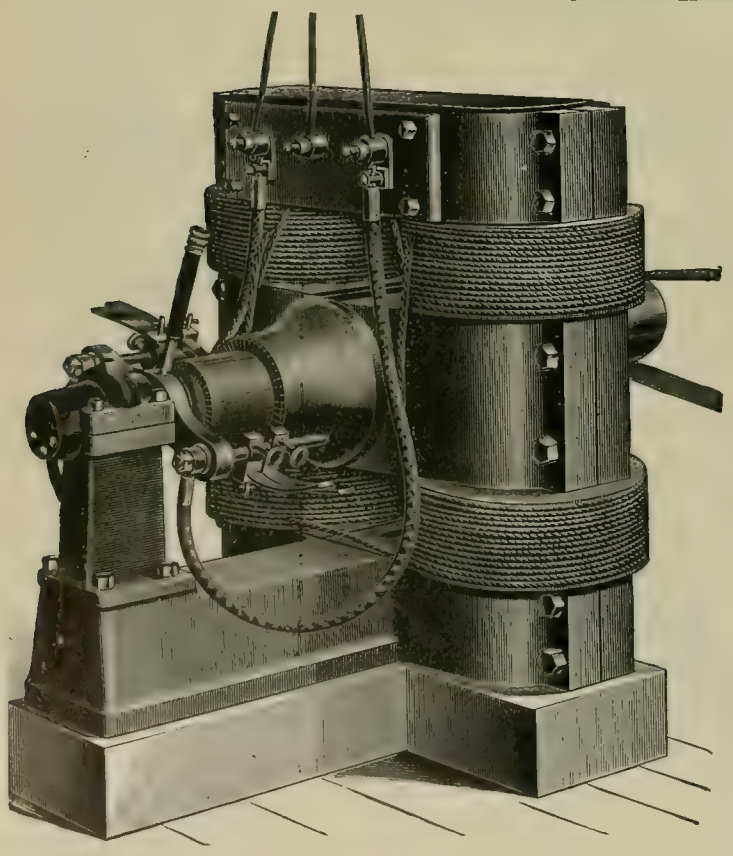
GENERAL ELECTRICAL SUPPLIES,

TELEPHONE BUILDING,
20 Cortlandt Street,

NEW YORK.

FOREE BAIN,

ELECTRICAL EXPERT AND MANUFACTURER.



I have more Electric Motors in Practical Operation in Coal Mines than all other manufacturers combined. They aggregate over

350 H. P. to Date.

These installations are not experimental—the Motors are in actual service cutting coal; some of them have been working

20 Hours Per Day

for more than one year, and during this time not one of them has required repairing.

NO SHORT CIRCUITS.
NO BURN-OUTS.

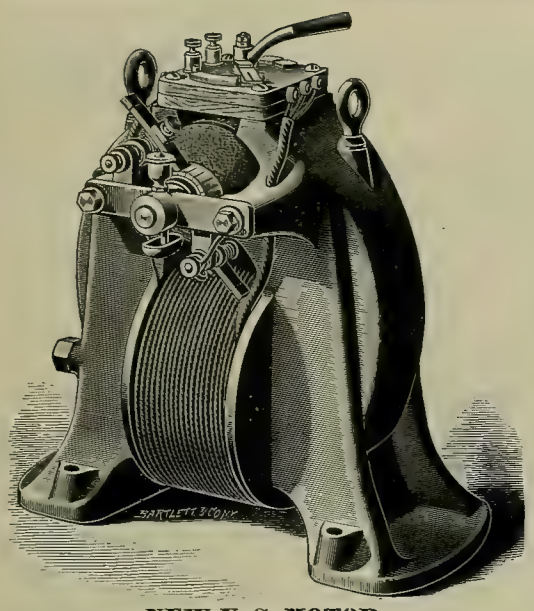
I have secured patents on a full and complete system of Mining by Electricity. Contracts solicited.

84 Market St., - CHICAGO.

THE UNITED STATES ELECTRIC LIGHTING Co.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos. — Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

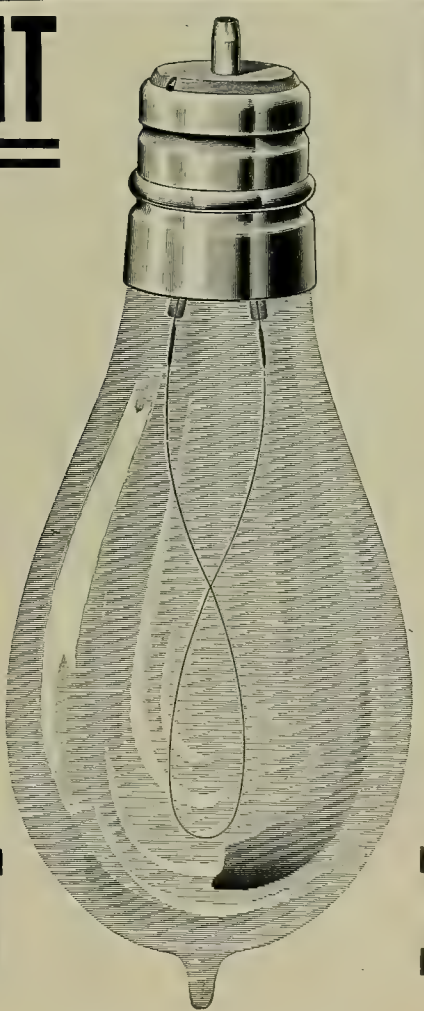
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.

INCANDESCENT LAMPS.



To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS

General Electrical Supplies of Superior Designs and Finish.

THE CHEAPEST.

Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, **NEW YORK.**

620 Atlantic Avenue, **BOSTON, MASS.**

217 La Salle Street, **CHICAGO, ILL.**

INCANDESCENT and ARC LIGHTING and MOTORS.
Isolated Lighting a Specialty.
H. H. HUMPHREY,
1034 New York Life Building.
Contracting and Consulting Electrical Engineer. OMAHA, NEB.

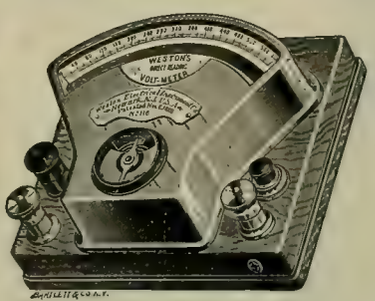
Pittsburgh Sheet Metal Tool Co.,
H. H. HIPWELL, Prop.
Mfrs. of Electric Specialties of Every Variety,
TOOLS, DIES, Etc.
202, 204 & 206 Robinson St., - - Allegheny, Pa.

THE E. S. CREELEY & CO.,
GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.
ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.
Illustrated Circular of Lamps and Lamp Novelties upon Application.
MINIATURE INCANDESCENT LAMPS.

PATENT PERFORATED ELECTRIC LEATHER BELTING
Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,
PATENTEES AND SOLE MANUFACTURERS,
Also New York, Boston, Philadelphia.
46 SOUTH CANAL ST., CHICAGO. ILL.

DUST-PROOF BELLS.
None Genuine Without the Washer.
STANLEY & HALL,
(Formerly HAZAZER & STANLEY,)
32 and 34 Frankfort St.,
NEW YORK.

THE WESTON STANDARD
Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.
Send for Illustrated Catalogue.
ADDRESS
WESTON ELECTRICAL INSTRUMENT CO.,
114 & 116 William Street, Newark, N. J.

THE THING for Electric Railways. **"CANVAS JACKET"** FEEDER WIRES.
INDESTRUCTIBLE PATENT WOVEN INSULATION.

POLES. POLES.
ELECTRIC LIGHT SUPPLIES ELECTRIC RAILWAY.
Send for descriptive circulars.

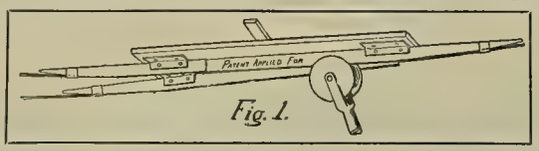


Fig. 1.

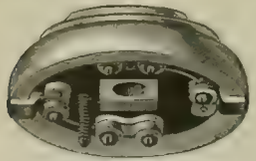
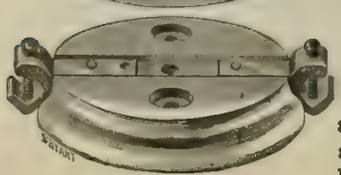
MURRAY OVERHEAD **TROLLEY SWITCH.**
CUSTOMERS REPORT:
"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."
THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE **INTERIOR CONDUIT & INSULATION CO.**
ARE ESPECIALLY APPLICABLE TO
ELECTRIC RAILWAY REQUIREMENTS.
A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.
INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.
UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.
For Catalogue, Price List and General Information, Address
INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.
Edw. H. Johnson, President.

—THE—
UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.
Charles Munson Belting Co
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. **CHICAGO.** SAN FRANCISCO. NEW ORLEANS.
28, 30, 32, 34 & 36. S. CANAL ST.
Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

PAISTE PORCELAIN PENDANT CUT-OUT ROSETTE.


Patented.
DOUBLE POLED.
CAP EASILY DETACHED.
ARTISTICALLY DESIGNED.
A contact of 10 amp. is guaranteed between cap contact arms and binding strips on base block.
H. T. PAISTE, 12th and Market Sts., Philadelphia, Pa.
Kept in Stock and for Sale by all Prominent Supply Houses.

GET THE BEST!
P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY
The Standard Paint Co.,
NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, DECEMBER 6, 1890. No. 23

Assembling Room, Western Electric Company's Factory, Chicago.

The accompanying cut gives a view of the assembling room of the Western Electric company's Chicago factory. It is located on the first floor of the south wing and is 90 by 210 feet. It is well lighted and admirably adapted to the requirements of this department. Adjoining it is a store room, in which the several parts of the dynamos as they are turned out of the factory are placed until required in the assembling room. By this arrangement the floor is not encumbered and more space can be utilized than if the parts of the dynamos were sent to this room direct from the factory. In addition to this advantage there is not so much danger of injury to the parts as if they were stored in the assembling room.

The room is fitted with the most approved testing apparatus. Ten dynamos of different sizes can be tested at the same time, putting each under full load or varying load as the case may require during the progress of the test. This gives the company a capacity of turning out machines for 100 arc and 1,000 incandescent lights per day. In this room is a transmission dynamometer to determine the commercial efficiency of the different machines. There is also special apparatus for testing the insulation resistance of the field magnets and armature windings. There is a complete system of overhead rails, with hoists and trolleys for handling the dynamos and their several parts while in the course of erection.

Chicago Telephone Company.

Several changes in the executive staff of the Chicago Telephone company were announced last week. A new office was created, that of general superintendent, and Charles H. Wilson was appointed to the position. Mr. Wilson has been superintendent of the company for some time and has proved a zealous and efficient official. He is recognized in telephone circles as a capable and energetic telephone man in the management of his department. In his new position Mr. Wilson will have a better opportunity to exercise his executive ability. W. E. Bell has assumed his position as superintendent of the A. D. T. service and W. W. Nichols has been appointed superintendent of the telephone service. Mr. Nichols formerly had charge of the electrical department of the C., B. & Q. railroad.

ASSEMBLING ROOM, WESTERN ELECTRIC COMPANY'S FACTORY, CHICAGO.

Telephone Work in Europe.

M. G. Kellogg, whose name is one of the most prominent in the list of telephone inventors, has recently returned to Chicago after a prolonged stay abroad. He has had an opportunity to see much of the telephone work which has been done on the other side of the Atlantic. Speaking of his observations, Mr. Kellogg said to a representative of the WESTERN ELECTRICIAN: "I find that in the telephone exchanges in most of the large cities in Europe, the multiple switch-board system is used as invented and devised in Chicago. The apparatus was sold and put up by American engineers. Among the cities which have the multiple switch-board are London, Liverpool, Manchester, Glasgow, Berlin, Brussels, Antwerp, Copenhagen, Geneva. In Paris the multiple system has not yet been introduced and the service is very poor. It sometimes takes ten or fifteen minutes to get a connection. The government took over the telephone business about a year and a half ago, and is planning to consolidate the branch exchanges in a building to be erected in the central part of the city. The multiple system will probably be used in the new office.

"The telephone lines in Paris," continued Mr. Kellogg, "are all metallic circuits, in cables placed in the sewers, and talking, when connection is finally got, is excellent.

"With the exception of Paris most of the telephone lines are overhead, although in many places they are placing some of the lines underground. The overhead construction is superior to what we have in America. It is not so ugly and for that reason not so objectionable. The poles and fixtures are of iron and are well designed and constructed.

"In some places in Europe the number of telephone subscribers in proportion to the population far exceeds the ratio in America. This is due to the low rates charged by the government, which own the telephone plants. In some places the business is said to be run at a considerable loss.

"In Berlin there are now about 14,000 subscribers, and the rate of increase is about 300 subscribers per month."

Manufacturing Incandescent Lamps.

The price of incandescent lamps has been reduced of late and, as a matter of course, manufacturers will now give closer attention to perfecting processes and devising methods through which the producers' profits may not be lessened. As a consequence it may be expected that the electrical inventive genius will not be idle. The illustration shows one of the latest attempts to improve upon one of the processes now employed in the lamp factory. As to its practicability the reader is left to judge for himself.

In order to create a vacuum in an incandescent lamp it is the usual practice to apply the suction apparatus at an opening at the top of

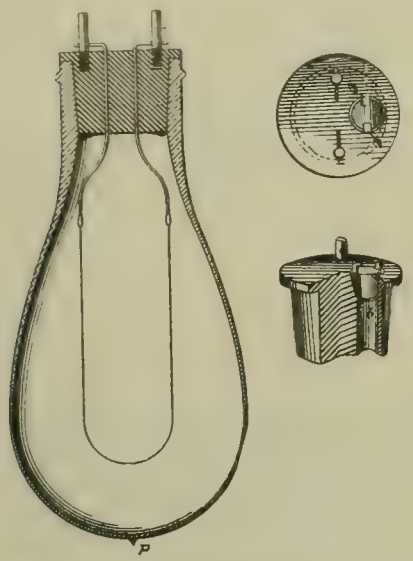


FIG. 1. MANUFACTURING INCANDESCENT LAMPS.

the lamp, as for instance at *P* in Fig. 1. This opening afterward has to be closed by sealing the glass, a more or less expensive operation.

In the present process which is the invention of A. Bornholdt of Brooklyn, N. Y., a lamp and apparatus of the form shown in the illustrations are used, and the air is removed through the butt of the lamp. To make clear the working of the process it will be necessary to explain the construction of the lamp: Referring first to Fig. 1 it will be seen that the lamp-butt is closed by means of a stopper. This stopper which is shown removed and in detail in the figure, is provided with a secondary stopper or

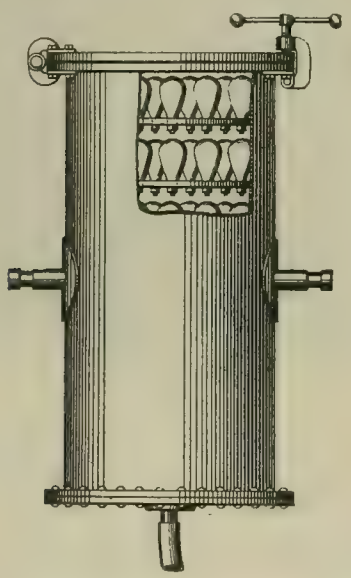


FIG. 2. MANUFACTURING INCANDESCENT LAMPS.

valve *b*. The relative positions of the lamp terminals and the valve are represented in the plan view of the stopper, Fig. 1. The advantage claimed for this construction will be understood. To exhaust a large number of lamps they are placed in a specially designed vessel, Fig. 2. This vessel or, more properly speaking, vacuum cylinder is so fitted with bearings at the sides that it may be readily inverted.

After the stoppered lamps have been arranged as shown on racks in the vessel and the air has been withdrawn, the cylinder with its contents is turned upside down so as to bring the butts uppermost. This action causes the gravity-stopper or valve of each lamp to drop to its seat and thus seal each lamp. Air is now admitted to the vacuum cylinder and the atmospheric pressure keeps the valve firmly in place. By this process, it is claimed, a vacuum to the desired extent may be obtained within each lamp.

Power House at Eau Claire, Wis., Destroyed by Fire.

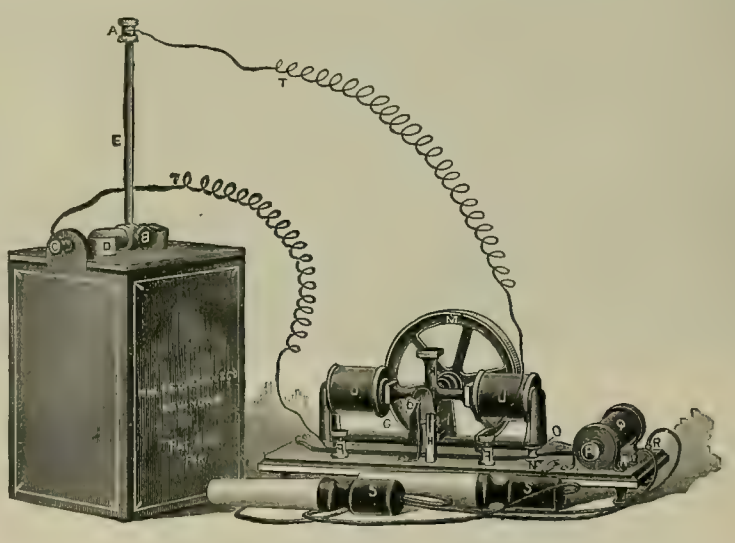
About 10 o'clock on the afternoon of December 1st, a fire was discovered in the dynamo room of the Eau Claire Street Railway, Light & Power company, and before the engines could arrive from the city, about one and one-half miles away, the building was completely gutted. The origin of the fire is a mystery. The company suffers the loss of one 1,000-light National alternator, one Fort Wayne 800-light alternator, one 80-horse power Edison railway generator, and two 60-light 2,000-candle power Brush arc machines.

Superintendent Russell has already made arrangements with the National Electric Manufacturing company to supply current for the alternating lines. This necessitated running a feeder about 4,000 feet from the National company's factory. The work was accomplished in four hours, and one alternator was started immediately.

Toy Motor and Coil Electrical Outfit.

The accompanying illustration would seem to bear evidence of the fact that the E. S. Greeley & Co., of New York, is not neglecting the entertainment of the little folks and amateurs in the Christmas season.

The cut in question represents a combination of battery, motor and medical coil. The battery is built under the Nowotny patents, and consists of a square shell of carbon, which forms one element of the battery and at the same time is the containing vessel for the fluid. Treatment of the carbon on the outside of the shell prevents all leakage. The zinc element is in the form of two fingers. These fingers are carried on a central shaft, as in the Grenet battery. All that is necessary to be done to put the battery in action is to lower the zinc. To



TOY MOTOR AND COIL ELECTRICAL OUTFIT.

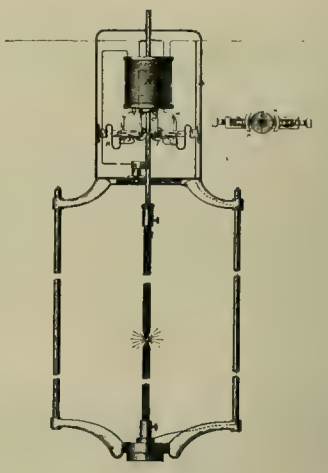
throw the battery out of action the zincs are raised and fastened in position by means of a small screw provided for that purpose.

The peculiar feature of the device is that the commutator of the motor acts as the circuit breaker for the medical coil, so that no vibrator whatever is required upon the coil. The coil may be either kept in action or thrown out as desired. In other words the outfit is supplied either with the motor alone or with the motor and coil combined.

It is claimed that the battery has the capacity to run the motor and coil for a period of about twelve hours at a single charging. The active solution employed is bichromate of potash, and is readily procurable at all electrical establishments and druggists.

Enholm Arc Lamp.

The arc lamp illustrated in the cut was designed by O. A. Enholm of New York. The features of the lamp will be understood after an inspection of the cut. In the figure *B* is a



ENHOLM ARC LAMP.

solenoid wound with the usual main coil and shunt coil. Attached to and suspended beneath this solenoid are spring hangers *D*, on the lower end of which are hung the inner ends of the flexibly supported brackets *E*. These brackets carry as shown the two gripping regulator-rollers *F*. These rollers are grooved and are arranged opposite each other on either side of the upper carbon-holder and are adapted to rotate as the upper carbon holder is fed downward. Just beneath the rollers *F* are the small brake-rollers *K*. These latter rollers are normally in contact with the rollers *F*, and are adapted to press against them as the upper carbon is fed downward and consumed. The rollers *K* are supported in the carriages *L*, which are attached to the inner-ends of the spring-pieces *H* independently of the brackets *E*. The carriages *L* are prolonged upward and their extensions *M* are bent inward and toward the lower terminus of the core *C*, as shown in the sectional view at the right of the lamp. These prolongations *M* which are provided at their inner and upper ends with semicircular soft-iron bars or armatures *N*, are normally excited by the proximity of the solenoid, and through this medium serve to hold the braking-rollers against the regulator-rollers. The main circuit

is shown by the heavy lines and the shunt-circuit by the light lines.

The operation of the lamp is described by the inventor substantially as follows: The arc is automatically formed when the upper carbon is resting on the lower carbon. The passage of the electric current through the main circuit causes the excitation of the solenoid *B*, and by this means draws upward the core *C*. The armatures *N*, becoming excited, move toward the core *C*, and will, through the intermediate mechanism, apply the braking-rollers *K* to the nipping-rollers *F*. The latter will then be forced against the upper-carbon holder *G*, and as the core *C* moves upward it will draw the holder *G* and upper carbon *R* with it, thus creating the arc. While the lamp is burning any abnormal increase in the length of the arc will cause an increase in the current in the shunt-circuit. This action permits the armature-core to drop, together with the upper-carbon holder and the regulating-rollers. The armature-core being now no longer excited, the soft-iron armatures *N* will become demagnetized and will fall away from the armature core, thus releasing the brake-rollers *K* from contact with the regulator-rollers *F*. When the upper carbon has reached the desired position the regulating and brake rollers will assume their normal place.

Electric Car Heater.

The heating of cars by electricity is a subject of great interest to every street car man. The ordinary street car heater is an abomination; it is exceedingly inefficient as far as increasing the temperature is concerned, but most effective in emitting noxious gas. In the cuts is shown an electric car heater just introduced by C. B. Hanna, general agent of the Carpenter-Nevens system of electric street car heating. The illustrations tell the whole story to those who have perused the descriptions in the WESTERN ELECTRICIAN of the heating apparatus manufactured by the company.

The heater consists of three wires of high resistance attached to a backing of asbestos. These wires are crimped, as the cut shows, as in the other apparatus for heating made by the company. The asbestos is inclosed in sheet iron, about 3 inches in width and about ¼ inch in thickness, which is intended to extend from one end of the car to the other, under the seats, on both sides, midway between the seat and the car flooring, and protected from the person or clothing of the passenger by a wire screen. It is inclosed on all sides except the face in a copper reflector in order that the heat may be radiated in the proper direction. A second strip of iron of the same dimensions is attached to the first strip by a single row of small bolts, extending from end to end, thus serving the purpose of a compressing plate and, at the same time forming the other side of the heater.

Fig. 1 shows the general arrangement of the heater in a car. Fig. 2 gives a plan of the device. As the cut shows, the arrangement of the circuits is such that one, two or three of the wires can be switched on in accordance with the demand for heat in the car. The switches are located on the platform, and the motorneer is charged with the work of regulating the heat.

The use of the heater, it is claimed, will be economical. When current is turned into the resistances, they will absorb at first 8½ or 9 amperes, but for a few minutes only. As the wires begin to heat the quantity of current

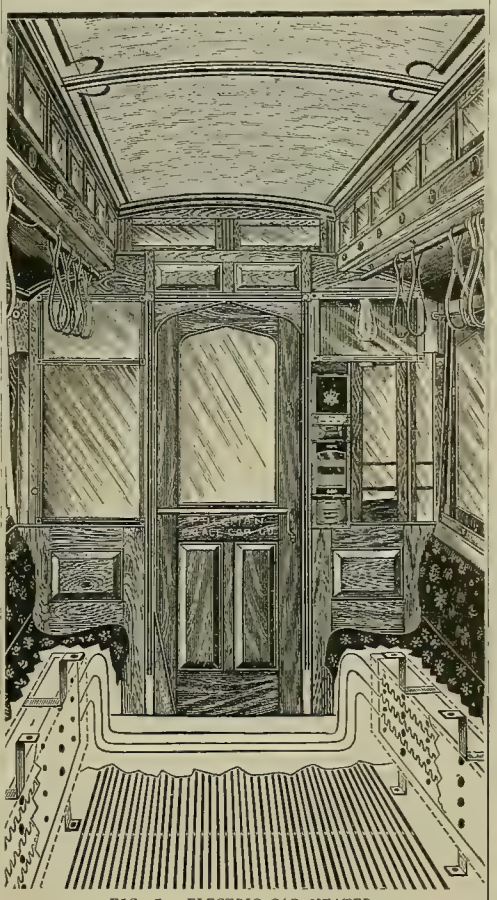


FIG. 1. ELECTRIC CAR HEATER.

absorbed decreases until it reaches about 1½ amperes. The consumption of current will then remain constant at this point. This calculation is based on the assumption that the standard potential of 500 volts is used on the line.

Overhead Wires for Hyde Park, Chicago.

An injunction was granted by Judge Horton last week in the case of the Hyde Park District Telegraph & Electric company against the city of Chicago prohibiting the latter from interfering with the company in erecting poles and stringing wires. In February, 1889, the trustees of Hyde Park granted a franchise to complainant to erect poles and lay wires in any street and alley in Hyde Park on the condition that it secured consent from a majority of property-owners abutting along such route. When the village became annexed to Chicago the telegraph company asked the commissioners of public works for authority to erect new poles, and this was denied, as the city ordinance requires all wires to be located underground. The company, however, insists that it has a right to string wires on new poles under the ordinance passed by the village trustees. In a few days the city will move to dissolve the injunction.

Municipal Control of Electric Plants.

An effort will soon be made by the city of Chicago to secure the passage of an enabling act by the legislature providing for the establishment of electric light plants for commercial work. The city council has authorized the appointment of a committee composed of the mayor, comptroller, chairmen of the judiciary and finance committees of the council and one representative citizen whose name has not yet been announced. This committee will consider several suggestions made in the recent communication of the mayor relative to public works and local improvements. One of the most important measures under consideration is the question of municipal electric light plants. Mayor Cregier has advocated the establishment of commercial plants since his election to office. At present, the city has no authority to engage in commercial lighting, and this power can only be conferred by the state legislature. For this reason the committee has been selected to take the necessary steps to secure the passage of the act by the legislature.

City Electrician Barrett has placed himself upon record as opposed to any scheme that will interfere with franchises now held by local companies. The fact that these companies have gone into the business, invested large sums of money in the establishment of their plants and the development of their systems, should insure for them recognition of their rights. "If the city should decide to engage in commercial lighting," said Prof. Barrett, "it should in justice to these local companies buy the franchises and plants now in their possession. Otherwise, the city should allow the companies to continue without opposition until the expiration of the terms of their franchises. These men have invested their money in good faith and common decency demands that their rights be respected."

When the legislature is petitioned to grant the city the power to engage in commercial lighting the interests of the local companies will undoubtedly be represented by the Illinois State Electric Light association. It will be remembered that this organization was formed under the auspices of the National Electric Light association to protect the members from unjust legislation. Several attempts had been made throughout the country to pass bills opposed to the interests of electric companies and the national association deemed it expedient to organize state associations to look after this work and protect the interests of the members. This is the first time the Illinois association has been called upon to take action, but it will undoubtedly prove equal to the occasion. Among

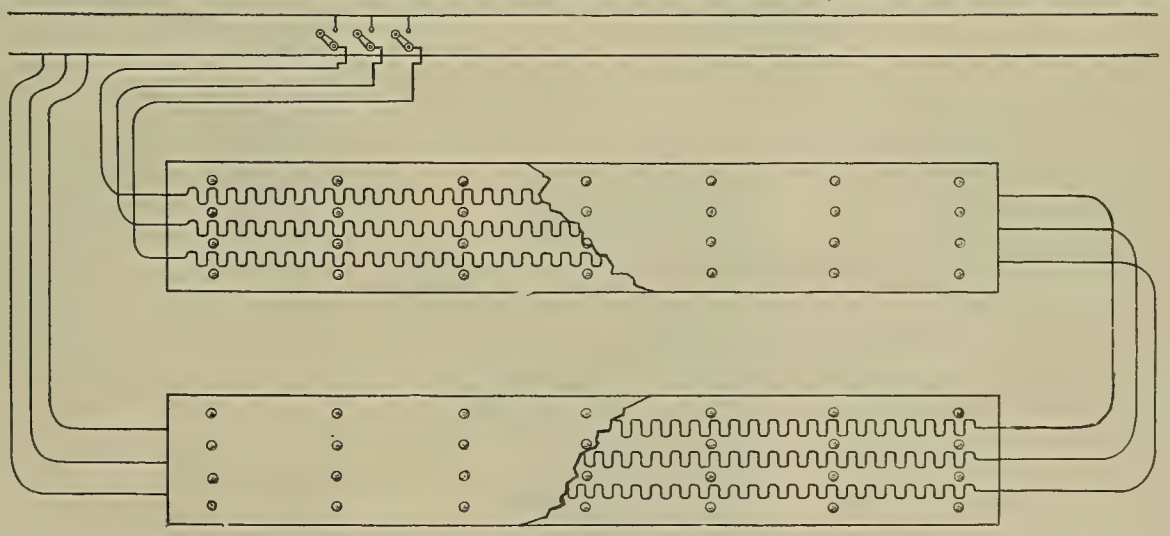
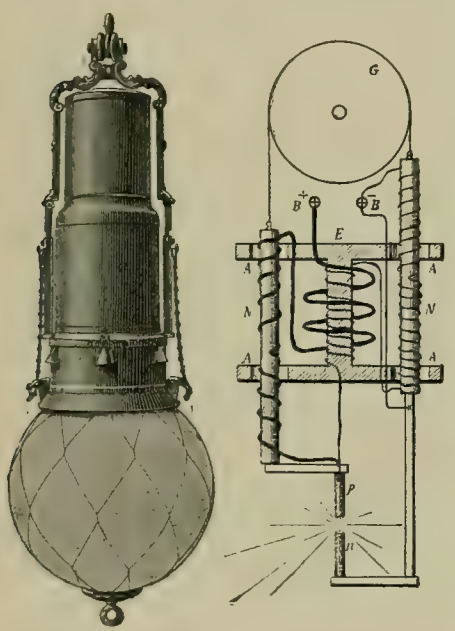


FIG. 2. ELECTRIC CAR HEATER.

those directly interested in the proposed legislation are C. H. Wilmerding, superintendent of the Chicago Arc Light & Power company; Charles E. Gregory, who is interested in the Sperry Electric company of Chicago and also manager of the Drexel Electric Light & Power company of Chicago; Charles I. Page of Englewood. Mr. Wilmerding is president of the state association, Mr. Gregory is secretary and treasurer, and Mr. Page is a member of the executive committee. It will, therefore, be seen that there is every reason to expect that a vigorous defense of the rights of the local companies will be made.

Pieper Arc Lamp.

The Pieper lamp, illustrated in the cuts, belongs to the class in which differential regulation is employed. The mechanism is simple, and the action of the coils is directly upon the carbon-carrier without the intervention of gear wheels or springs. Most regulators of this character have a series coil and a shunt coil; the predominance of the action of the one over the other effects the regulation. It will be noticed that the Pieper lamp is supported by a frame, which is continuous, except at the point where the carbons are placed. The carbon holders are extensions of the tubes attached to a common cord running over a pulley. An



PIEPER ARC LAMP.

electro-magnet *E*, which is located in the center, is so constructed that the poles are extended laterally on each side embracing the two tubes at the points *A*. The winding of the electro-magnet is differential. Within the tube is an iron filling designed to close the magnetic circuit of the electro-magnet. The core of the lower carbon-holder is wrapped with fine wire in series with that of the main electro-magnet. Both windings are, however, in shunt to the carbons. The core of the upper carbon-holder is wound with heavy wire in series with the carbons and the large wire on the electro-magnet. The two tubes, when the lamp is not in operation, are in equilibrium. It should be stated also that the suspending mechanism is extremely sensitive.

When the circuit is opened through the lamp the carbons remain separate for an instant, but as the fine wire is operative, the lower carbon carrier is raised, and the carbons come immediately into contact. At this moment the main current is established. This action stops the difference of potential, which gave rise to the circuit in the shunt. It follows then that only the series coil operates and raises the upper carbon holder. At the same time, therefore, there is created a difference of potential which causes a flow of current in the shunt coil. From this it will be seen that as the coils are wound in opposite directions on the electro-magnet they tend to neutralize each other, and feeding of the carbons is effected by the predominance of the one over the other.

Magnetic Cut-Out.

The cut-out shown in the illustration comprises an electro-magnet wound with wire, included in or taken as a shunt from the circuit to be controlled, the external wires being secured by the binding screws. These screws are arranged on conducting pieces, one being electrically connected with the conducting piece carrying the mercury cup on the right, and the other being similarly connected through the coil of

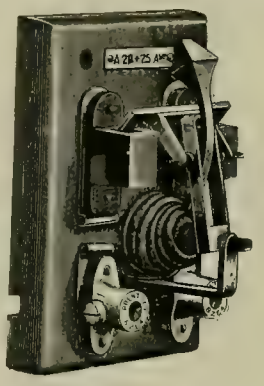


FIG. 1. MAGNETIC CUT OUT.

the magnet with the conducting piece carrying the second mercury cup. Into these cups dip the ends of the horizontal bridge piece, which is provided with arms carrying the armature. These arms are connected by a cross piece extending behind the vertical lever, which has a counterbalance weight at its upper end, and a tail piece constituting a kicker. The screw shown in front of the armature makes it possible to adjust the position of the latter relatively to the end of the magnet core. The parts are mounted upon a base of enameled slate. When the normal current is passing, the armature, bridge, arms and lever remain as shown in Fig. 1; but on the current increasing abnormally, the electro-magnet attracts the armature and the cross piece moves the vertical lever so that its weighted head causes it to fall over in such a manner that its tail end kicks the bridge and knocks it over into the position shown in Fig 2, thus removing the contacts out of the mercury cups, and breaking the circuit.

Government Telegraph System.

Postmaster-General Wanamaker presented his annual report last week. In the course of his review of the affairs of the postal department, he refers to the project of establishing government telegraph service in connection with the postal work. He says:

"The swiftest mail is not fast enough in these days for all the needs of commerce and social correspondence. The conviction steadily grows upon me that the postoffice should do more than employ fast mails and stage coaches and that the electric wires should carry letters; that the people who pay in postage rates the cost of the postal system have a right to use the postal plants as a means of reducing the cost of the telegraphic correspondence and for the instant transmission of postal money-orders. We strain every muscle and nerve trying to gain an hour or two on this collection or that delivery. We worry the railroads with importunities for new trains or faster ones that shall save perhaps three or four hours. All the while the quickest service, by which electric letters might be transmitted and whole days or whole nights be gained or saved, is kept out of the reach of the country's postal service. The postal service has proved itself able to manage successfully the telegraph business in connection with the postal system and as a part of it. In one form or another the public imperatively demands cheaper telegraphy, and the postoffice department can supply it at less cost than any corporation, unless the latter has rent, light and fuel free and carriers and clerks without pay. The postal service is the government's kind hand, protecting and promoting the correspondence of its people, and communication by telegraph as well as by mail is essential to its best development. The plan proposed for a postal telegraph is familiar to the public. There would be no outlay of money, no appointment of clerks and no financial liability. The persistent misstatement of the facts at the outset led to some misunderstandings on the part of a small portion of the public. The actual plan is surely entitled to a just statement and a fair consideration. If there is a better one it will be quickly discovered and adopted."

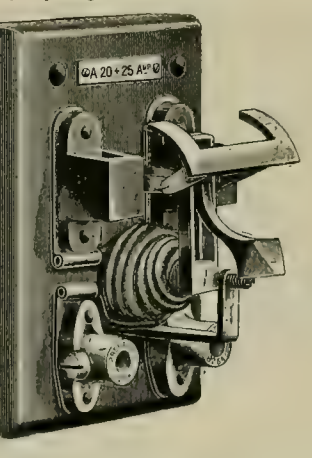


FIG. 2. MAGNETIC CUT-OUT.

The National Electric Manufacturing Company's Transformer.

The general design of the transformers of the National Electric Manufacturing company of Eau Claire, Wis., and the method of hanging them to the pole, are illustrated in the cut. A feature of this converter, and one that will undoubtedly commend itself to linemen, is the fuse-box which forms a part of the outfit. A glance at the illustration will make an explanation almost unnecessary. The four fuses are carried as shown by lugs screwed to the hinged bottom or lid of the converter. The act of

NATIONAL TRANSFORMER.

closing the lid inserts each lug between two contacts and brings the fuses into circuit. While attaching the fusible strips there is practically no chance of a shock or accident from a melting fuse. The current can only pass through the strips when the lid is closed.

Underground Electrical Work.

To the Editor of the WESTERN ELECTRICIAN:

In the last issue of your valued journal there appeared an alleged criticism of my paper recently read before the Chicago Electric Club. Inasmuch as I stated at the time I read the paper that I confined my statements to the advancement of the work in the United States, I fail to see where the array of figures presented by Mr. Webb concerning other countries has aught to do with the matter.

His assumption of what the Chicago Electric Club requires in the way of information, is simply impertinence.

Further, for the information of Mr. Webb, I desire to say that the Chicago Electric Club does not tolerate nor permit the reading of any papers that savor in the least of advertising, or even partisanship.

If this Mr. Webb has had any experience outside of his own barnyard, he will have no difficulty in recognizing the "ordinary galvanometer" I referred to, as the "Wheatstone Bridge sets," composed of a resistance box, etc., with most of which you can rarely get results beyond a megohm.

Referring to my ability to skip about in handling my subject, I would respectfully submit that "Herbert" is something of a Grasshopper" himself, as a casual perusal of his cleverly concealed self advertisement will perhaps best testify.

Take his article all in all, and robbed of its spleen and the magnanimous admission that Coulomb had a hand in the early efforts at insulation, I see nothing but a clever attempt to foist upon the reading public an advertisement of a specially stated kind of insulation for cables, which rightfully belongs in the columns set aside for advertising.

purposes, and I must decline to pay further attention to any such apparent scheme in connection with my name.

The telephone companies have in force to-day, and have had for a long time, a set of specifications that exact certain conditions that are met in every particular.

I have no desire to "talk shop" in this connection, but if Mr. Webb wants any information as to the ability of telephone cable makers to meet his views, let him consult the advertising columns and do a little correspondence with the manufacturers of that line of goods.

Very truly yours,
F. E DEGENHARDT.

Chicago, Nov. 28, 1890.

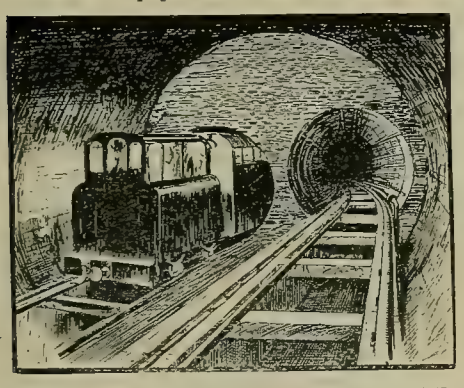
City and South London Railway.

In the last issue of the WESTERN ELECTRICIAN appeared a somewhat extended description of the underground electric railway in London. The accompanying cuts, showing the route of the road, the appearance of the trains, the interior of the coaches, and the tunnels

CITY & SOUTH LONDON RAILWAY, LONDON, ENGLAND.—INTERIOR OF COACHES.

form an interesting addition to that article. The illustrations are reproduced from English illustrated weeklies. The fact has been mentioned that the elevators leading to the underground stations are operated by hydraulic power. That electricity was not used for the purpose has caused some criticism. A contemporary says: "It appears to us that the use of hydraulic power in this way shows a want of enterprise. We should have preferred to see electricity used for this purpose. Nothing could be better adapted for working lifts than motors, and the saving in expense would have been considerable. Unless the elevators are balanced, there is a plunger volume of high pressure water wasted every time each hoist is used, whereas if motors were employed, the generators would need supply little more than the power wasted in general friction."

The same paper criticises the use of air



CITY & SOUTH LONDON RAILWAY, LONDON, ENGLAND.

brakes on the trains in the following terms: "We have already suggested that the use of an air brake when electric power is available is somewhat unnecessarily timid. It might be urged that the block system arrangements, and the cut off of the supply from a moving train in case of necessity, are objections to its use. If this is the objection, it could be easily overcome. The special leads which supply the carriage lamps might have supplied the motive power for the brakes. It seems unnecessary to adopt at one and the same time hydraulic distribution, compressed air, and electric traction."

Several applications for franchises for establishing and operating electric light, power and street railroad plants in San Francisco have lately been under consideration of the Board of Supervisors.

Amendments to the Constitution and By-Laws of the Chicago Electric Club.

At the last meeting of the Chicago Electric club, held on the evening of December 1, the following amendments to the constitution and by-laws of the club were passed:

Changing Article III., Section 1, to read as follows: Resident members shall pay an entrance fee of $50 and annual dues of $40.

Article III., Section 2 - Non resident members shall pay annual dues of $20.

Article III, Section 3—Non-resident members becoming resident members, must pay the entrance fee.

Article III., Section 4—The financial year of the club shall commence on the first day of April of each year.

Article IV., Section 2—The president or one of the vice-presidents shall preside at all meetings of the club; in their absence a temporary presiding officer may be elected.

Article IV., Section 6—At all meetings of the Board of Managers the chairman shall preside; in his absence a temporary presiding officer may be elected.

Article IV., Section 6—To be numbered Section 7.

Article VII., Section 1—Resident members only are entitled to vote at any regular or special meeting of the club, and they must vote in person.

Article VII., Section 2—No member who is in arrears for dues shall be entitled tovote at any meeting or election

Litigation Over Fire Alarm Patents.

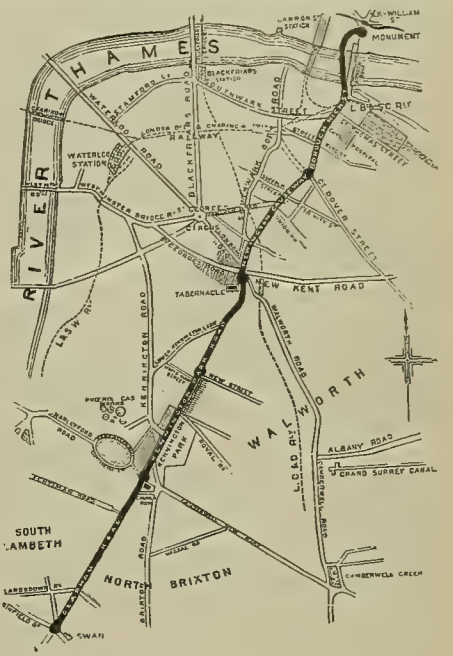
A suit was commenced last week in the United States court for the Northern District of Illinois, by the Gamewell Fire Alarm company against the city of Aurora. The Inter-State Fire Alarm company, the owners of the Ruddick patents, has introduced in Aurora and other cities what is claimed to be an improved electrical non-interfering fire alarm system, but which the Gamewell company alleges is an infringement of the Stoner patents owned by the latter corporation. Judge Gresham or Judge Blodgett will hear this case at an early day and whatever the result an appeal will undoubtedly be taken to the United States Supreme court. Butterworth, Hall, Brown & Smith have been retained for the defense and the suit will undoubtedly resolve itself into a prolonged contest between the two fire alarm companies to determine the priority of the invention and other claims which are understood to be involved.

Electric Railway at Hammond, Ind.

The Hammond, East Chicago & Whiting Railway company has been formed with a capital stock of $100,000 by Theodore M. Foote, Charles Huntoon and Frank Weeks. This company, which is composed of Hammond and Chicago capitalists, is about to build an electric line connecting the towns in the Calumet basin. From the Hammond council it has secured the exclusive right to build and operate a line on the following streets: Indiana street, from the east limits of Hammond to Hohman street; Hohman street the entire distance from the south to the north limits of Hammond, Ives street west from Hohman street to the state line, Gostlin street east from Hohman street, and Root street west from Hohman street to the city limits. The company proposes to build a line to East Chicago, another line to Hegewisch, and a main line north to Whiting and South Chicago. Some time ago this company was granted a charter by the council, but with restrictions which were not warranted. The new charter is satisfactory and work on the main part of the line will begin at once. It will be completed within one year.

The Use of the Telephone.

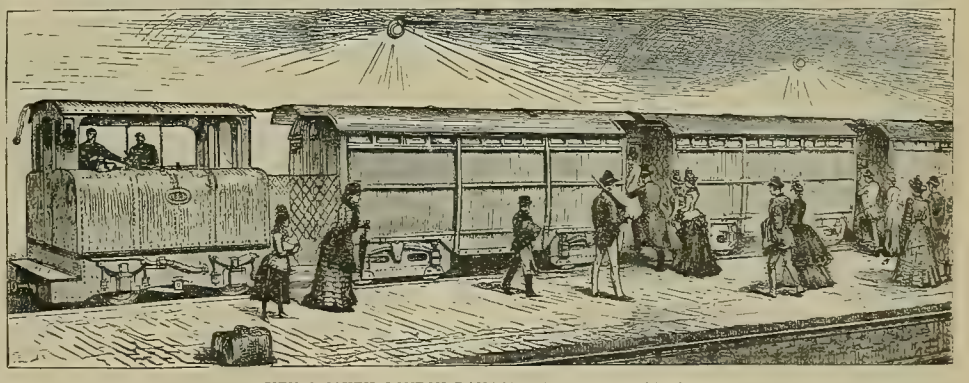
J. J. Carty, electrician of the Metropolitan Telephone & Telegraph company, delivered an interesting lecture on telephony in New York, November 25th, before an audience composed of members of the Young Men's Christian association and their friends. The lecture was illustrated by very clear and instructive diagrams showing sections of the human throat and mouth at one side and the various delicate and intricate parts of the ear on the other. The lecturer showed the simplest method of transmitting sound to a distance, viz., by means of the ordinary speaking tube in which the voice is conducted by a column of air protected from external disturbance by the containing tube. The next step in the transmission of the voice was



CITY & SOUTH LONDON RAILWAY, LONDON, ENGLAND.—MAP OF ROUTE.

made by the substitution of a better conductor of sound than air, such as a tightly stretched cord or string attached at each end to a diaphragm. This idea was indicated by a drawing of the "lover's telegraph," in which the vibrations produced by the voice are taken up by the diaphragm at the speaking end, producing mechanical disturbances in the string and thereby affecting the diaphragm at the further end, throwing the air into vibration and reproducing the sounds of the voice.

The great step in telephony was of course the invention of the electric telephone in which the sound waves are transformed into electrical waves transmitted to a distance by means of wires and re-transformed into sound waves at the receiving end. Mr. Carty explained very lucidly the construction of the Bell telephone and the Blake transmitter, illustrating his description by means of diagrams. In doing this he asserted it was necessary that every one using the telephone should have some knowledge of the working of the instrument and the action that goes on in the line. He said that with the other applications of electricity with which the public is daily brought in contact, this necessity does not exist. To use the telephone properly every man has to become in a certain sense a telephone operator. He should know when to ring his bell and when to leave it alone; how near to approach the transmitter and how to modulate his voice. A general knowledge of the construction of the apparatus will enable him to use it far more intelligently and with better results.



CITY & SOUTH LONDON RAILWAY, LONDON, ENGLAND.

The city council of Davenport, Ia., after wrangling for ten days over the electric lighting bids that had been submitted, decided to reject all bids and readvertise for bids to light the city by ten arc lights of 2,000-candle power and 300 incandescents of 32-candle power. Bids are to be made for three, five and seven years as the bidder sees fit. Bids are to be opened Dec. 5. All bids must be filed with the city clerk by noon of that day, and must be accompanied by a certified check for $500.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Assembling Room Western Electric Company's Factory, Chicago Illustrated 303
Chicago Telephone Company 303
Telephone Work in Europe 303
Manufacturing Incandescent Lamps. Illustrated 304
Power House at Eau Claire, Wis., Destroyed by Fire 304
Enholm Arc Lamp. Illustrated 304, 305
Electric Car Heater. Illustrated 305
Overhead Wires for Hyde Park, Chicago 305
Municipal Control of Plants 305, 306
Pieper Arc Lamp. Illustrated 306
Magnetic Cut-out. Illustrated 306
Government Telegraph System. Illustrated 306
National Electric Manufacturing Company's Transformer. Illustrated 306
Underground Electrical Work (Communication from F. E. Degenhardt) 306, 307
City & South London Railway. Illustrated 307
Amendments to the Constitution and By-laws of the Chicago Electric Club 307
Litigation over Fire Alarm Patents 307
Electric Railway at Hammond, Ind 307
The Use of the Telephone 307
Editorial 308
Electricity in Mines and the Proposed Mining and Electrical Display at the World's Fair. By E. F. Browne. Illustrated. (Chicago Electric Club) 309, 310
Paris Telephone System 310
A New Method of Analyzing Armature Reactions of Alternators. By Charles Steinmetz (American Institute of Electrical Engineers) 310, 311
Overhead Wires in New Orleans 311
Schoop Storage Batteries with Gelatinous Electrolyte 311

DEPARTMENTS.

Correspondence 311, 312, 313
The Electric Light 313
The Electric Motor 313
Electrical Patents 314

A BRIEF interview with M. G. Kellogg referring to telephone work in Europe appears elsewhere in this issue.

IT was expected that another experiment with electricity as a means of inflicting the death penalty would be made this week in New York state. Appeals have been taken which will cause at least a brief postponement of the execution. The arrangements which have thus far been made at Sing Sing prison are referred to in the New York letter.

PITTSBURG will soon be the scene of another legal struggle between the telephone people and an electric railway company. It is the same old story. The telephone company claims that as its franchises antedate those of the electric roads, the latter have no right to string wires which are the means of interference with the telephone service. The suit, which has just been instituted, is for $15,000. This, however, is only a beginning, as it is stated that new suits are to be entered as soon as this is settled.

POSTMASTER-GENERAL WANAMAKER succeeded in inducing President Harrison to insert an indorsement of the limited postal telegraph scheme in the latter's annual message. The president has this to say: "The use of the telegraph by the postoffice department as a means for the rapid transmission of written communications is, I believe, upon proper terms quite desirable. The government does not own or operate the railroads and it should not, I think, own or operate the telegraph lines. It does, however, seem to be quite practicable for the government to contract with the telegraph companies, as it does with the railroad companies, to carry at specified rates such communications as the senders may designate for this method of transmission. I recommend that such legislation be enacted as will enable the postoffice department fairly to test by experiment the advantages of such a use of the telegraph."

AN interesting story is reported from Ottawa in connection with the expedition for discovering a suitable route for the new cable across the Pacific, between Australia and British Columbia. The commander of the British cruiser, Egeria, which is detailed for this work, has evidently devoted much time to territorial acquisitions, as the dispatches announce that he is "hoisting the British flag on all the islands in the Pacific that are not under the protection of any foreign power." There are thousands of important islands in the path selected by the commander of the British cruiser, and it may be necessary for that officer to send home for a special consignment of flags. In the meantime and while awaiting their arrival, those interested in telegraphy will be anxious to learn something of the progress of the work in which he is ostensibly engaged—exploring the bottom of the Pacific for the purpose of finding a suitable bed for the new cable.

AT the last meeting of the Chicago Electric club E. F. Browne presented a paper on electricity in mining and on the electrical and mining exhibits at the World's Fair. The paper appears elsewhere in this issue. After speaking of the importance of electric signaling devices in mines, the author takes up the disadvantages necessarily connected with the use of steam underground. These are many and serious, and it is not surprising that miners are so generally interested in the applications of electricity to their work. Mr. Browne alludes to the use of electric motors for hoisting and pumping. The inventor of a successful sinking pump operated by electricity, says the author of the paper, has a fortune within his grasp. He speaks of the difficulties which lie in the way of a solution of the problem, and it must be said that they do not appear to be insurmountable. Summing up the roles which electricity is to play in a mine he says: "Electricity should drill the hole, fire the shot, supply the light and air, keep dry the mine, hoist the rock, crush it up and place it in the furnace and perhaps melt it." Mr. Browne then describes a World's Fair mining display, which he proposes to locate 500 feet below the ground. His project, in brief, is at that depth to have a large number of drifts, representing all the principal mines in the country. At the same place he proposes to locate a general electrical exhibit as well as special displays of apparatus illustrating the application of electricity to mining work.

No little interest, both here and abroad, has been taken in Lieut. Bradley W. Fiske's paper on "The Civilian Electrican in Modern Warfare," of which an abstract appeared in a recent number of the WESTERN ELECTRICIAN. His recommendation that corps be formed in seaport towns to take charge of all electrical work relating to the army and navy, seems to be generally indorsed. It seems to be the almost unanimous opinion, that governments are behind the times in their failure to appreciate the importance of the applications of electricity to the art of war; and in their neglect to organize trained bodies of men thoroughly competent to execute all work of an electrical character. The London *Electrical Review's* leader in a recent issue, is devoted to a consideration of the paper to which it gives its unqualified indorsement. It believes England should take the same steps that Lieut. Fiske recommends to the United States. It says: "We heartily commend Lieut. Fiske's paper to the perusal of our naval and military authorities. From it they will learn to what extent others are preparing for the dire emergency of war—a war which, when it does come, will be one in which science, and especially electrical science, will play the most important part. When war comes, no matter what our preparation may be, it will still find plenty wanting. Let our preparations be ever so great, let us feel that we are even prepared, and there will yet be far more to do than can be done at the time."

THOSE who enjoy the discussion of socialistic principles will be gratified to learn that the outlook for a very interesting squabble in the next legislature of the state of Illinois is unusually good. It appears that the city administration of Chicago has determined to act upon the mayor's suggestion and endeavor to force through the legislature a bill empowering the city to enter into competition with local electric light companies. The mayor has been advocating this measure throughout his entire term and now a bill is being prepared which, if adopted by the legislature, threatens to ruin the business of the local electric lighting companies. City Electrician Barrett has declared himself squarely in opposition to any project that would bring the city into competition with companies operating under franchises. In an interview presented elsewhere in this issue Prof. Barrett points out the injustice of such a course. It is to be hoped that the pernicious idea of paternalism, nationalism, or whatever else this fad may be termed, shall not pervade the legislature at Springfield. At any rate the electric light companies of Chicago should see to it that nothing is left undone to defeat this measure. If such a bill should pass the Illinois legislature it would work no end of mischief throughout the country. It behooves the Illinois State Electric Light association to move in this matter at once. One of the objects for which this organization was formed was to guard the electric lighting companies against legislation prejudicial to their interests. In this case the association will receive the support of the electrical fraternity of the country.

THE application of the telephone in the New York City hospital, where the wards by this means are put into communication with the reception room so that patients suffering from infectious maladies may safely communicate with their visitors, is suggestive. When the telephone was first brought out there were prophecies without number as to what would be the future development of telephone communication. We all remember how we were to listen to sermons, concerts, etc.; how we were to have them on tap,—turn a key or switch, and listen; that was all. Up to the present time, however, the telephone in many localities has never proceeded beyond the business district, and it is needless to say there are few sermons or concerts enjoyed through the instrument. The reason for this is well known. A telephone is a luxury. When the instruments are placed on the market at lower figures we may look for their use under a greater variety of circumstances. In this connection a thought of the phonograph brings to mind that this wonderful mechanism might also be put in service in hospital work. Place, for instance, a number of phonographs, or even one phonograph, in a ward, and with a large and constantly renewed supply of cylinders, what a source of amusement and pleasure the instrument would become! Let our philanthropic and charitably disposed citizens think of this suggestion We do not desire to advertise an already much advertised invention. We merely suggest that which, it appears, might be a most praiseworthy application.

Electricity in Mines and the Proposed Mining and Electrical Display at the World's Fair.[1]

By E. F. Browne.

Until a few years ago the use of electricity in mining was unknown, but its rapid progress is easily accounted for when the subject is investigated.

There is no doubt that the United States stands pre-

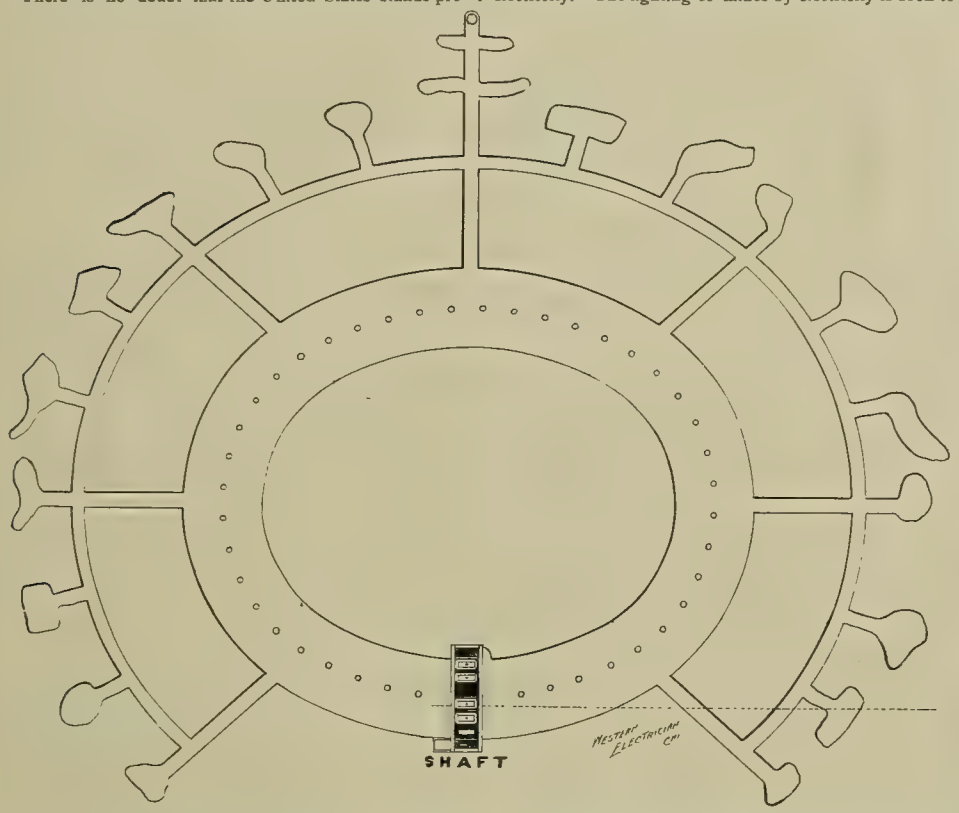


FIG. 3 MINING AND ELECTRICAL DISPLAY AT THE WORLD'S FAIR—PROPOSED ARRANGEMENT OF CORRIDOR AND DRIFTS.

eminently at the head of all nations in scientific mining, in that to-day it furnishes not only the most expert miners but the finest mining appliances and machinery in the world. Right here in Chicago is located a firm that furnishes mining machinery to China, Japan, Central and South America, Africa and Australia in addition to this continent. In fact, the whole world pays tribute to its skill.

The American is recognized as a man who is composed of that kind of stuff that does not allow any obstacle to prevent his attaining the end in view. Our proficiency in mining has been acquired within the past forty years. The miner of the present day has not yet become fossilized or wedded to his gods, but is willing to try every new and live invention that appears, throwing away that which is valueless and fostering that which is useful.

Thus when electricity was introduced and presented to the miners by you electricians in various forms to be tested, the new agent was met in a friendly, progressive spirit and the results of the past few years have been astounding.

Electrical science has been of short duration. No graduates in electrical science have as yet grown old, they have as yet the fire and ambition of youth or sturdy manhood to push them on to conquest and to wealth. This is the reason that the two sciences of mining and electricity are so closely allied. They are both young, vigorous and offer just that field of action that is compatible with the driving, pushing character of the American of to-day.

The use of the telephone was adopted by the miners at once. Most mines are to a certain extent in difficult positions on precipitous mountains. That instrument enabled the manager to be in close communication with his mine at all hours, both day and night. When difficult ground or heavy flows of water were encountered, arrangements could be made to control the situation at once, without the loss of hours in communicating the necessity.

The electric bell and annunciator now tell the story of what is wanted and what is going on below in deep shafts or inclines.

The touch of a button tells the top men and engineers if ore or waste, tools or men are coming up and what level they are coming from. Another signal tells if timber, wedges, tools or the foreman is required below.

Formerly when a bell rope from 500 to 1,000 feet in length was used it was so heavily counterweighted or held by such a counter spring that it took an able-bodied man with a six-foot run to sound the gong above. Wants were only known by tickets attached to the bucket or skip, or after the toilsome climbing of messengers to the surface.

Now the tool "nippers" and the "powder monkey" are the only traveling men in the ground below. The remainder of the shift stays at the level until relieved.

When you take into consideration the fact that the human voice can not be heard over one hundred feet under ground, and that the last mine I managed had over two miles of underground work, you can see the benefits of electric communication.

The battery for firing shots is another great assistance, especially when "rounds" of holes are fired, as they can be controlled and fired together while by any other means there would certainly be a perceptible period of time between shots.

The foregoing are the lighter uses of electricity that probably all novices in the use of that force fully understand; but there are later developments that have opened up a greater and wider field of operations for the uses of electricity. The lighting of mines by electricity is soon to revolutionize the system of lights in all kinds of mines.

The smoky lamp of the coal miner destroys as much oxygen as fifteen men, while the flame of the candle of the silver miner uses as much air as eight men. The electric light does not consume the air at all, but leaves it entirely for the use of the workmen. It is gradually gaining ground in this field. You electrical engineers and inventors should see that some better form of insulation is made for this purpose, as most mines are damp, and the present wiring is expensive, so much so that the candle is still a far cheaper luminant.

The field that is now the most inviting to the student of electricity is the design of a practical "sinking" pump for deep mining, the pump which follows up the workman and keeps the flow of water down to such a point that miners can go on with sinking deep shafts. I must acknowledge that I as yet have not seen one that would answer the purpose.

Pumps that have their plungers attached to the motor or any of the pumps that are geared in the ordinary way to a motor, and that can lift a column of water over five hundred feet are too bulky for anything but work at the station. Unless they are geared with cogs instead of belts or rope, I would not advise their use.

The use of steam on a sinking pump is accompanied with several vexations and inconveniences that I would call your attention to:

First. Although expansion joints are used, the expansion of a steam pipe a thousand feet in length is a continual source of annoyance, either from creeping or weakening of joints, which leads to leaks.

Second. The heat is so great in the pump room and sump, no matter if you exhaust in the sump or a condenser, that it is a nuisance.

Third. If the mine had been planned for circulation by ejectors, the heat at times from the pumps reverses the circulation, leaving dead ends to drifts.

It should be borne in mind that a rotary pump will not do this work because the depths from which water must be pumped are such that quick forcing is not the thing, but continual and persistent lifting of the water is necessary. While the rotary will throw a stream with great force, the mine lifting pump that overcomes a pressure of from 200 to 400 pounds per square inch of water, with a setback that has to be checked by specially constructed valves, is a radically different machine. It must be something that pushes the water up the column, and a very solid column at that. The Virginius mine in Southern Colorado this week will try a station pump attached to a 50-horse power motor, and I hope it will do the work. The man who makes a sinking pump to run by electricity able to lift a column of water five hundred feet, the pump and motor attached not to weigh over one ton, will have a fortune in his grasp, because it will drive the steam pump out of deep mines altogether.

In the matter of drills I may say that while the coal-cutting appliances now turned out by the electric companies, and the prospecting or diamond drills are nearly perfect, I think you should increase the blow on the percussion drills, as they do not come up to the air drills as yet in execution while working on rock.

The first extensive use of electricity in hoisting rock was at Aspen, Col., where my home is located, and I suppose that up to the present time our electric plant is the most economical in the world, considering the great power developed, and while the hoists are good and do their work, there is something yet to be done in that line.

If it is possible to make such a slow speed motor that some of the gearing may be dispensed with, it would be a safer and more satisfactory machine. As it is now, the hoists are not of a kind that passengers should ride upon, because if one of the numerous cogs would strip an accident might occur, while the use of a belt in a hoist involves three more chances of accident on a hoist than should be possible, viz.: Breaking of belt, slipping off of pulley, and slipping on pulley through becoming too loose. I call your attention to these things particularly, because it is just such bodies of men as I see before me now that should correct them. I have such confidence in the inventive genius of Americans that I know that when they are told what is necessary their fertile brains will think out the remedy. It is better plainly to know what is required and then build up to the requirements.

When the electric system is used the convenience with which a power hoist can be placed at any point under ground and the ease with which the power can be transmitted are too well known to need any emphasis. Most great mining camps are located on rapidly running streams with plenty of head for water pressure. The economical use of water in conjunction with the Pelton wheels, and the ease with which the dynamos can be operated by that means, are all features that make the uses of electricity in mining attractive.

I examined this fall and reported on a mine owned by one of your most distinguished citizens. It is so located that when the uses of electricity in mines are perfected the whole plant could be run by that agency. While the mine

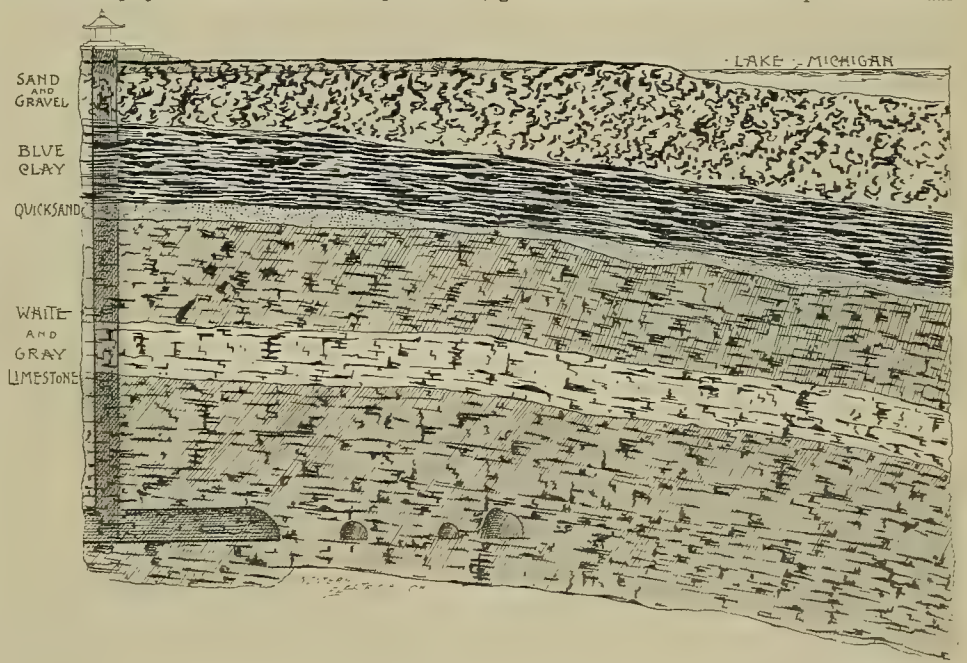


FIG. 2. MINING AND ELECTRICAL DISPLAY AT THE WORLD'S FAIR—STRATA TO BE FOUND IN SINKING A SHAFT 500 FEET DEEP ON THE LAKE FRONT.

[1] Read before the Chicago Electric Club, Dec. 1, 1890.

is located on a precipice in eternal snow, in the gorge of a tumbling, turbulent stream runs onward toward the west with head enough and water enough to generate 2,000 horse power if it were needed. While standing at the mine and looking over the grand scene I thought how bountifully nature had provided; how the gently falling snow, would be stored up, while it would be reserved for the sun to loosen the moisture, gradually starting on its way a rivulet which becomes first a stream, then a roaring torrent that by the ingenuity of man can be controlled, its forces bridled and the power thus secured carried to and into the mountains to explore their very centers.

Electricity should drill the hole, fire the shot, supply the light and air, keep dry the mine, hoist the rock, crush it up and place it in the furnace, perhaps melt it, who knows?

Gentlemen, in the foregoing remarks I have tried to show you how closely allied are the mining and electric interests; how the progress of one is hailed with delight by the other. I have a subject to present to you in which I think these two interests should unite and together make a display at the World's Fair that would be the wonder of the world.

I have arranged to make a mining display at the World's

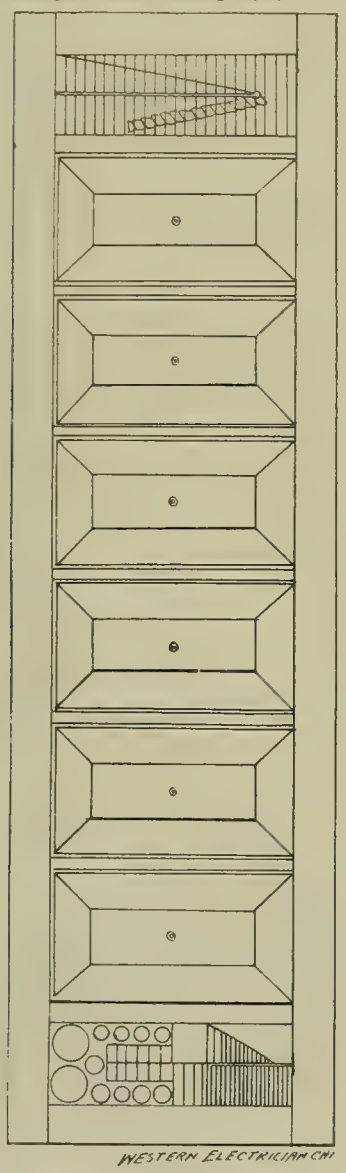


FIG. 1. MINING AND ELECTRICAL EXHIBIT AT THE WORLD'S FAIR.

Fair that will be a greater attraction than an Eiffel tower and a novel feature that will bring thousands of people to the fair, and after the fair is over will continue to be one of the great attractions of Chicago. I refer to my proposed underground mining exhibit, of which you undoubtedly have heard, or the "World's Fair Mine." I invite the electricians to join me in producing wonders in the way of electricity to be exhibited in this magnificent display.

My proposition, as you are aware is to place a great underground exhibit of mines, minerals and electric effects at a point five hundred feet below the park at Lake Front. I will make a shaft five hundred feet deep, fifty feet by twelve in the clear, with eight compartments (Fig. 1) one of which will have the water columns, air and steam pipes, and wiring for the electrical appliances, and at the other side of the shaft will be a pair of iron stairs for employes and "cranks," while in the center six will be placed six passenger cages, capable of carrying forty passengers each.

On the surface will be the finest hoisting plant of machinery ever made, while in the sump at the bottom of the shaft will be the greatest and best pumps constructed. This shaft is not so hard of construction as at first appears. There is no surface water below the layer of blue clay that underlies the city, and lies over the solid rock (Fig. 2). My shaft will be backed by eighteen inch timber, and in sinking the first hundred feet into the rock (87 feet), it will be suspended from the surface, and kept so until the bottom is well set into the rock. At a point where the rock becomes solid I will rim the shaft about ten feet all around, and bedding timbers or iron girders to support the upper shaft, in concrete, will absolutely connect the upper portion with the rock below and make it water tight. This disposes of the surface water as the shaft would be caulked like a ship, and lined with boiler iron to that point.

Below that point the backing would be with timber, one foot thick and lined with corrugated iron with fluting running down, so that not a drop of water would be seen except in the sump below the shaft. Once safely in the rock there is no great flow of water in the Niagara limestone that lies under the city until a point nearly 1 600 feet is reached. Such flow of water does not signify anything to a miner provided with the appliances in use to-day. From the bottom of the shaft I propose to run a corridor from one side of the shaft around to the other in the form of an ellipse (Fig. 3). This corridor will be an underground palace seven hundred feet in length, forty feet in width and twenty feet high, with a row of columns in the center composed of the various building stones embellished as the advertisers desire. Tennessee, Colorado, Vermont and Georgia marble, sandstones, quartzites, granite and imitation, all will be represented.

The floor will be paved with marble, the walls will be marble and plate glass, and the roof of iron, painted and finished in a way both pleasing and startling. The inner face of the circle will be trimmed with cabinets filled with ores of beauty or of too much value to have exposed.

Outside of this corridor will be a circle of drifts that will be reached by various adits and in these will be placed the mine displays.

In one drift the Comstock Lode will be represented by bringing ore from the Comstock mines and putting it in the same position as it is found in nature. The Aspen, Leadville, the great Montana, Utah, and Michigan mines will be represented in the same way, so that a trip through these various drifts would enable a person to see just how the ore looks and how it lies in all the great mines in the United States.

Not only the mines of precious metals, but the iron, coal, salt, lead and zinc mines would all be there, where they could be seen with ease and comfort. While in the corridors and the various adits the various light effects that could be made would be of rare beauty.

I have figured this out to be not only a great display, but it will make money for the projectors and stockholders. If 10 per cent. of the attendants at Chicago go down the mine (at 50 cents apiece), the company will get their money back and have a grand mineral museum on their hands after the fair is over.

The Eiffel tower took this proportion of the attendants at Paris and paid for itself during the life of the exposition, but owing to the fact that there were two transfers to be made, and that the space at the top was limited, crowds waited in line for hours for a chance to ascend, and thousands that would have otherwise taken the trip did not make the attempt.

My object in having this mine of such great size is to make its capacity such as to prevent a recurrence of such a state of things. Running as a day and night display, fifty thousand people daily can pass through the mine, and as many as seven thousand people can be below at once.

I honestly believe that 40 per cent. of the people that attend the fair will go down the mine, so you can see how much the mine is expected to pay.

Can you conceive of a better chance than this to display electric light, as well as electric machinery? It could be an electric light display by day as well as by night, one that fog, rain, moonlight or the sun would not interfere with, and one that you could positively regulate and control as you wish. Beautiful fountains and miniature falls of artesian water, all shades of color and degrees of strength, would be shown at the several adits.

The display could be so extraordinary that if we should have an electric tower over the shaft, no matter how beautiful, it would only whet the appetite of the spectator and spur him on to go below and see the more extraordinary things there.

It is quite proper that the electric display should be grouped with the mine. They both need a heavy steam plant, and by being together it would be more economical.

I hope the idea impresses you favorably; the mine must have electricity, and if we could induce you to join us in such a display, one would help the other, so that in the coming World's Fair the two sciences of electricity and mining could continue to be hand-in hand and together present a feature of the exposition that would be the talk of the civilized world.

Paris Telephone System.

A system of delivering telephone messages is to go into effect in Paris. A person will be allowed to speak to any of the telephone offices a message to be transcribed and conveyed to a person living in the district. The charge will be 50 centimes for five minutes, and the message will be limited to 100 words. The work of altering and enlarging some of the main sewers, with a view of facilitating the connecting of the new central telephone exchange in the Rue Gutenberg with the various subsidiary exchanges, is now being vigorously pushed on. In some instances the sewers will be entirely transformed. Thus in the Rue Faubourg Montmartre the tunnel will be about 13 feet broad by 10½ feet high, with a cunette 4 feet deep in the middle. On either side of this cunette there will be a platform 2 feet wide, one of which will be used by the Municipal Sewers Department, while the other will be given over to the telephone service. The roof of the tunnel will rest on cast iron pillars, and on brackets fixed to these will be run the Patterson 50-wire telephone cables.

A New Method of Analyzing Armature Reactions of Alternators.[1]

By Chas. Steinmetz.

It results from the discussion of Mr. Reid's paper, read before the Institute last month that the assumption of the constancy of N, the field magnetism and ρ, the magnetic resistance of an alternator, can not generally be considered true enough to be accepted, and therefore the equations given by Mr. Reid can not be considered complete, although being very valuable on account of their simplicity.

To complete these equations by taking into consideration the pulsating nature of the field magnetism, which fluctuates by more than 50% in the kind of alternator tested, as shown in the paper of Messrs. Tobey and Walbridge, and by considering the periodical variations of ρ, we start from the fundamental equation (6), given in Mr. Reid's paper.

By substituting equation (8), this equation (6), takes the form:

$$E = -\frac{d}{dt}\left\{ S\,N\cos\frac{2\pi}{T}\,t + S^2\,\mu\,i \right\}. \qquad (1)$$

where we introduce, instead of the magnetic resistance ρ, its inverse value, the magnetic conductivity,

$$\mu = \frac{1}{\rho}, \qquad (2)$$

in order to make the equation hold also for the other method of considering the phenomena, by means of the term "coefficient of self induction," this being proportional to the magnetic conductivity by the equation:

$$L = S^2\,\mu \qquad (3)$$

Substituting: $E = Ri$, introducing the transformation:

$$\phi = \frac{2\pi}{T}\,t, \qquad (4)$$

and substituting, $$s = \frac{T}{2\pi}, \qquad (5)$$

we get:

$$s\,R\,i = -\frac{di}{d\phi}\left\{ S\,N\cos\phi + S^2\,\mu\,i \right\} \qquad (6)$$

or, expanded:

$$S^2\mu\frac{di}{d\phi} + s\,R\,i + S^2\,i\,\frac{d\mu}{d\phi} = S\,N\sin\phi - S\cos\phi\frac{d\,N}{d\phi}, \qquad (7)$$

as the complete differential equation of the phenomenon.

Now we have to consider N, ρ and μ also as periodic functions of the time t, and therefore of the angle ϕ; but as such functions, which have two periods during one period of the alternating current, and therefore, as univalent periodics, they must have the form:

$$\begin{aligned} N &= F + \chi_1\sin 2\phi + \chi_2\sin 4\phi + \ldots. \\ &\quad + \beta_1\cos 2\phi + \beta_2\cos 4\phi + \ldots. \\ \mu &= \sigma + \zeta_1\sin 2\phi + \zeta_2\sin 4\phi + \ldots. \\ &\quad + \xi_1\cos 2\phi + \xi_2\cos 4\phi + \ldots. \end{aligned}$$

In the first approximation, by using only the first three terms of each expression, and making some changes, these equations assume the form:

$$\left.\begin{aligned} N &= F - G\cos(2\phi - \alpha) \\ \mu &= \sigma - \gamma\cos(2\phi - \vartheta) \end{aligned}\right\} \qquad (8)$$

Substituting these values in equation (7), we get:

$$S^2\left\{\sigma - \gamma\cos(2\phi - \vartheta)\right\}\frac{di}{d\phi} + s\,R\,i + 2\,S^2\gamma\,i\sin(2\phi - \vartheta) = \\ = S\,F - S\,G\left\{\sin\phi\cos(2\phi - \alpha) + 2\cos\phi\sin(2\phi - \alpha)\right\}, \qquad (9)$$

the complete differential equation of an alternator, where α is the angle of lag of the field magnetism, *i. e.*, field exciting current, and ϑ the angle of magnetic lag, caused by hysteresis and eddy-currents.

This equation (9) is integrated by the periodic function:

$$i = A\sin\phi + B\cos\phi + C\sin 3\phi + D\cos 3\phi. \qquad (10)$$

if we neglect the exponential factor of the integral, which gives the phenomena in starting the alternator, but disappears after a few thousandths of a second.

Value (10) substituted in equation (9) gives us, after cancelling all the terms of tertiary order: $G\gamma$, $C\gamma$, $D\gamma$, etc., and making a few changes, for the determination of the coefficients A, B, C, D, an identical equation in $\sin\phi$, $\cos\phi$, $\sin 3\phi$, $\cos 3\phi$.

The coefficients of this equation placed $= 0$, gives us four equations, from which we get:

$$A = \frac{S}{s^2R^2 \times \sigma^2 S^4}\left\{ s\,R\,F + \frac{G}{2}(\sigma\,S^2\sin\alpha - s\,R\cos\alpha) - \frac{\gamma\,F\,S^2}{2}\sin\vartheta \right\}$$

$$B = -\frac{S}{s^2R^2 + \sigma^2 S^4}\left\{ \gamma\,F\,S^2 - \frac{G}{2}(\sigma\,S^2\cos\alpha + s\,R\sin\alpha) + \frac{\gamma\,F\,S^2}{2}\cos\vartheta \right\} \qquad (11)$$

$$C = \frac{3\,S}{2(s^2R^2 + 9\,\sigma^2 S^4)}\left\{ \frac{3\,F\,S^2}{\sqrt{s^2R^2 + \sigma^2 S^4}}[s\,R\sin(\vartheta - \varepsilon) + 3\,\sigma\,S\cos(\vartheta - \varepsilon)] - \sigma\,G\,[s\,R\cos\alpha - 3\,\sigma\,S\sin\alpha] \right\}$$

$$D = \frac{3\,S}{2(s^2R^2 + 9\,\sigma^2 S^4)}\left\{ \frac{\gamma\,F\,S^2}{\sqrt{s^2R^2 + \sigma^2 S^4}}[s\,R\cos(\vartheta - \varepsilon) - 3\,\sigma\,S\sin(\vartheta - \varepsilon)] + \sigma\,G\,[s\,R\sin\alpha + 3\,\sigma\,S\cos\alpha] \right\}$$

These values substituted in equation (10), give, after cancelling again the terms of tertiary order, substituting (5), and calling the number of periods per second,

$$n = \frac{1}{T}, \qquad (12)$$

[1] A note presented at the meeting of the American Institute of Electrical Engineers, November 18, 1890.

the expression for the armature current in the alternator:

$$i = \frac{2\pi n F S}{R\sqrt{1+\frac{4\pi^2 n^2 \sigma^2 S^4}{R^2}}}\sin(\phi-\varepsilon) - \frac{\pi n G S}{R}\left\{\frac{\sin(\phi-a-\varepsilon)}{\sqrt{1+\frac{4\pi^2 n^2\sigma^2 S^4}{R^2}}}+\frac{3\sin(3\phi-a-\eta)}{\sqrt{1+\frac{36\pi^2 n^2\sigma^2 S^4}{R^2}}}\right\} - \frac{2\pi^2 n^2 \gamma F S^3}{R^2\sqrt{1+\frac{4\pi^2 n^2\sigma^2 S^4}{R^2}}}\left\{\frac{\cos(\phi-\vartheta)}{\sqrt{1+\frac{4\pi^2 n^2\sigma^2 S^4}{R^2}}} - \frac{3\cos(3\phi-\vartheta-\varepsilon-\eta)}{\sqrt{1+\frac{36\pi^2 n^2\sigma^2 S^4}{R^2}}}\right\} \quad (13)$$

where we introduced the substitutions:

$$\frac{2\pi n\sigma S^2}{R} = \tan\varepsilon, \quad (14)$$

$$\frac{6\pi n\sigma S^2}{R} = \tan\eta = 3\tan\varepsilon, \quad (15)$$

the angle of lag of the armature current.

From the equation (13) we get the square root of the mean square, or the effective current:

$$I = \frac{\sqrt{2}\pi n F S}{R\sqrt{1+\frac{4\pi^2 n\sigma^2 S^4}{R^2}}}\left\{1-\frac{G}{2F}\cos a - \frac{\pi n\gamma S^2\sin(\vartheta-\varepsilon)}{2R\sqrt{1+\frac{4\pi^2 n^2\sigma^2 S^4}{R^2}}}\right\}. \quad (16)$$

The first term of this expression is the value given in Mr. Reid's paper under equations (15), (17), (19), and therefrom the e. m. f.:

$$E = \frac{\sqrt{2}\pi n F S}{\sqrt{1+\frac{4\pi^2 n^2\sigma^2 S^4}{R^2}}}\left\{1-\frac{G}{2F}\cos a - \frac{\pi n\gamma S^2\sin(\vartheta-\varepsilon)}{2R\sqrt{1+\frac{4\pi^2 n^2\sigma^2 S^4}{R^2}}}\right\}. \quad (17)$$

For a constant potential alternator, where the self-induction of the armature current is low enough to be neglected, equation (17) assumes the form:

$$E = \sqrt{2}\pi n F S\left\{1-\frac{G}{2F}\cos a - \frac{\pi n\gamma S^2\sin(\vartheta-\varepsilon)}{2R}\right\} \quad (18)$$

Here again the first term is given Mr. Reid's paper under Fig. 20.

For a constant current alternator, where the self induction of the armature is so high that the other terms may be neglected, equation (16) takes the form:

$$I = \frac{F}{\sqrt{2}\sigma S}\left\{1-\frac{G}{2F}\cos a - \frac{\gamma}{4\sigma}\sin(\vartheta-\varepsilon)\right\} \quad (19)$$

its first term given in Mr. Reid's paper in equation (16).

If there are no precautions taken against the fluctuations of the field current, angle a approximates 0; and cos a therefore =1.

On the other hand, the influence of the second term, the fluctuations of the exciting current, can be decreased by increasing angle a, therefore decreasing cos a; that is, by throwing self induction in the exciting circuit.

This latter phenomenon I had occasion to observe some time ago, the potential of an alternator, which I tested, being raised from 22 volts to 160 volts by means of two impedance coils (transformers with open secondary), connected in the exciting circuit.

An approximate calculation shows that, although the term of magnetic saturation, the third term, in equations (16) to (19), is small enough to be neglected in most cases, the second term, which accounts for the influence of the fluctuations of the exciting current, cannot well be neglected.

Even the equations given above can hardly be considered as an absolutely complete solution of the problem of armature reactions of alternators, because they still neglect terms of tertiary order.

But they will be found to hold for almost all the types of modern alternators, and only in those few machines, where the fluctuations of the field current are unusually heavy (especially where the electric induction is produced by changes of the magnetic resistance, and field magnetism and armature magnetism are connected in series in the magnetic circuit), do those fluctuations become so important, that a more particular calculation of them, including the consideration of self-induction in the field circuit, has to be made. Into this, however, I do not need to enter deeper, because such machines, although they were operated many years ago (Klimenko's alternator, for instance, tested at the Electrical Exhibition in Vienna, 1883), have not come into more extensive commercial use.

Overhead Wires in New Orleans.

The question of regulating the construction of electric plants in New Orleans has received considerable attention from the city officials. The mayor and several other representatives of the city government visited several Northern cities recently with a view of investigating the systems in operation. The result of this investigation appears in the ordinance submitted to the city council. The superintendent of the city fire alarm telegraph system was given charge of this department and strict rules to govern the installation and operation of electric plants were prepared. It will be the duty of the superintendent to enforce compliance with these rules. The Louisiana Electric Light company, it is stated, will be obliged to expend $50,000 upon its system in order to meet the requirements of the ordinance.

Schoop Storage Batteries with Gelatinous Electrolyte.

During the last year Prof. W. Kohlrausch of the University of Hanover, Germany, made an extended test of the accumulator cells made by the Oerlikon Works. These batteries are constructed in accordance with the patents of Dr. Paul Schoop, at present a resident of Chicago. The batteries are the same as those manufactured by the Chicago Battery & Power company. The professor's report was as follows:

The tests were made with a view to know the behavior of the accumulators if subjected to rough usage. For this reason trying tests were followed by regular tests with ordinary currents in order to get an opinion of the damage eventually done by the hard trials.

After a series of regular charges and discharges, the cells were finally charged and remained idle during a month's time. In charging the cells again, 52 ampere-hours were absorbed but a strong development of gases occurred at the end of the charging period. The whole capacity in charging with 10 amperes being 73 ampere-hours, it is obvious that about five-sevenths of the former charge seems to have disappeared during the rest of 30 days. Probably a part of this lost energy has been consumed in a certain chemical or physical transformation of the "active material" perhaps to the advantage of the accumulator.

A normal discharge and charge were now made, and it proved that the cells were yet in a good working order. The discharge was with 72 ampere-hours, indicating an increase in the capacity, the former trials having given only 65 ampere-hours on the average. The factory claims 70 ampere-hours as a normal discharging capacity.

Again the same cells were discharged with the normal rate of current *i. e.*, 9 amperes. After the discharge of about 73 ampere-hours, the current decreased and could only be maintained by decreasing the external resistance of the circuit; at last the cells were short-circuited in order to get the last energy out of the accumulators. In this way again 36 ampere hours were drawn out and the whole discharge was 109 ampere-hours. The cells were now charged with only 6 amperes (too weak a current) until gas bubbles were developed, and soon afterward (after 1½ hours rest) were discharged with a current of 50 amperes (*i. e.* 5 times the normal rate of discharge). The capacity was 41.6 ampere-hours, about four sevenths of the normal capacity. It is a well-known fact, that the capacity decreases if the discharging current increases.

Again the accumulators were charged at the normal rate of current and delivered, discharged with the normal current, 68. 2 ampere-hours; charging and discharging was in every sense normal.

The discharged cells were now charged in the reversed direction with 124 amperes, the electro-chemical reaction on the plates were exchanged, *i. e.*, the former kathode was anode, and the former anode had become kathode. At the end the tension of the cells was again two volts.

During this trial at first 68. 2 ampere-hours had passed the plates voluntarily in the direction of the discharging-current; afterward 124 ampere-hours had passed involuntarily altogether 192 ampere-hours.

Now the accumulators were again charged with 9 amperes with the current in the original direction and after 223 ampere-hours the cells were again fully charged and began to develop gases. During this forced charging and discharging the efficiency was 86 per cent., the efficiency under normal conditions being 89 per cent.)

The following discharge with 9 amperes yielded 68.3 ampere-hours. It is obvious, that this series of abnormal tests did not decrease the efficiency and capacity of the cells; the capacity in fact increased a little. I think, that during the long rest of the cells, probably also during this abnormal treatment parts of the active material had been powerfully excited, parts which had before not been affected electrically, having been transformed into true active material.

One of the cells was now dismounted and I have seen, that with the gelatinous electrolyte the whole construction of the cell was of remarkable rigidity and constancy. The two sections of plates could only be separated with considerable power after a previous softening of the gelatine. After the plates had been fully cleaned of the gelatine they looked perfectly normal, just as before the trials.

The grids are very thin and soft, but it is this reason that I think it improbable that plates can "buckle." The stiff gelatine could not easily be removed so that the plates would touch each other, an inconvenience too often observed in the case of other cells with thin plates and narrow distances between them.

Falling or dropping of the active material off the plates is made impossible by the gelatine also it is improbable that active material could penetrate through the gelatine.

The most important question now is that of the durability of those cells. Of course it is only possible after a longer time, at least a year or two, to give an opinion. How long will the thin grid of lead resist the combined action of the electrical and chemical changes within the electrode? How long will it take to have the metallic support eaten up by daily action of the cells, until the whole grid is converted into the same "active material," which does only practical work if imbedded in a perfect metallic conductor?

I have observed on other systems with thin plates, that often the grids becomes brittle and break, which is a practical damage to accumulators.

I would say that the grids of the plates may last a year or two with daily use, but it is possible that the cells will c
lease to give daily practical service after three to five years. I hope to have an opinion more definite on this matter after shall have used the cells for a longer time, say a year or two.

The present trials have shown, that these cells endure an abnormal and very rough treatment in a satisfactory manner indeed, and that they are a practical electrical apparatus.

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 29.—The question of electrical execution is once more a timely topic and the legal lights and electrical experts are again discussing the validity of the law. The Supreme Court of the United States has reaffirmed the decision that the new method of inflicting capital punishment is not cruel and unusual within the meaning of the constitution, and it has been decreed that both Wood and Jugiro shall die according to law. As soon as this decision was reached, the warden of Sing Sing, where the executions will take place, began his arrangements for the event. It was agreed that the proper course to pursue was to kill the usual number of horses and cows, and this was accordingly done. It was expected that Wood's execution would take place next week, but now it appears a fight will be made on his case, though not on the same grounds as in the cases of Kemmler and the Jap. Some time must necessarily elapse before his case will be finally decided. It is therefore probable that the Jap will first be executed. The ground on which Wood's appeal is taken is the exclusion of colored men from the grand and petit juries which indicted and convicted the condemned man. The case will not be called until the first Monday in January.

In the annual report of the Lighthouse Board attention is again called to the electric lights on the Brooklyn bridge which, it is claimed, interfere with the navigation of the East river. The board also says that it cannot enforce the law providing for the proper lighting of bridges over navigable rivers, as no penalty is prescribed for its infraction. An appropriation of $60,000 is asked for by the board to complete the pedestal of the Statue of Liberty, the lighting of which, it will be remembered, is by an isolated arc light plant, of the old American system.

The members of the New York Electrical Society visited the new station of the Edison Electric Illuminating company at Twenty-sixth street, New York, Tuesday evening. There was a large gathering of electricians and they followed with interest the remarks of J. Van Vlech, the chief engineer of the company, in explanation of the details of the plant. The station is in superb order and its inspection was a privilege thoroughly appreciated by the visitors. After the tour of the building had been made supper was served and brought to close another of the pleasant and profitable evenings of which the meetings of the New York Electrical Society never fail to be the occasion. The society is steadily increasing its membership and enlarging its sphere of usefulness. At its next meeting E. P. Thompson will read a paper on "Invention as a Science," which is looked forward to with great interest.

The season for underground work is practically closed and Commissioner Gilroy has issued the usual order to clear up the work now on hand. Permits for opening the streets will be refused until the beginning of next season.

Henry Villard, president of the Edison General Electric company, has returned to New York. He arrived this morning on the steamer Aller from Bremen.

Members of the Electric club enjoyed a dinner at the club house Thursday evening. An excellent programme had been prepared by the committee on entertainment, and the members thoroughly enjoyed the evening.

Even the New York papers are beginning to weary of the failure of the Board of Electrical Control to do its duty. In the course of an editorial the *World* said the other day:

"In the mean time the city is interested in knowing why the Board of Electrical Control does not fix the rents. Why is the settlement of the public's interests postponed while the lawyers tie them up in endless briefs? Who is responsible for delaying the Board's decision? It looks as though the Subway company had more influence than the people." W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Nov. 29.—The St. Paul City Railway company has made a slight change in its directorate. A special meeting of the board of directors was held at the company's office to act upon the resignation of Col. Barr from the offices of vice-president and director, and of George B. Harris as a director. C. G. Goodrich was elected vice-president and director in Col. Barr's place, and Superintendent A. L. Scott will fill the vacant seat on the board occasioned by the retirement of Mr. Harris. One of the principal purposes of the meeting was to discuss the ordi-

nance recently passed by the city council of that city granting an extension of time for the completion of electric lines and prescribing certain changes in the operation of those already built. All of the propositions of the ordinance were formally accepted.

President Lowry has set at rest the anxious speculation of the public in regard to the adoption of the storage battery system on Twin City lines. He says that he has made no special investigation into that system, being fully satisfied with the present system, and will wait until the experiments now in progress have clearly demonstrated the superiority of the storage battery before undertaking any change.

The Minneapolis Street Railway company has the superstructure of its big power house completed, and the new machinery will be set up at once. The Sixth street electric line, which has been awaiting the completion of these improvements, will be put in operation immediately. This is one of the most important lines in the city running through the most thickly populated residence wards.

Two new lines were put in operation Wednesday: one running to Lake Harriet and the other on Twentieth avenue north to Penn. The latter line is the one which will connect at Thirty-second avenne and the city limits with the tracks of the Robinsdale Electric Railway company, which has completed the grading on its 2½ miles of line. An arrangement for the operation of this line is understood to have been effected with the city company whereby the latter will operate it on a guaranteed business of $2,000 per year.

Robt. Taylor, an employe of the Brush Electric company, was seriously injured by a fall while making repairs in a building on Nicollet avenue and Sixth street.

The first accident resulting from the location of trolley poles in the center of the streets has occurred. An old man ran against one while running to catch a car, and sustained severe injuries on the forehead and concussion of the brain. His injuries will not necessarily prove fatal.

The St. Paul Brass Works company have undertaken the construction of a new type of dynamo and motor. It is the invention of Walter F. Brown, a St. Paul electrician. N. O. F.

Pittsburg, Pa.

PITTSBURG, Nov. 29.—The stockholders of the McKeesport Electric Light company have for some time been dissatisfied with the board of directors of the company, and the trouble has at last led the dissatisfied parties to go into court for an adjustment of their grievances.

Judge Ewing of Pittsburg, before whom the matter came up, was asked in a petition to issue a writ of mandamus on Thomas L. White, acting president of the company, commanding him to call a special meeting of the stockholders. The petition is signed by the Edison Electric Light company, Samuel Insull, the Edison General Electric company, Thomas Petty, D. A. Farley and Magnus Pflaum, all of whom claim to be stockholders in the company. They state that they are the majority stockholders; that at a meeting held on Oct. 14, 1890, the minority stockholders and the president, although a majority in number, but not owning a majority of stock, obstructed the business pending before the meeting. The case will be heard before Judge Ewing next week.

The Central District & Printing Telegraph company of Pittsburg, which operates all the telephones in this city and the surrounding country has entered suit against the Second Avenue Electric Railway company for damage to its telephone wires in this city. The company alleges that the electric railway wires interfere with the telephone service, and it claims that over $15,000 damages has already been done to the system.

The telephone company is apparently determined to fight the electric street railway wires to the bitter end, and this suit is supposed to be the first only of a number to be instituted against the other electric street railway companies in this city. It is said by the telephone people that, since the advent of the electric railroads in this city the telephone service has been practically rendered useless in certain parts of the city. It is next to impossible, they say, to telephone, for instance, to Sewickley or other places around the city. The completion of additional electric roads makes it probable, in the opinion of the telephone company, that the system will be even more seriously affected than at present. For this reason the company expresses its intention of protecting its property, and having franchises which ante-date those of the electric roads, claims that the railroad wires have no right to interfere with the telephone wires.

General Manager Metzger of the telephone company, says in regard to the matter: "Our lines are damaged to a considerable extent by the electric railway wires. Some of our long straight lines have in fact been rendered entirely useless where the electric street car wires run parallel with them, and in one instance we have been compelled to lay an entirely new line. We had to give up our regular Second avenue wires and build new lines in another direction in a very roundabout way to take their place. In some parts of the city we cannot put up new lines, and we have to suffer the interference. We have improved the service very much in some sections of the city by putting up a complete return wire, and instead of connecting every telephone with the earth, all are connected with this return wire. A complete metallic circuit is produced, and no ground connections are made at all. The Pleasant Valley wires do not trouble us nearly so much as the Second avenue wires, but we also have been obliged to put up new lines on account of the former. We apprehend a great deal of trouble when the Pittsburg, Allegheny & Manchester road is finished, as well as from the Duquesne Traction line, which is now being constructed. Our company has already been damaged for over $15,000, and this seems to be only the beginning of the trouble because the construction of electric roads is only just commencing in the city. We have sued the Second Avenue company first because that company has damaged us more than the others, and when that suit is settled we will proceed against the rest of the companies." E. H. H.

Kansas City, Mo.

KANSAS CITY, Mo., Nov. 28.—Councilman Brinkley is collecting information as to the possibility of compelling the telephone, electric light and telegraph companies to put their wires underground. An ordinance which he will introduce will provide that all wires in the street in the business part of the city shall be put underground, but will leave it at the discretion of the Board of Public Works to designate where the wires shall be taken down. There is no especial hurry about the matter but Chief Hale of the fire department is very anxious that the ordinance should be introduced and passed.

President Cannon of the Upper House of the Council, is afraid that it would not yet be practicable to put the electric light wires underground, because no perfect underground system has been devised.

Chief Hale considers the plan proposed by Mr. Brinkley to be entirely practicable and he expressed an earnest hope that the council would adopt the ordinance.

Within a very few weeks the southern extension of the L road in Kansas City, Kan., will be placed in operation. This road leads from the junction of the main line and the Riverview branch, south on Fifth street and Colorado avenue over the Seventh street viaduct to the Sixth ward, penetrating the great manufacturing districts in the southern part of the city.

The cars will be operated by electricity and the dynamos have already been placed in position at the electric light plant. When this road is in operation it will do as much, if not more, toward the consolidation of the cities west of the line than the Seventh street viaduct did. The facilities for reaching the southern part of the city at present are very inadequate. It will only require about ten minutes to make the trip when the new road is in operation. The road bed has been completed and the poles and wires have been placed in position. All that now remains for the completion of the line is the arrival of motors and cars from the East. The line will be connected with the main line at Riverview, but it has not yet been stated what changes will be made in the running of the main road when the new line is started. It is understood that the elevated company will also adopt electricity for motor purposes on the Riverview branch. The southern extension will be the only line put in operation in this city this fall, but next year the Metropolitan Street Railway company will extend its Fifth street line from Tenth and Minnesota streets to the western city limits. The West Side Railway company will also soon commence the construction of its line in this city, but it will not be completed and ready for operation until May 1, 1891.

The question of establishing a fire alarm box system is now occupying the attention of the Kansas City, Kan., council. Almost every councilman is in favor of putting in a box system of some kind, and the workings of several methods have been examined.

Chief Hale has attached to his buggy two little incandescent lamps, with powerful reflectors, connected by switch to a twenty-six pound storage battery, fastened in the back of the vehicle. The members of the fire committee will be asked to inspect the buggy and to authorize him to put such lights on the hose carts and ladder trucks. A light much stronger and steadier than that furnished by the ill-smelling torches could be produced at much less cost.

The torches are kept burning all night and gas is burning in the engine house, whereas if electricity were used the house could be kept in darkness and the ringing of the alarm could be made to turn on the lights. The constant light is found to be bad for the horses. A large storage battery, so says Chief Hale, could be placed on the ladder truck and a powerful light could be reflected upon buildings where the men are at work. P.

Indianapolis, Ind.

INDIANAPOLIS, Nov. 29.—Mr. Hatfield, agent for the Kester Electric company, has just finished putting in a hundred light incandescent plant in Hetherington & Benner's foundry and machine shop, and also a 75 light plant in the shop of the Coleman Stove & Heating company.

The Fort Wayne Jenney Electric company has just closed a contract with the postoffice authorities here for lighting that building. The current is to be furnished from the plant in the When clothing store, just across the street, to which have just been added two incandescent machines, one arc dynamo and an engine. There are to be 275 16-candle power incandescent lights inside the postoffice and 10 arc lights outside.

The street lighting question has come up again in city council. Two weeks ago the committee on lighting reported a majority and minority report. The former provides that of the lights required for street illumination 150 should be arc lamps, and the remainder gas jets. This report was adopted. Such a breeze was caused by the adoption that a number of councilmen who claimed they had not fully understood the report, and who had voted for the majority report, called up the question last Monday night and the matter was reconsidered.

A resolution calling for advertising for bids for lighting the city by electricity for a period of five to ten years, was adopted. Several of the large electric companies have representatives in the city looking over the ground with view to bidding. M.

Nashville, Tenn.

NASHVILLE, Nov. 29.—The Citizens' Rapid Transit company has about settled all its differences with the city government and its litigation with the United Electric Railway company. One of the most serious of these arose from the necessarily joint use by the two corporations of a single track over a distance of 4,000 feet. It was decided that each company should use its own trolley wire. The trolley wires of each company are placed at the same elevation and are only eight inches apart. How this arrangement will work remains to be seen. The Citizens' Rapid Transit will run its cars regularly on and after Nov. 29 inst. The track is five miles in length, including turnouts and side tracks, and is constructed in a very substantial manner. The rails within the city limits are 45-pound, Johnson girder and outside 40-pound T rails, laid on 8-foot ties, 2,640 to the mile, and having very heavy and substantial chairs of new design. The line is nearly straight throughout its entire length. Longer cars will be used than on any other line in the city. The cars, five in number, are of the latest design of the Stephenson make, equipped with Edison motors and track brakes. The latter is a new feature in this city and consists of a shoe carrying a piece of hard wood 2x3 inches and 18 inches long, which can quickly be brought down on the rail, if emergency should require, until it supports the entire weight of the car, thus bringing the car to a standstill on any grade as suddenly as compatible with the safety of the passengers and the machinery. There are some new features connected with the power house, dynamos, trolley wires and connections.

The track of the Nashville Electric Railway & Power company is being rapidly laid. The line is three and one-half miles in length and will be laid with the same kind and weight of rails as the Citizens' Rapid Transit with the exception that the ties will not be as long nor as heavy. The line will have several short curves and will run cars of medium length and weight. Five have been ordered from the John Stephenson company. The brick work of the power plant is nearly completed and all the machinery has been ordered.

The United Electric Railway company, operating about sixty miles of roadway, is doing an immense business and giving first-class service.

The Capital City company has greatly extended its service during the past two months both for public and private lighting. The city is better lighted at present than ever before

Fred W. Fairfield, city electrician, said recently: "I have just returned from a tour through the principal electrical cities of the North and Northwest, and Nashville uses more electricity to the square mile than any other city in the United States, so far as my observation and information extends."

The Postal Telegraph Cable company has completed its line to this city from its southern connections and opened a handsome office on Union street in the business center

of the city. This company has had a great deal of trouble about the right of way, as all the railroad lines are covered by the Western Union, and it had to "take to the woods," so to speak, and follow the turnpike roads and old time mail routes. The construction of the line was very costly, but in this state has been well done. The poles used are Tennessee red cedar of very large size and through wooded sections all the timber on both sides of the right of way that could fall on the line has been cut down. The work of constructing the line northward has already reached the city limits and is being pushed by three large forces. The office here is now receiving business for all the principal northern and eastern points and nearly all leading points south except on the Gulf coast. The only litigation the Postal Cable has here now is with the telephone company. The Cumberland Telephone company rents its boxes to all city subscribers except the Postal Cable Telegraph company for a charge of $5 per month. Of the latter 15 per cent. of its local receipts was demanded as compensation for the use of the telephone. This demand was refused. The telephone company served a notice on the telegraph company that it would remove the box, or what amounts to the same thing, would shut off its connection. The Postal Telegraph Cable company obtained a temporary injunction to restrain this action and tne matter comes up for argument next week. B.

THE ELECTRIC LIGHT.

The Morgan Park Electric company was incorporated last week at Chicago to furnish electric light, power and heat; capital stock, $25,000; incorporators, F. S. Wheaton, George A. Meech and J. H. Westover.

The *Globe-Democrat* is responsible for the statement that the city and electric light companies of St. Louis had reached an agreement whereby the city shall pay one-half as much for its light as private consumers.

A committee appointed by the Seattle Wash., trustees to investigate the subject of the cost of electricity and gas for street lighting, recommended that bids be solicited for new contracts for all kinds of lights, for a term not exceeding one year; also, that the city should own and control its own system of lights.

THE ELECTRIC MOTOR.

Arrangements have about been completed for the extension of the Colfax avenue electric line of Denver, Col., south to Fairmont cemetery, and it is expected to have the cars running by January 1.

At the last meeting of the Chicago Electric club a reference was made by one of the speakers to the successful operation of a storage battery car. In the report of the discussion which appeared in the WESTERN ELECTRICIAN, the city in which the road was operated was given as *Topeka*. The statement would have been correct had *Dubuque* been substituted. The plant was installed by the Accumulator company of New York.

Theo. P. Bailey, manager of the railway department of the Thomson-Houston company at Chicago, states that he has had a tremendous rush of orders for the perfected snow sweeper manufactured by his company. He has taken orders for twelve sweepers during the last fortnight. He also reports the sale of electrical apparatus and equipment for fifteen additional cars, including generators and overhead equipment for ten miles of track, to the San Antonio Street Railway company, San Antonio, Tex. This is the third increase in sales to this company of Thomson-Houston apparatus, and comprises altogether about thirty cars.

A big deal in street railroad property was made in Pine Bluff, Ark., last week, whereby the two companies were consolidated under one management, the Citizen's line selling out to Wiley Jones, the owner of the Jones line, and a stock company. For some time past New York capitalists have been trying to buy the Citizen's line, but having failed to come to time, this week the opposition company signed an agreement to take the property at $125,000, Wiley Jones buying and John O'Connell and H. P. Bradford selling. This consolidation gives Pine Bluff one of the wealthiest street car corporations in the South. There are fourteen miles of road in the new company's line.

Personal Mention.

D. H. Bates, vice-president and general manager of the Accumulator company of New York, was in Chicago last week.

W. A. Willard, general sales agent of the Interior Conduit and Insulation company of New York, was in Chicago this week.

H. S. Wynkoop, M. E., assistant district engineer of the Edison General Electric company, has been transferred from the Central to the Pacific district of his company.

George A. McKinlock and Miss Marion Rappleye were married by Bishop Cheney, Dec. 2, at the bride's residence, 3636 Prairie avenue, Chicago. The ceremony was witnessed only by immediate relatives. Mr. and Mrs. McKinlock will pass their honeymoon in Europe. They sail on the Etruria and will make an extended tour of the continent. Mr. McKinlock is treasurer of the Central Electric company, Chicago, and despite his desire to have a quiet wedding, many of his friends learned of the event and extended congratulations. Among the presents received was a very fine set of silverware of eighty-nine pieces. Accompanying it was a note from Durant Cheever, W. L. Candee and Geo. Manson of the Okonite company, New York, in which they extended their congratulations and good wishes to the happy couple. Mr. McKinlock has a host of friends in the electrical fraternity who will wish him continued happiness and prosperity.

C. E. Stump, who has been connected with the *Electrical World* of New York for the last eight years, has resigned his position as business manager of that journal to accept the vice-presidency and business management of the Street Railway Publishing company. The latter company publishes the *Street Railway Journal*. He will also have an interest in the *American Journal of Railway Appliances*. Mr. Stump is one of the best known men in the electrical field. He has formed a wide circle of acquaintances among electrical men, and has wielded a marked influence. He possesses great executive ability and to his untiring labor not a little of the success of the paper with which he has been identified for so many years is to be ascribed. Mr. Stump's friends are glad to know that he will still be connected with electrical interests, for to-day a street railway paper is to a great extent an electrical journal. The WESTERN ELECTRICIAN knows that a host of friends throughout the country will join with it in expressing the heartiest wishes for Mr. Stump's success in his new field.

Business Mention.

Among the many handsome calendars that have come to hand for the year 1891, is one issued by H. A. Cleverly, of Philadelphia. It is exceedingly handsome.

The Universal Radial Drill company has mailed its December calendar. This calendar has been issued monthly for two years and the company states that many commendatory notices relative to it have been received.

The Pittsburg Sheet Metal company of Allegheny, Pa., have a thoroughly equipped factory, and are prepared to manufacture electrical goods of any description. They have lately added many special facilities for their class of work, and feel that they can guarantee satisfaction in every case.

The Crosby Electric company of New York city has just issued a circular notifying the trade that it has purchased the business of the Federal Electric company, heretofore carried on at 10 Cedar street, New York, together with the stock and patents under which this latter company manufactured its goods.

M. C. Chase, manufacturer of hard rubber goods and electrical specialties, formerly at 84 Market street, finding his quarters too small for his rapidly growing business, has just secured a new location for both office and factory in the Metal Workers building, 43 to 49 South Canal street, Chicago, and will soon be in shape to receive his friends.

The Bassett combination portable and bracket which has been placed upon the market by the Electrical Supply company, 171 Randolph street Chicago, should meet all ordinary requirements where it has been necessary before to use separate articles. This article is moderate in price, therefore will probably meet with large sales. It is, as its name implies, a combination of both a portable and bracket.

The Weston Electrical Instrument company, of Newark, N, J., is about settled in new and handsome quarters, 114 and 116 William street. The company has every facility in the way of expert help and machinery of the most improved patterns, as well as many ingenious special tools, of its own design, for the perfected manufacture of standard voltmeters and ammeters. The company is busy perfecting some instruments which are expected will shortly be put before the public.

Geo. E. Fisher of the Commercial Electric company of Detroit, reports a large and increasing business this fall. There has been unusually heavy demand for their specialties and their sales for all staple articles have been unprecedentedly large. They have recently made arrangements whereby they have secured the exclusive sale of all the Edison patent specialties in the city of Detroit. In order to accommodate a constantly increasing trade in the northern part of Michigan, they have opened an office at Bay City.

The Buckeye Electric company of Cleveland, O., which recently opened a sales department in this city in connection with the Western Mineral Stock company, at 182 Jackson street, have their new incandescent lamp perfected and are now offering it to the trade. While very modest in their claims they contend that their lamp is equal to the best made in efficiency as well as life. Patents on a new material for the filament, as well as an improved process of manufacture are pending, and the lamp is to be kept up to the highest standard.

The Electric Merchandise company, Chicago, write that they have supplied about seventy-five electric roads with their rawhide pinions. Speaking of this specialty the United Electric railway of Nashville, Tenn., say: "We have used your rawhide pinions and are very well satisfied with them. While the life of the rawhide pinion is not quite so long as a good bronze pinion the saving on the iron gear makes them quite economical. You will remember we purchased your pinions about five months ago. Some of these are still in service."

The Wm. D. Gibson company, Chicago, are manufacturing out of crucible cast steel, trolley and car seat springs, and in fact all other patterns used in any form of electrical machinery. This company reports an excellent demand for products, with the best of prospects ahead. The firm makes a specialty of this class of goods, having an improved tempering process which enables them to turn out an article that is giving universal satisfaction. Their factory located on North Clinton street is claimed to be the largest in the West devoted exclusively to this line.

The Magnolia Anti-Friction Metal company has reason to feel encouraged. The latest accounts are to the effect that Magnolia metal has been indorsed by the United States and German governments. The Hamburg-American steamship company writes also, "It has never cut, has never become warm or melted, and has invariably put a splendid surface on the journals. The lasting quality of the metal is very great; the saving of oil very considerable. The Magnolia metal is particularly useful in re-lining worn-out brasses." They write further that they consider it to be the best of all anti friction metals in the market, and shall continue to use it on their steamers.

The mining department at the western office of the Thomson Houston company is now being rapidly organized by Prof. F. B. Badt. It was only recently that Prof. Badt entered upon his duties as manager of this important branch of the Thomson-Houston business, and already the prospects are such as to indicate a prosperous and rapid development in this particular field. In organizing the mining department an effort has been made to thoroughly systematize the business methods so that mining engineers, contractors, etc., would not only be able to obtain from the office all information as to electrical equipment, but also find reliable data, prices, etc., appertaining to the strictly mechanical portions of a plant. In other words the aim is to make the mining department a bureau of general information for miners.

George, Cutter who recently sold his interest in the Great Western Supply company, Chicago, has started a new enterprise. For a long time Mr. Cutter has been desirous of devoting his time exclusively to developing electrical novelties, and of late he has been actively engaged in arranging his plans to that end. His twenty years' experience make him peculiarly fitted for this work. Mr. Cutter already controls a number novel of electrical specialties and is arranging for such others as will best meet the demands of electrical people. His quarters will be in the Rookery building, Chicago, and he will be surrounded by a picked corps of assistants. In addition to bringing out electrical novelties Mr. Cutter will engage in electrical engineering work. It is almost needless to state that his facilities as well as his previous record bespeak for him a prosperous career.

Jas. McLaughlin, electrical and mechanical engineer, calls attention in this issue of the WESTERN ELECTRICIAN, to the enlarged facilities which he has provided at his factory on North Clinton street. Mr. McLaughlin claims to be a pioneer in the electrical business, and his claims, it would appear, are well founded. His first employment was with Hiram S. Maxim in New York in 1876, and since that time he has been constantly engaged, his first work in the West being with the Heisler company in St. Louis, after which he filled other important positions until the Vanderpoele company was organized in this city in 1880. He was then made superintendent of the factory, where he remained for nearly eight years. When they sold out he started a repair shop and factory of his own. Mr. McLaughlin gives personal supervision to every piece of work intrusted to his care, which is a sufficient guaranty that it will be well done, and he will undoubtedly meet with the success he deserves.

The Central Electric company report a continually increasing demand for improved Candee wire, and in order to meet this demand have stocked their warerooms with a larger quantity than ever. As an instance of their unequaled facilities for doing business in a hurry, they received an order last week for 12,000 pounds of this wire to be shipped with a rush and the wire was at the freight depot in less than one hour after the order passed through the office. The handsome little special circulars gotten up by this company exhibiting a piece of Okonite wire that has been in use five years, and which was referred to in these columns in a late issue, has attracted much attention, and the company has received numerous applications for specimen circulars to frame as souvenirs. The Central Electric company has obtained patents on a new form of glass insulator, especially designed for heavy railroad work. The Highland Park Electric Light company have adopted improved Candee wire for their primary circuits throughout their system, and have over fifteen miles of it in use. They report that recently after three days of continuous rain, a test showed that the insulation resistance of the primary circuits were over one megohm notwithstanding the fact that the wires are built through alleys, and in a great many cases hang through trees.

Electrical Patents.

Issued Nov. 18 and 25, 1890.

440,614. Electric Switch. Ernest T. Barberie and James Des Brisay, New York, N. Y.

440,627. Electric Meter. Sebastian Z. De Ferranti, Hampstead, County of Middlesex, England.

440,640. Electric Welding Transformer. Hermann Lemp, Lynn, Mass.

The invention consists, essentially, in securing uniform heating at different parts of the work by supplying the different parts of the work from different sources of energy and regulating the different sources independently of one another.

440,641. Electric Welding Apparatus. Hermann Lemp, Lynn, Mass.

440,654. Lightning Arrester. Edwin W. Rice, Jr., Lynn, Mass.

440,662. Electric Arc Lamp. Elihu Thomson and Edwin W. Rice, Lynn, Mass.

The last claim reads as follows:

"12. The combination, in an electric arc lamp, of a feed regulating lever supporting the carbon, a low resistance branch around the arc containing a magnetic

coil acting on the same lever, and a contact closing catch, or its equivalent, as described, controlled by said lever, whereby the low resistance branch is maintained until the feed regulating lever is brought to normal position for producing a feed of the carbon."

440,663. Electric Arc Lamp. Elihu Thomson and Edwin W. Rice, Lynn, Mass.

We give claim one

"The combination, in an electric lamp, of a stationary high resistance derived circuit magnet, an armature therefor, a lever carrying said armature and supporting the electrode and actuated in opposite directions by said derived circuit magnet and a suitable resistance."

440,664. Method of Electric Welding. Elihu Thomson, Lynn, Mass.

440,665. Trolley Arm for Electric Railways. Elihu Thomson, Lynn, Mass.

440,685. Electric Cut-out. George H. Alton and Edwin W. Rice, Jr., Lynn, Mass.

440,686. Electric Railway Car Motors. Isaac F. Baker, Lynn, Mass.

440,689. Electric Railway Car. Warren S. Belding, Chicago, Ill.

The improvement relates to the application of electric motors to the propulsion of railway cars in such manner as to permit of the constant rotation of the armature of the motor while the car is stationary or in motion.

440,691. Electric Collecting Device or Brush. Harold P. Brown, New York, N. Y.

440,699. Electric Motor. Charles E. Dressler, New York, N. Y.

440,700. Electric Motor and Generator. Charles E. Dressler, New York, N. Y.

440,717. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn.

440,718. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn.

440,720. Electric Switch. Charles A. Pfluger, Chicago, Ill.

440,753. Cross-over Block. Frederick Bathurst, London, England.

440,759. Apparatus for Flashing Filaments. Hermann Lemp, Hartford, Conn.

The object of the invention is to construct an apparatus of peculiar arrangement for flashing the filaments for incandescent lamps, which will automatically control the same, so that when the filament reaches the desired resistance or cross section it will be automatically cut out of circuit.

440,766. Telegraphy. Patrick B. Delany, New York, N. Y.

The last claim is given:

"10. In a system of multiplex telegraphy in which the line is split up by means of series of insulated segments at each end of the line distributed among different operators, over which synchronously actuated trailers connected with the line traverse, the improved method of operating on long lines, which consists in sending an impulse of electricity into the line at one station through a segment, and receiving said impulse at the other station through a segment so located according to the time or length of the line that when the trailer reaches said segment the arrived current will be discharged into it irrespective of the position of the sending trailer."

440,767. Synchronous Telegraphy. Patrick B. Delany, New York, N. Y.

Of the ten claims we give the fourth:

"The combination of the primary driven spindle, a second spindle, interposed mechanism by which the latter spindle is driven at an increased speed, the trailer carried by the latter spindle, and the circle of segments."

440,768. Multiplex Telegraphy. Patrick B. Delany, New York, N. Y.

440, 776. Electric Motor. Harry B. Pullman, Cambridge, Ohio.

440,780. Underground Conductor. Edmond Verstraete, St. Louis, Mo.

440,781. Trolley or Plow for Electric Railways. Edmond Verstraete, St. Louis, Mo.

440,789. Overhead Conductor for Electric Railways. Robert D. Cushing, Boston, Mass.

The invention consists in an insulating guard of novel construction applied directly to the overhead conducting wire in such manner as to leave its under surface exposed and uninsulated.

440,813. Push Button. Hjalmar Von Kohler, New York, N. Y.

440,814. Trolley for Electric Railways. Charles A. Lieb, New York, N. Y.

440,817. Yoke and Brush Holder. Frank B. Rae, Detroit, Mich.

440,821. Electric Motor. Leo Bock, Jr., New York, N. Y.

The purpose of this invention is to provide a motor to be operated by an alternating current.

440,822. Electric Conduit. William J. Brewer, New York, N. Y.

440,845. Electric Switch. Charles H. Herrick of Winchester, Mass.

440,881. Signaling Apparatus for Electric Railways. Frank F. Loomis, Akron, O.

440,898. Calling Device for Clock Telephone Lines. John A. McManman, Milwaukee, Wis.

440,906. Electric Railway. Samuel Trott, Halifax, Canada.

450,908. Dynamo Electric Machine and Motor. Frederik V. Andersen and John O. Girdlestone, London, Eng.

The object of this invention is to reduce the magnetic resistance of the air spaces around the armature to a minimum, to arrange and dispose the iron in the field magnets in the most effective and economical manner, and to reduce the weight of the machines.

440,925. Railway Signal. Joseph W. Riggs, Minneapolis, Minn.

440,926. Railway Signaling Device. Joseph W. Riggs, Minneapolis, Minn,

440,927. Railway Signaling System. Joseph W. Riggs, Minneapolis, Minn.

440,934. Ceiling Block. Daniel A. Tompkins, Charlotte, N. C.

440,976. System of Electrical Transmission of Power. Charles J. Van Depoele, Chicago, Ill.

The invention relates to new and useful improvements in the utilization of electricity as a motive power, whereby an electric motor can be converted into a generator, and the current then produced thereby be added to the main current of the line from which the current is taken to run the system.

440,977. Generator for Pulsating Currents. Charles J. Van Depoele, Lynn, Mass.

The means whereby the generator is adapted to produce rising and falling currents comprise, broadly, a double or four pole field magnet, and a continuous current armature having a sectional commutator provided with four commutator brushes at equidistant points, each pair of brushes being in circuit with one of the motor coils of the engine.

441,030. Train Signal for Railroads. William D. Sheldon, Providence, R. I.

441,031. Train Signal. William D. Sheldon, Providence, R. I.

441,032. Railroad Gate. William D. Sheldon, Providence, R. I.

441,033. Train Signal for Railroads. William D. Sheldon, Providence, R. I.

441,034. Lighting Railroads. William D. Sheldon, Providence, R. I.

441,043. Underground Wire System. Edmond Verstraete, St. Louis, Mo.

441,044. Electric Railway Signal. William H. Waddell, Lexington, Va.

441,059. Incandescent Electric Lamp Socket. James W. Collier, New York, N. Y.

441,060. Process of Magnetically Concentrating Ore. Gurdon Conklings, Glens Falls, N. Y.

441,066. Thermal Protector. Hammond V. Hayes, Cambridge, Mass.

441,122. Contact Trolley for Electric Railways. Norman C. Bassett, Lynn, Mass.

The invention consists in the combination of the pivoted trolley and spring support with the bow spring connected to the trolley and support respectively, and tending to press the former up into contact with a suspended conductor.

441,123. Trolley for Electric Railway Cars. Norman C. Bassett, Lynn, Mass.

441,127. Manufacture of Incandescent Electric Lamps. Adolph Bornholdt, Brooklyn, N. Y.

441,128. Incandescent Electric Lamp. Adolph Bornholdt, Brooklyn, N. Y.

441,130. Electric Battery Connections. Horatio J. Brewer, New York, N. Y.

"Claim 7: The combination, with a zinc electrical connection, of a copper conductor leading thereto, and an interposed piece of tin."

441,157. Electrical Call, Lighting and Alarm System. Charles A. Hale, Cleveland, Ohio.

This is a general system for transmitting calls between the office and the room, and contemplates automatic signals controlled by clockwork, and means for lighting and extinguishing the gas in the guests' rooms and sounding an alarm on one or more floors at a time.

Of the seventeen claims the sixth is as follows:

"In an electrically operated system for buildings, an alarm-board having two series of contact points and a brush to touch the points in both series simultaneously, call bells and lamps, and wires running thereto from said alarm-board, floor switches for the lamps and the call bells and battery service in circuit with said parts."

441,158. Flash Light Photographic Apparatus. William H. Harbeck, Toledo, Ohio.

441,210. Electric Street Railway System. Malone Wheless, Nashville, Tenn.

The claim reads:

"The combination of a continuous power line, a trolley line composed of sections insulated from one another, a car having thereon a motor circuit in electrical connection with the trolley line, a local circuit, part of which containing the source of electricity is on the car, and a switch between the local and the trolley line and power line, whereby when the local is closed a section of the trolley line is connected to the power line."

441,211. Electric Street Railway System. Malone Wheless, Nashville, Tenn.

The last claim is given:

"3. The combination of an insulated power line, a trolley line insulated therefrom, a local circuit having a magnet the armature of which connects the working conductor to the power line, and a magnet between the power and trolley lines which holds such connection, the contact plates with which the armature makes the connection being resilient."

441,212. Conduit for Electric Railways. Malone Wheless, Nashville, Tenn.

441,213. Auxiliary Contact for Electric Railways. Malone Wheless, Nashville, Tenn.

441,214. Electric Railway Cut-out. Malone Wheless, Nashville, Tenn.

441,215. Insulated Brake. Malone Wheless, Nashville., Tenn.

441,216. Electric Railway System. Malone Wheeless, Nashville, Tenn.

This invention relates more particularly to the way of arranging the armature and the device for connecting the power line with the working conductor section, so as to make a larger break when the working conductor section is cut out.

441,217. Electric Railway System. Malone Wheless, Nashville, Tenn.

441,218. Electromagnetic Switch for Electric Railways. Malone Wheless, Nashville, Tenn.

441,219. Electric Railway System. Malone Wheless, Nashville, Tenn.

441,220. Trolley for Underground Electric Railways. Samuel E. Wheatley, Washington, D. C.

441,221. Conduit for Electric Railways. Samuel E. Wheatley, Washington, D. C.

441,246. Armature Body. Charles A. Lieb, New York, N. Y.

441,248. Means for Hanging Electric Lights. Timothy J. Lynch, Danvers, Mass.

441,250. Telpherage System. James E. Maynadier, Taunton, Mass.

441,256. Dynamo Brush Clamp. Thomas Reese, Jr, Newark, N. J.

441,258. Conduit for Electric Railways. Nicholas Seibert, Malden, Mass.

441,293. Rheostat. John Doyle, Hoboken, N. J.

The rheostat or resistance is formed of a cylinder of earthenware, having a grooved surface and resisting material in such grooves, and connections for the electric conductors.

441,304. Annunciator. Charles W. Holtzer, Brookline, Mass.

441,305. Electrically Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa.

441,312. Suspending Device for Electric Wires. Walter B. Marks, John G. Lauer and Robert R. Ralston, Richmond, Va.

441,330. Method of Operating Electric Brakes for Electrically Propelled Cars. William M. Schlesinger, Philadelphia, Pa.

The method consists in successively shifting the circuit of the brake electrically actuating devices to a circuit having a source of supply of gradually decreasing intensity and volume, and then to a circuit having a source of supply of constant intensity and volume.

441,391. Method of Winding Dynamo Armatures. Chas. E. L. Brown, Zurich, Switzerland.

The metnod consists in winding one layer of wires upon the drum, placing a suitable continuous insulation upon said layer of wires, and then winding a second layer of wires upon the insulation.

441,396. Telephone. Frank L. Capps, Springfield, Ill.

The fourth claim reads:

"The combination, with a permanent magnet having forked arms or pole pieces, of an armature pivotally supported between its ends between the said pole pieces and a coil connected in the line circuit and surrounding said armature."

441,401. Method of Electric Welding and Metal Working. Mark W. Dewey, Syracuse, N. Y.

441,403. Galvanic Battery. Oscar A. Enholm. New York, N. Y.

441,413. Secondary Battery. George E. Hatch, Cambridge, Mass.

441,458. Automatic Electric Gas Lighter. LeRoy S. White, Waterbury. Conn.

441,487. Wire Joint for Commutators. Walter E. Harrington, Atlantic City, N. J.

441,488. Pyrometer. William S. Hensley, Cardiff, and William H. Grindley, Tunstall, England.

441,542. Device for Transforming and Controlling Electric Currents. Oscar A. Enholm, New York, N. Y.

441,543. Arc Lamp. Oscar A. Enholm, New York, N. Y.

441,565. Electrically Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa.

441,571. Electric Railway. Hosea W. Libbey, Boston, Mass.

Claim one is as follows:

"A conduit for electric railways, divided vertically into parts, one part being slightly larger than the other, and provided at its lower end with a recess forming a gutter, the two parts of said conduit being each provided with a flange and connected together by bolts."

441,572. Electric Railway. Hosea W. Libbey, Boston, Mass.

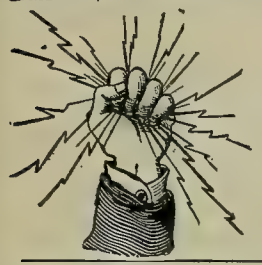
441,579. Apparatus for and Method of Registering and Indicating the Course and Position of Marine Vessels. John O'Neil, New York, N. Y.

441,588. Electrical Switch. George Schultz, Old Charlton, England.

441,622. Electrical Thermostat. Charles H. Shaffer, Rockford, Ill.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

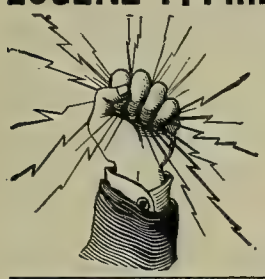
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS

4 LASALLE AVE CHICAGO.

MAKE ANYTHING IN BRASS.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

---

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:

W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

IF YOU HAVE A BATTERY,

Gravity or Leclanche, use the Delany Battery Strip. It prevents salts from creeping, keeps batteries and shelves clean, prevents local action, and prolongs life of battery. **WARRANTED.** Per doz., Gravity, 60c; Leclanche, 50c.

PATRICK B. DELANY,

South Orange, N. J.

FOR SALE.

VERY CHEAP.

Several 10, 15, 25 and 50-H. P. Van Depoele Electric Motors, made for Street Cars; also Gear and Attachments for same; also one 150-H. P. Van Depoele Electric Generator; also two Street Car Trucks, with 4½-inch Axles and Bemis Gear; also a lot of Pulleys and Hangers.

For particulars address

W. A. STILES,

Room 1028, 112 CLARK ST., CHICAGO.

HENRY C. EDDY,

MANUFACTURER'S AGENT,

Electrical Goods and Machinery,

Room 22, 170 La Salle St, CHICAGO.

Binders FOR THE Western Electrician $1.00.

EDISON LAMPS REDUCED TO 44 CTS.

16 CANDLE POWER LAMPS.

Lots of 25 to 150 ..... 44 cents each.
Lots of 150 to 500 ..... 42 cents each.
Lots of 500 ..... 40 cents each.

Other sizes in proportion. All sizes in stock, with bases to fit any make of lamps or sockets.

Full Line OKONITE WIRES in Stock. Safest and best wire made.
Full Line of Edison Sockets and Appliances.

STANDARD ELECTRICAL WORKS, CINCINNATI, OHIO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

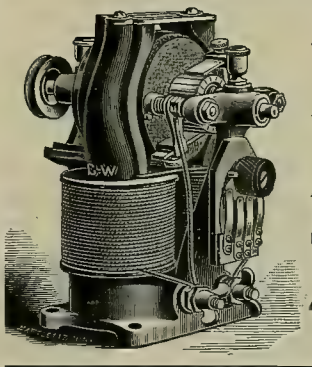
Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.



THE CROCKER-WHEELER

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base—Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies o be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Prest.

CARDEW VOLTMETERS.

These are the only standard Voltmeters that can be used on **alternating** as well as **direct circuits.**

DIRECT READING. DEAD BEAT.

CAN BE LEFT IN CIRCUIT CONTINUOUSLY.

Send for Catalogue 1-66 of Electrical Test Instruments.

QUEEN & CO., PHILADELPHIA.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL OKONITE COMPANY, Limited, - - 13 Park Row, NEW YORK.

BRANCHES Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

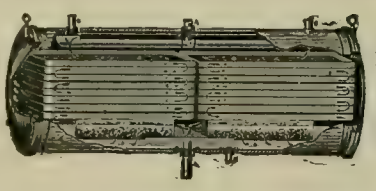
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE BARD PORCELAIN.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed. Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

A MODEL RAILWAY.

The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 45c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 8 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.

G. W. GRIFFIN, Superintendent of Construction.

THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

ALUMINUM ALLOY COMPOSITE. Reduced from $2.00 to 75c. per lb. in 100 lbs. (sample) containing 7½ per cent. Aluminum sent prepaid for only $7. We desire to establish an Agency in every large city for our Metal Alloy. For terms and city rights address THE SCHMIED-BARENGUSS FURNACE CO., Newport, Ky.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ELECTRIC RAILWAY LIGHT AND POWER.

JAS. McLAUGHLIN.

14 Years' Experience.

A Pioneer in the Business.

Repairs and Parts for all Systems.

48, 50 and 52 NORTH CLINTON ST.,

CHICAGO, ILL.

HAVE YOU SEEN IT?

— NEAT. — — CLEAN. —

Always Ready for Use.

Especially for Grenet Medical and Bichromate Plunge Batteries.

Box making 1-pint solution. **Price 15c.** Postpaid.

LIBERAL DISCOUNT TO THE TRADE.

BUBIER MANUFACTURING CO., Lynn, Mass.

FOR SALE.

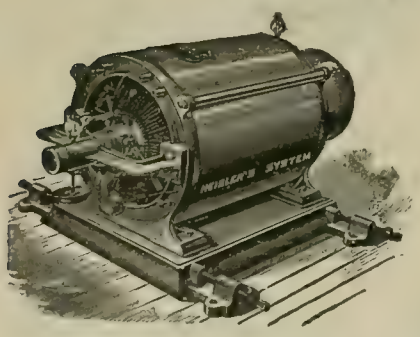
One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

THE HEISLER PATENT LONG DISTANCE INCANDESCENT ELECTRIC LIGHT SYSTEM.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and Domestic Illumination from Central Stations. Plant may be located where power can be secured Cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest, and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained, and Perfectly Automatic.

SEND FOR CIRCULAR. **CORRESPONDENCE SOLICITED.**

HEISLER ELECTRIC LIGHT CO.,

809-817 South 7th Street, - - - ST. LOUIS, MO.

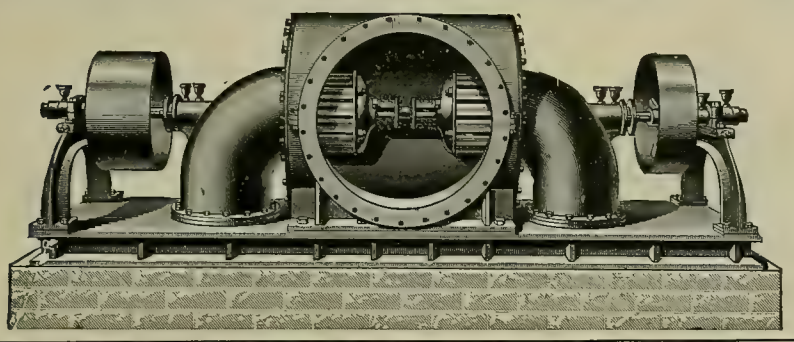
ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators. Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

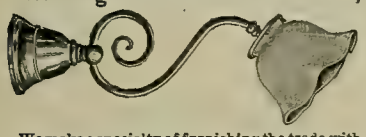
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

JAMES LEFFEL WATER WHEELS

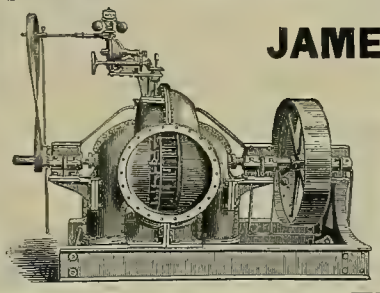
BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental **MACHINERY.**

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

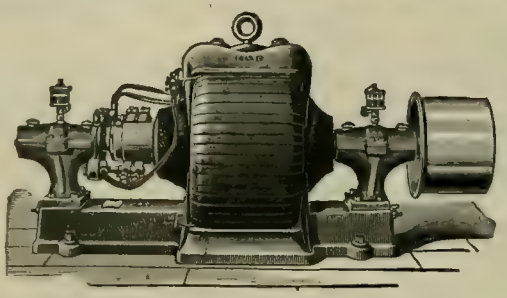
THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

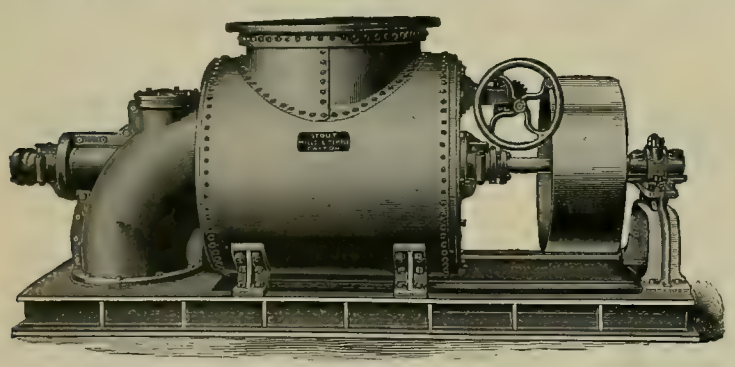
Correspondence regarding Underground and Overhead Cables, Insulated Wires, Electric Lights, Telegraph Instruments, House Goods, and other electrical apparatus solicited. Our new Illustrated General Catalogue will be furnished to the trade on application.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

STANDARD ELECTRICAL WORKS, Agents, CINCINNATI, OHIO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

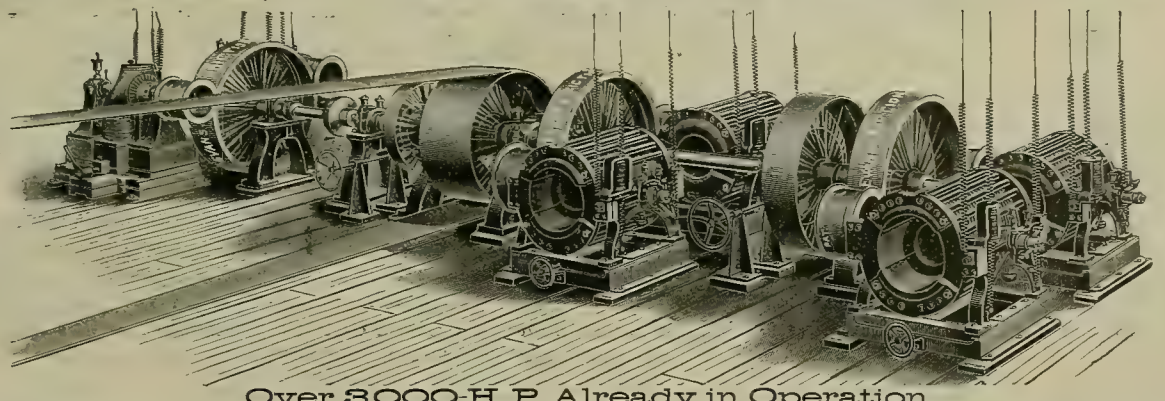
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

(STATION OF THE NORTH ATTLEBORO STEAM AND ELECTRIC CO.)

This Station has been in Successful Operation Since March, 1890.



Write for Full Particulars and List of Parties who are Using.

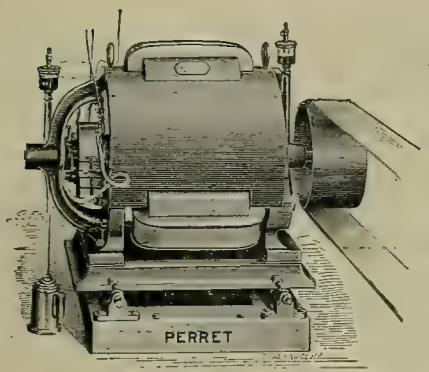
Over 3,000 H. P. Already in Operation.

Send for Catalogue "D" to **THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.**

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—



Perret 20 H. P. Motor, Speed 550, Weight 1,300 lbs.

Perret Electric Motors and Dynamos

**LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.**

*Motors of any size for any purpose. Factories equipped throughout with Electric Power.
Isolated Plants for Incandescent Electric Lighting.*

—SELLING AGENTS:—

CHICAGO, ILL., C. M. Barclay, 205 Canal St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
BALTIMORE, MD., W. W. Donaldson, 215 N. Calvert St.
ST. PAUL, MINN., F. J. Renz, 327 Minnesota St.
PHILADELPHIA, PA., Cleverly Electrical Works, 1018 Chestnut St.

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

—Manufactured by—

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

ESTABLISHED 1867.

FRANKLIN S. CARTER,
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

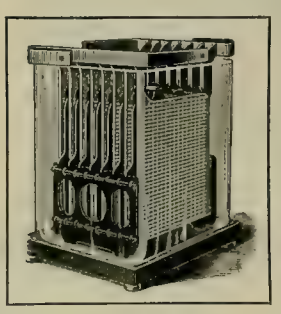
BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF

FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR CO.,

44 Broadway, NEW YORK.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 Carter Street, Philadelphia, Pa.
CHICAGO AGENCY:—239 La Salle St. SAN FRANCISCO:—220 Sutter St.
BOSTON:—HOLTZER-CABOT ELECTRIC CO., 111 Arch Street.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

OKONITE TRADE MARK.

Okonite and Candee WIRES.

Okonite and Manson TAPES.

PRICES TALK.

WRITE TO US FOR THEM.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

THE RICE AUTOMATIC

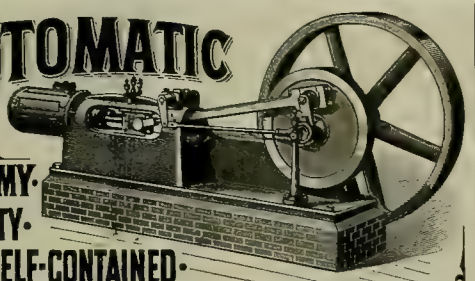
GUARANTEED ECONOMY.

REGULATION·DURABILITY·

SIMPLICITY·SELF-CONTAINED·

8 TO 300 H.P. · PAIR & TANDEM · COMPOUNDS ·

THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.



POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul

SELLING AGENTS.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,

MANUFACTURING ELECTRICIAN,

Office, 63 Broadway, New York.

Factory, 118-120 Park Avenue, Brooklyn, N. Y.

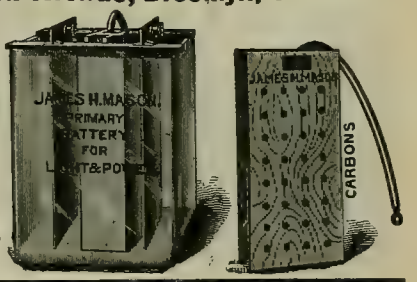
COMPLETE PLANTS FOR SMALL STORES.

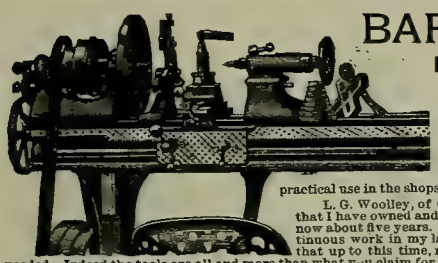
Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.





BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

The S. S. White Dental Manufacturing Co.

PRINCIPAL DEPOT:
Chestnut St., cor. Twelfth, Philadelphia.

BRANCH HOUSES.
Nos. 767 & 769 Broadway, New York.
" 1260 & 1262 Broadway, New York.
" 160 Tremont Street, Boston.
" 151 & 153 Wabash Avenue, Chicago.
" 444 Fulton Street, Brooklyn.

Cable Address: White, Philadelphia.

Founded by Samuel S White in 1844.

JAMES W WHITE, President. J. CLARENCE WHITE, Secretary
HENRY M. LEWIS, General Manager. SAMUEL T. JONES, Treasurer.

Philadelphia November 4th, 1890.

Edison Mfg. Co.,

Orange, N. J.,

Gentlemen:

Yours of October 16th duly received, and sickness has caused the delay in answering it. As to the Edison Laland Battery, we have been using primary batteries to operate dental electric pluggers and motors since 1875, and am compelled to say that the Edison Laland Battery far excells all other batteries we have ever used.

Yours truly,

The S. S. White Dental Mfg. Co.

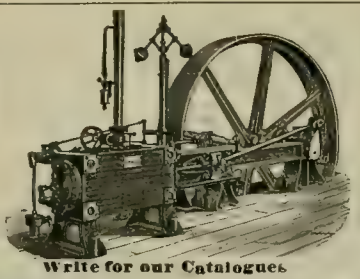
E J Stark

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues.

SOLE BUILDERS

EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

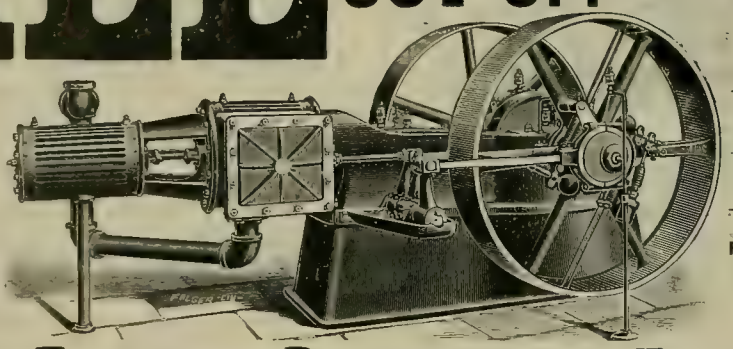
BALL AUTOMATIC CUT OFF ENGINE

Standard.

Cross Compound.

Triple Expansion.

Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Building, CHICAGO, ILL.

WILLIAM T. BONNER,
618 New York Life Insurance Building, OMAHA, NEB.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

BALL ENGINE COMPANY, ERIE, PA.

CINCINNATI HEADQUARTERS

ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.

WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE · FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS ·

THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.

The JONES-BROS-ELECTRIC-CO. 28 30 & 32 WEST COURT ST.

DR. GASSNER'S

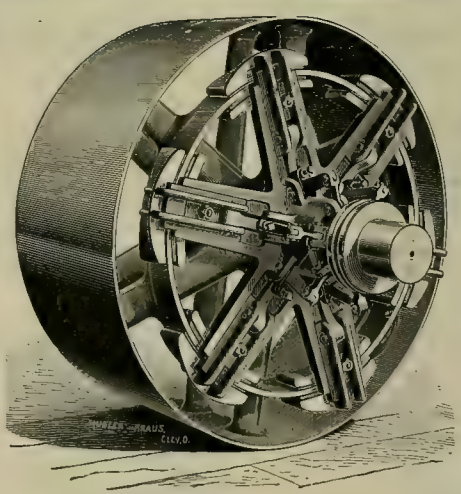
DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅜ in. x 3¼ in.
17.	"	7½ "	3⅜ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY:
1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

JOHN STEPHENSON CO.,

LIMITED,

NEW YORK.

STREET CARS

FOR

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.

W. N. Hobart, Pres't. L. O. Maddux, Vice-Pres't and Treas. J. H. Eickershoff, Sup't.
J. C. Hobart, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 TO 300 HORSE-POWER. COMPOUND AND VALVELESS.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS. NO ECCENTRICS. NO STUFFING BOXES.
NO PISTON RODS. INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.

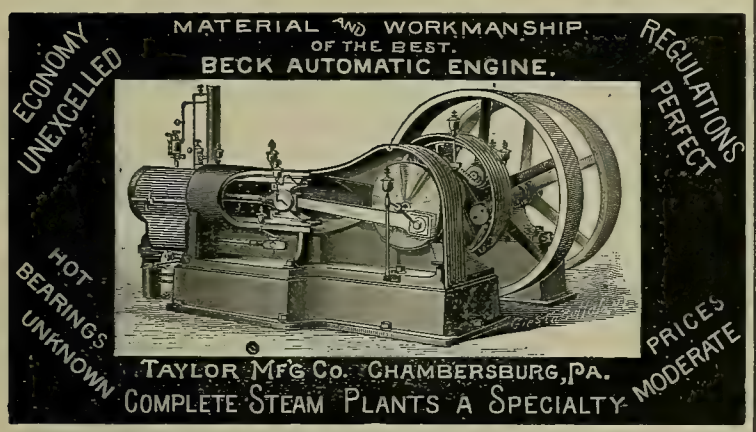
The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.



For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

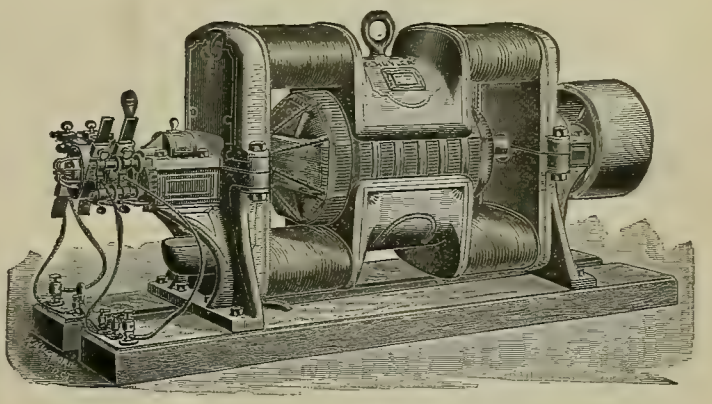
The LECLANCHE BATTERY CO., NEW YORK.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

THE

Thomson-Houston Electric Co.'s

RAILWAY SYSTEM

Embodies all the Essential Requisites of a First-Class Equipment.

THE ONLY SYSTEM FULLY PROTECTED AGAINST LIGHTNING.

Companies desiring Center Pole Construction should see the Indianapolis Plant, illustrated below. Also, Washington, D. C., Rochester and Brooklyn, N. Y.

Citizen's Street Railway, Indianapolis, Ind.—Thomson-Houston System.

THE THOMSON-HOUSTON PERFECTED SNOW SWEEPER

IS NOW READY FOR DELIVERY. IT WAS USED EXCLUSIVELY BY THE WEST END COMPANY OF BOSTON, LAST WINTER, AND IS FULLY INDORSED BY THEM, AND OTHER COMPANIES WHO HAVE USED IT.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,

GENERAL WESTERN AGENTS

PERKINS ELECTRIC LAMP CO.

To Fit Any Socket, Any Candle Power,
Highest Efficiency.

GRIMSHAW WHITE CORE

Wires, Cables

and Tapes.

ANNUNCIATORS,

BURGLAR ALARM BELLS, BUTTONS, ETC.

PORCELAIN CUT-OUTS,

Main and Branch Cut-Outs, Rosettes and Switches, Underwriters' Weather Proof Wires and Line Supplies.

Write for Prices on these Specialties. Our New Catalogue for 1891 Just Out.

54 & 56 FRANKLIN STREET, CHICAGO.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

A STRONG COMBINATION

For Underground Work
For Underwater Work
For Concealed Wiring
For Breweries
For Packing Houses
For Soap Factories

For any work requiring Rubber Insulation, and especially where the conditions to be encountered are extra trying

HABIRSHAW INSULATION SHOULD BE USED

PREMATURELY OLD

WILL BECOME THE MAN WHO DOES NOT USE

SHIELD BRAND INSULATION

FOR HIS OVERHEAD CIRCUITS

R. S. V. P.

A Note. A Sample. A Test. Another Note. A Quotation. An Order. A Bill (not THE BILL.) A Check. Happiness.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

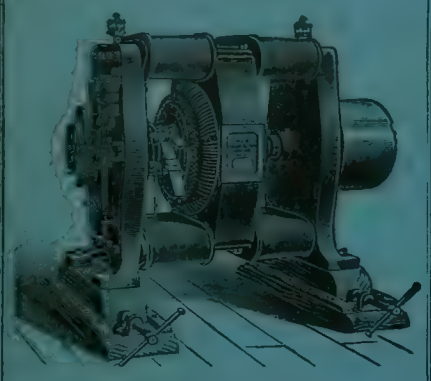
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



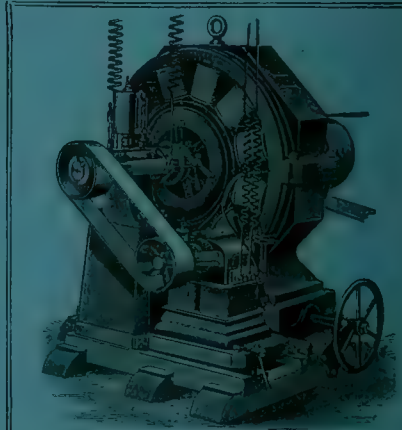
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

The Consolidated Electric Storage Co.,

MANUFACTURERS OF

THE JULIEN
ELECTRIC STORAGE BATTERY.

Exclusive licensees for the whole of the United States of the Storage Battery Patents of Charles F. Brush [lately owned by the Brush Electric Company], and sustained by the Circuit Court of the United States.

Electrical Accumulator Company vs. Julien Electric Company, 38 Federal Reporter, 117.
Brush Electric Company vs. Julien Electric Company, 41 Federal Reporter, 679.

BATTERIES FOR LIGHT AND POWER,

Sold at Prices so Low as to Defy Competition.

For Agencies and Licenses apply at the Company's Office at

120 BROADWAY, NEW YORK CITY.

All other inquiries, more especially those in relation to Purchase of Batteries, should be addressed to the Philadelphia Office of the Company.

926 Drexel Building, PHILADELPHIA, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. VII. CHICAGO, DECEMBER 13, 1890. No. 24

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. { PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin' ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

INDORSED BY THE UNITED STATES AND GERMAN GOVERNMENTS.

NEW YORK AND BROOKLYN BRIDGE, BROOKLYN, Nov. 7, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—This certifies that we have had your metal in use about six months on the crank pin of a four hundred and fifty horse power Wright engine, and also as packing rings on the piston rod of a locomotive. In both places it has given entire satisfaction, not causing the least trouble.

Yours very truly, C. C. MARTIN, Chief Engineer and Supt.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.

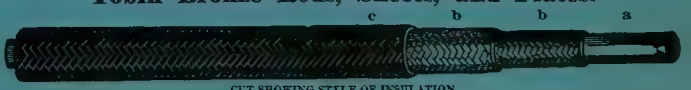
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.



CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, { 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

THE MILLIKEN PATENT ELECTRIC RAILWAY POLE.

—MANUFACTURED BY—

MILLIKEN BROS.,

No. 55 LIBERTY STREET, NEW YORK. | No. 59 DEARBORN STREET, CHICAGO.

Standard Side, Center and "Pull-Off" Poles. Special Attention Given to Insulation. Special Poles of any Required Length, or to Stand any Strain Made to Order.

Adopted by all the Leading Roads and Recommended by the Best Engineers.

In use in the following cities: NEWARK, BUFFALO, JERSEY CITY, PATTERSON, TROY, PITTSBURGH, HAMILTON, O., ETC.

Over 6,000 Ordered in the Last 3 Months.

ORDERS FOR STANDARD POLES FILLED FROM STOCK.

WRITE FOR PARTICULARS.

E-D-I S-O-N

Miniature Incandescent

ELECTRIC LAMPS.

1-2 to 36 Candle Power.

For use with Batteries or Dynamos.

3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

THE THOMSON-HOUSTON ELECTRIC CO.,

Arc and Incandescent Electric Lighting Apparatus.

620 Atlantic Ave., Boston, Mass.
148 Michigan Ave, Chicago, Ill.
115 Broadway, New York, N. Y.
215 W. 4th St., Cincinnati, Ohio.
N. Y. Life Ins. Bldg., Kansas City, Mo.
115 N. 3d St., St. Louis, Mo.
15 First St., San Francisco, Cal.

Electric Railway Equipment. Electric Motors.

THE ONWARD MARCH!

Some Facts in Electric Lighting.

No. of Companies using Thomson-Houston Arc Apparatus, Jan. 1, '90	516	
No. of Companies using Thomson-Houston Arc Apparatus, July 1, '90	587	
Increase 6 months, ending July 1, '90		71
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, Jan. 1, '90	68,203	
Total No. of Arc Lamps of Thomson-Houston Manufacture in use in Central Stations, July 1, '90	79,387	
Increase 6 months, ending July 1, '90		11,184
No. of Co.'s using Thomson-Houston Incandescent Apparatus, Jan. 1, '90	337	
No. of Co.'s using Thomson-Houston Incandescent Apparatus, July 1, '90	436	
Increase 6 months, ending July 1, '90		99
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, Jan. 1, '90	281,555	
Total No. of Thomson-Houston Incandescent Lights in use in Central Stations, July 1, '90	408,515	
Increase 6 months, ending July 1, '90		126,960

There are also in the United States Isolated Plants using in the aggregate
20,000 Thomson-Houston Arc Lamps,
and over 100,000 Thomson-Houston Incandescent Lamps.

ELECTRIC RAILWAYS.

Roads in Operation, July 1, 1890	80
Number of Motor Cars	1,069
Roads under Construction, July 1, 1890	43
Number of Motor Cars	408

Grand Total.

Number of Roads 123 Number of Motor Cars 1,477
Total Length of Track (in miles) 897

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co..... xx
Abendroth & Root Mfg. Co.. xv
Alexander, Barney & Chapin. xii
Allis, E. P. & Co..... xx
American Electrical Works.. xv
Ansonia Brass & Copper Co.. i
Automatic Switch Co..... vii
Baggot, E..... xvi
Bain, Foree..... xvii
Ball Engine Co..... xvi
Barnes, W. F. & Jno..... xxi
Barton, Geo. P..... —
Baxter Electric Motor Co.....xxviii
Bernstein Electric Co..... xxi
Bleckert & Nelson..... xvii
Brush Electric Co..... xxvii
Bubier Publishing Co..... xvii
Bunnell & Co., J. H..... xiv
Butler Hard Rubber Co..... xx
C. B. & Q. R. R..... —
C. & C. Electric Motor Co... xviii
C. & N. W. R. R. Co..... —
Central Electric Co..... xi
Chicago Electric Club..... —
Cleverly Electrical Works... iv
C. M. & St. P. R. R. Co..... —
Colburn & Co., I. W..... xvi
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co..... xii
Consolidated Electric Storage Co..... —
Continental Dynamo Co..... iv
Cowles Electric Smelting and Aluminum Co..... xvi
Crocker-Wheeler Motor Co... xv
Crosby Electric Co..... iv
Curtis Regulator Co..... —
Day s Kerite Insulation..... i
Dayton Globe Iron Works Co.xviii
Delany, P. B..... —
Eastern Electric Cable Co. xv
Eddy Electric Mfg. Co..... ix
Edison Mfg. Co..... xxi
Edison General Electric Co.,— Lighting and Power Dept... viii
Edison General Electric Co.,— Lamp Dept..... i
Electric Construction & Sup. Co iv
Electrician Publishing Comp'y .....xx, xxii
Electrical Supply Co.....xxvi
Elektron Mfg. Co..... xix
Empire City Electric Co.....xviii
Empire China Works..... xvi
Eureka Tempered Copper Co.. xvii
Evans Friction Cone Co..... xix
Fibrone Mfg. Co..... xv
Fletcher &Fletcher Electric Co xv
Forest City Electric Works.... —
Fort Wayne Electric Co..... xxviii
Gibson Co., W. D.....iv
Globe Carbon Co..... xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S..... —
Harmount, G. A..... vii
Hawkeye Electric Mfg. Co.... iv
Hazelton Tripod Boiler Co... xvi
Heisler Electric Light Co..... —
Hill Clutch Works..... —
Holmes, Booth & Haydens.....xvii
Holtzer-Cabot Electric Co..... i
Humphrey, H. H..... —
Illinois Electric Material Co.... xiv
India Rubber & Gutta Percha Insulating Co..... i
Interior Conduit&InsulationCo. xiv
Ireson, Chas. L..... i
Jewell Belting Co..... xv
Jones Bros. Electric Co..... xx
Knapp Electrical Works..... xxv
Laminar Fibre Goods Co..... xvii
Law Telephone Co..... xv
Leclanche Battery Co.....xxiii
Leffel & Co., Jas..... xvi
McLaughlin, James.....xvi
Magnolia Anti-FrictionMetal Co i
Mason, James H..... ... xxi
Milliken & Co..... i
Monitor Electric Co..... vii
Munsell & Co., Eug..... xv
Münson Belting Co., Chas..... xiv
National Carbon Co..... iv
National Electric Mfg. Co..... x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T... ... —
N. Y. Belting & Packing Co... xiv
Okonite Co..... .. xv
Ostrander & Co., W. R. xviii
Page Belting Co..... —
Paiste, H. T..... xiv
Peckham Street-Car Wheel & Axle Co..... vii
Partrick & Carter xx
Pennsylvania Co..... xvi
Phillips Electrical Works, E. F xv
Phoenix Glass Co.....xxviii
Pittsburgh Sheet Metal Tool Co..... xv
Pond Engineering Co..... xxi
Powell Co., Wm..... —
Proposals for Lighting City of Indianapolis..... xvi
Queen & Co..... xvi
Roeblings' Sons Co., Jno. A... xix
Sawyer-Man Electric Co..... xiii
Schieren & Co., Chas. A..... xiv
Schmiedbarenguss Furnace Co.. xvi
Schoverling, A ..... —
Schuyler Electric Co.....xxiii
Shultz Belting Co..... ..... —
Southern Electrical Supply Co. xxi
Sperry Electric Co..... xviii
Standard Electrical Works ... xv
Standard Paint Co. xiv
Standard Underground Cable Co. i
Standard Carbon Co..... xx
Stanley & Hall.....xiv
Star Electrix Co..... vii
Stephenson & Co., Jno..... xii
Stiff, E. D. & Co.... ..... —
Stiles, W. A..... xv
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xx
Taussig, S..... xvi
Taylor Mfg. Co..... xxiii
Thomson-Houston Electric Co. Lighting department..... ii
Thomson-Houston Electric Co., Railway department..... xxiv
Triumph Compound Engine Co xxiii
Turner Brass Works..... xv
Union Hardware Co..... xiv
United Electric Traction Co....xxiii
United States Electric Lighting Co..... .....—
Van Nuis C. S..... —
Wanted.....xv, xvi
Western Electric Co xviii
Westinghouse Electric and Mfg. Co.... xiii
Weston Electrical Instrument Co..... —
Wollensak, J. F..... iv
Woodbridge & Turner..... xv

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co

Aluminum.
Cowles Electric Smelting & Refining Co.
Schmiedbarenguss Furnace Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
McLaughlin, Jas.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bubier Mfg. Co.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
GreatWestern Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.'
Leclanché Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S..
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.

Belting—continued.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
McLaughlin, Jas.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D.
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Con't'd
Southern Electrical Supply Co.
St. Louis Electrical Supply Co
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Elektron Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Great Western Electric Supply Co
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Queen & Co.

Springs.
Gibson Co., W. D.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.
Writing Telegraph Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel&AxleCo.
Stephenson Co , Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

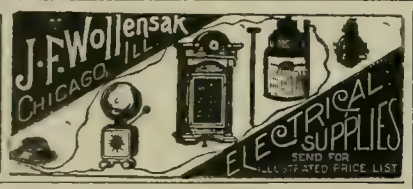
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



Cleverly
1018 CHESTNUT ST.
PHILA

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

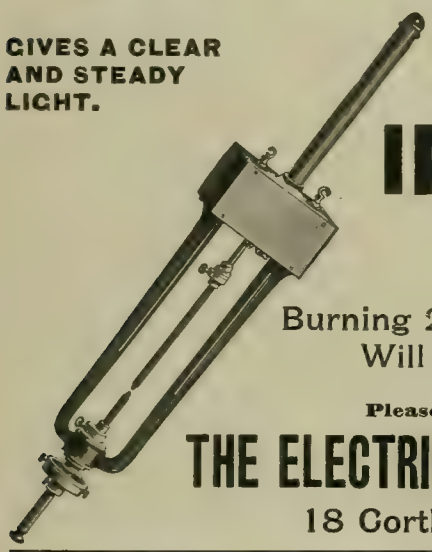
THE WM. D. GIBSON CO.,

65 N. Jefferson St.,
CHICAGO, ILL.

SPRINGS

FOR ELECTRICAL MACHINERY A SPECIALTY.

GIVES A CLEAR AND STEADY LIGHT.



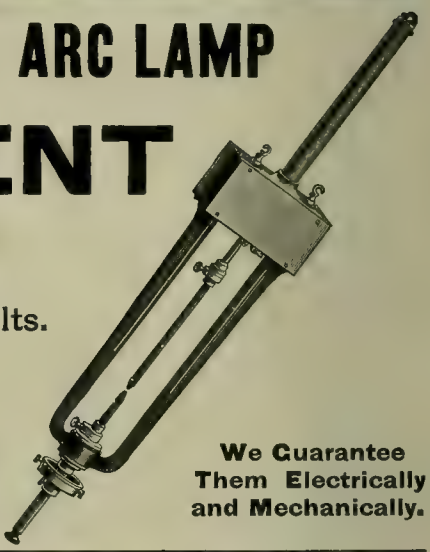
THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.



We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT,
CLEAN,
EFFECTIVE,
SIMPLE,
COMPACT,
PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

87 and 89 South Fifth Avenue, - - NEW YORK.

THE HAWKEYE ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station AND ISOLATED PLANTS, ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps***, Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

GREAT WESTERN ELECTRIC SUPPLY COMPANY,

190--192
FIFTH AVE.,
CHICAGO.

Makers of the Choicest Electrical Supplies.

ELECTROLIERS
—AND—
COMBINATION FIXTURES.

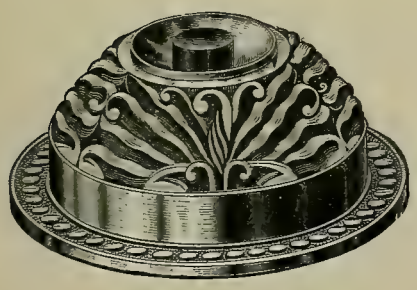
EVERY VARIETY OF
SHADES
PLAIN AND FANCY
ARC GLOBES.

DO YOU NEED ANY WIRE?

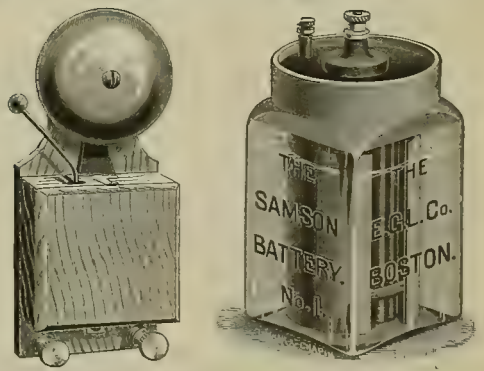
SIMPLEX IS THE BEST.

TRY IT ONCE, AND BE CONVINCED.

"YOU PRESS THE BUTTON"
AND
"WE DO THE REST."



HEADQUARTERS FOR
Bell - Hangers' - Supplies.



REMEMBER OUR PRICES ARE THE LOWEST.

IMMENSE STOCK!!
BOTTOM PRICES!!

Electrical Supplies

OF ALL KINDS.

NORTHWEST
THOMSON-HOUSTON
ELECTRIC CO.,

403 & 405 SIBLEY ST., · ST. PAUL.

OUR POLICY:

First Class Goods, Small Margins and Quick Delivery.

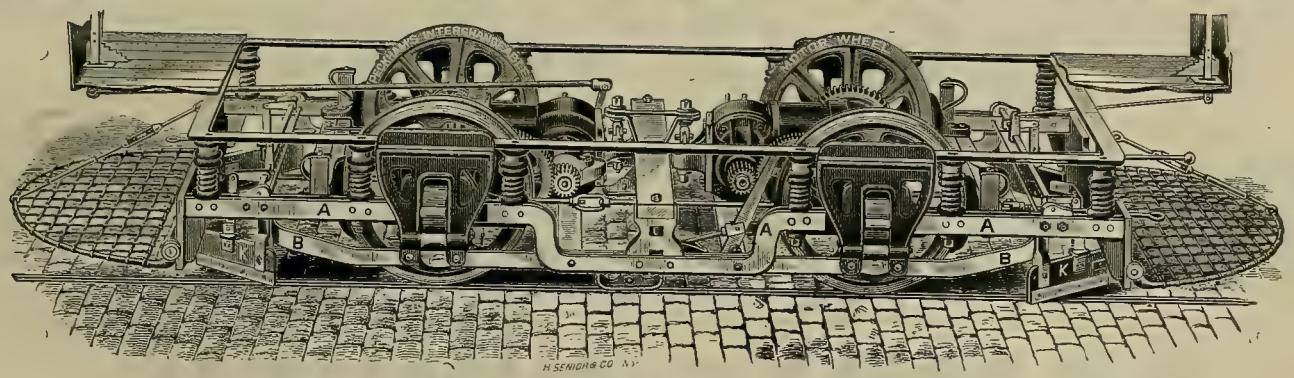
LARGE STOCK OF

Grimshaw White Core,
Holmes, Booth & Hayden's "K. K."
Underwriters' Line Wire & Magnet Wires.

FULL LINE OF PORCELAIN GOODS.

"ELECTRIC BLOCK", 403 & 405 SIBLEY STREET, ST. PAUL, MINN.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

'Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes, Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

ELECTRIX.

To Central Station Mgrs., Contractors and Dealers.

Gentlemen:—We beg to apologize for a slight delay on orders and samples during the past week, as we have been literally "snowed under," but with the aid of a largely increased force we hope to be able to meet all requirements promptly hereafter.

Very truly,

THE STAR ELECTRIX CO.,

1320 Wallace St., Philadelphia, Pa.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

AUTOMATIC SWITCH CO.,
No. 8 KEYSER BUILDING,
BALTIMORE, MD., U. S. A.

Sole Manufacturers of the
WHITTINGHAM
AUTOMATIC SWITCH.
The only reliable protector to the Armature of an Electric Motor.
Applicable to Constant Potential Motors of all sizes and patterns.
SEND FOR CATALOGUE.

EDISON PATENTED APPARATUS.

For Sale to all Parties in U. S.

Except for use in certain localities already exclusively licensed, list of which will be furnished upon application.

SAMPLE PRICES.

GENERATOR.	MOTOR.	RATING.	PRICE TO PURCHASER.
5 light,	*¼ H. P.*	*.250 Kilowatts.*	*$37.84*
10 light,	*½ H. P.*	*.500 "*	*$58.76*
20 light,	*1 H. P.*	*1. "*	*$106.83*
45 light,	*2½ H. P.*	*2.5 "*	*$177.02*
90 light.	*5 H. P.*	*5. "*	*$278.77*

ARTICLES.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.	ARTICLE.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.
Standard Keyless Socket,	*1*	*$0.297*	*Porcelain Ceiling Cut-out,*	*397*	*$0.3575*
Standard Key Socket,	*2*	*$0.627*	*Porcelain Double Pole 10-light Switch,*	*511*	*$1.2925*
Standard Keyless Receptacle on Porcelain Base,	*3*	*$0.275*	*Pendulum Ampere Meter up to 200 Amperes,*	*377*	*$12.10*
Attaching Plug,	*V 69*	*$0.1925*	*Standard Pressure Indicator,*		*$41.25*
Two-Wire Branch Cut-out,	*1935*	*$0.44*	*Ground Detector,*	*152*	*$4.125*
Safety Plugs for Cut-outs, 1 to 30 Lights,	*181*	*$0.0715*			

16 C. P. LAMPS {in lots of 25} 44 CENTS EACH.

Write to nearest district office, or any Electrical Supply House, or Electrical Engineering Concern.

EDISON GENERAL ELECTRIC COMPANY.

MAIN DISTRICT OFFICES:

Canadian District, Bank of Commerce Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 38 Pearl Street, Boston, Mass.
Rocky Mountain District, Masonic Building, Denver, Colo.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Southern District, Cotton Exchange Bldg., New Orleans, La.

EDDY ELECTRIC MOTORS

For all kinds of Stationary Work. Built in all sizes from one-half to 300 H. P.

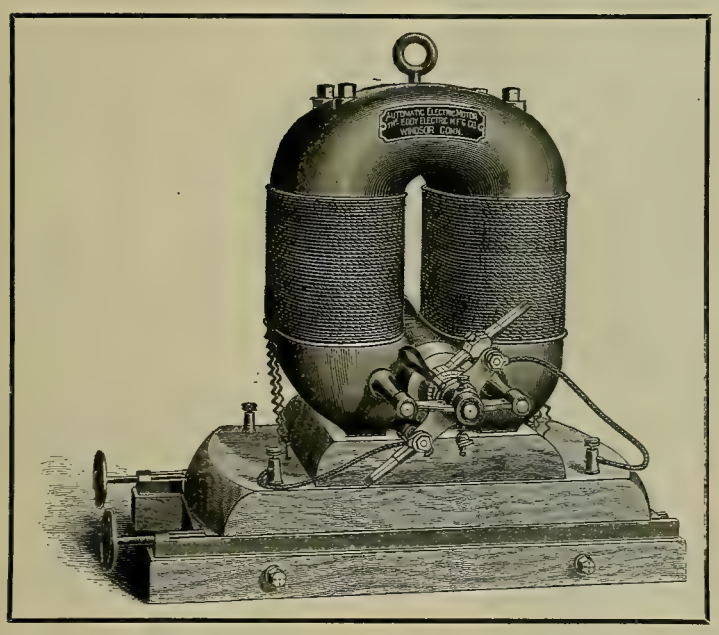
ELECTRIC POWER TRANSMISSION

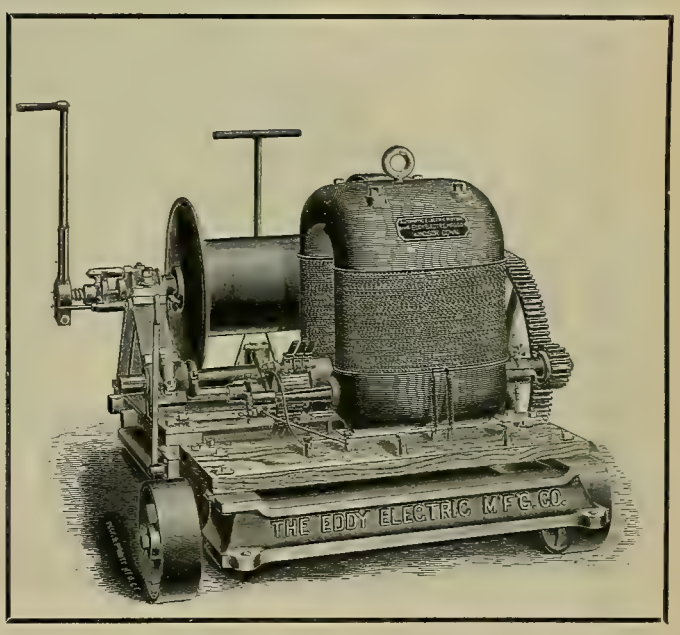
A SPECIALTY.

ELECTRIC HOISTS

OF ANY CAPACITY.

ELECTRIC MINING MACHINERY.





CORRESPONDENCE SOLICITED.

THE EDDY ELECTRIC MFG. CO.,

WINDSOR, CONN.

15 Cortlandt St., NEW YORK.

BOSTON, 111 Arch St.
PHILADELPHIA, 506 Commerce St.
NEW ORLEANS, 78 Custom House St.
KANSAS CITY, Rialto Building.

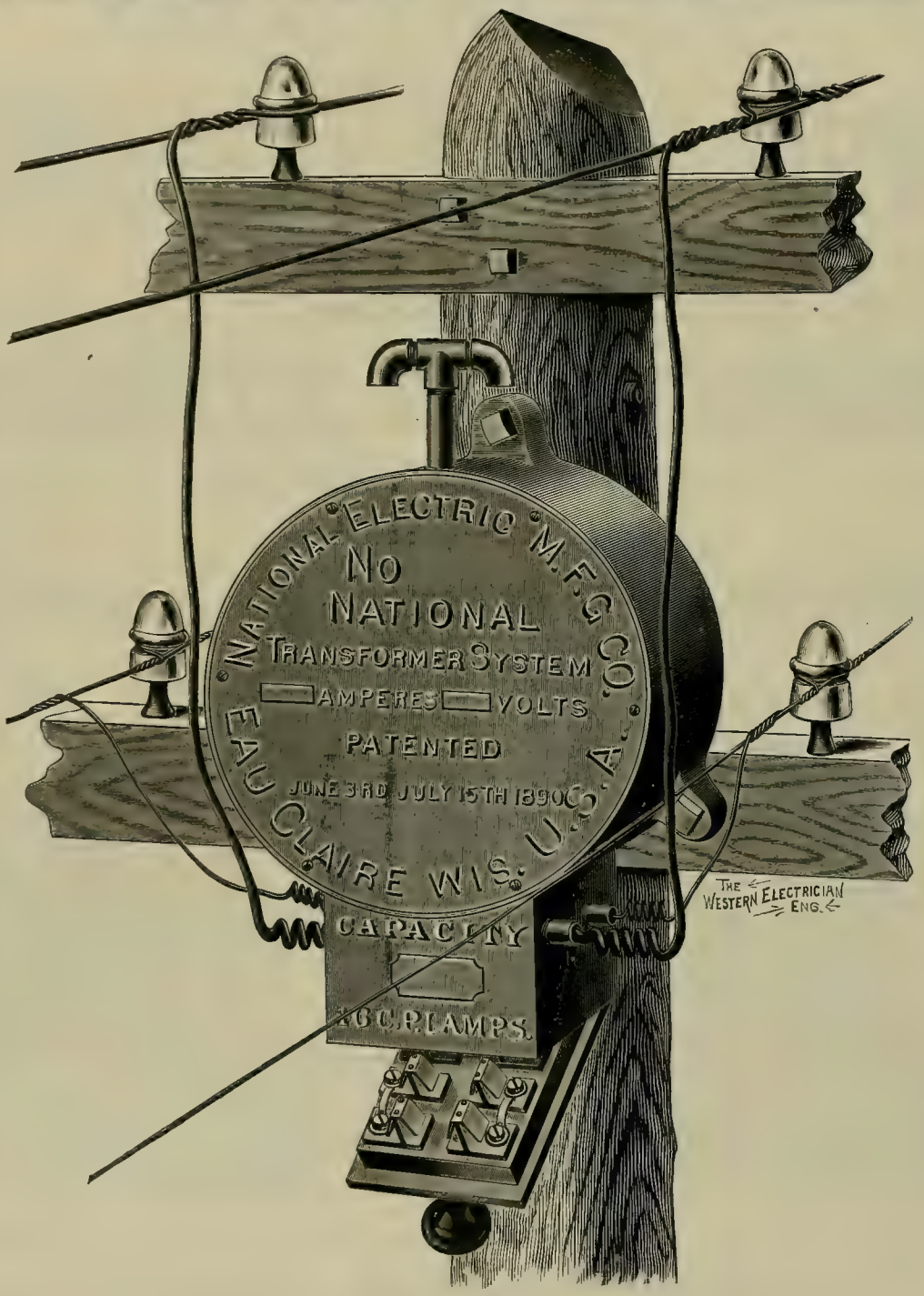
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

Transformer on Pole Showing National Safety Fuse Box.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., - - - - - - Seattle, Washington.	W. N. GRAY, Special Agt., - - Room 12, Chamber of Commerce, Cincinnati, O
THOMAS WOLFE, Southwestern Agt., - - Union Depot Hotel, Kansas City. Mo.	NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Bldg., 50 Broadway, N. Y. City.
LITTLE, McDONALD & CO., Gen l Agts., - - 141 East Seneca St., Buffa'o, N. Y.	NATIONAL ELECTRIC DEVELOPMENT CO., 314 - California St., San Francisco Cal.
METCALF, REED & CO , Western Agts., - - - 1517 Larimer St.. Denver, Colo.	SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Ag'ts., - Winnipeg, Manitoba
CHAS. M. BLANCHARD, Agt., - - - Girard Building, Philadelphia, Pa	A. IRVINE, Agt., - - - - - - - Emilie Building, St, Louis, Mo
L. N. COX, Agt., - - - - - - - 16 Fifth St., S. E., Washington, D. C.	

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

Has that last lot of old
Lamps proven bad?
Then try
A NEW LAMP,
THE "A. B. C."

TRADE A.B.C. MARK

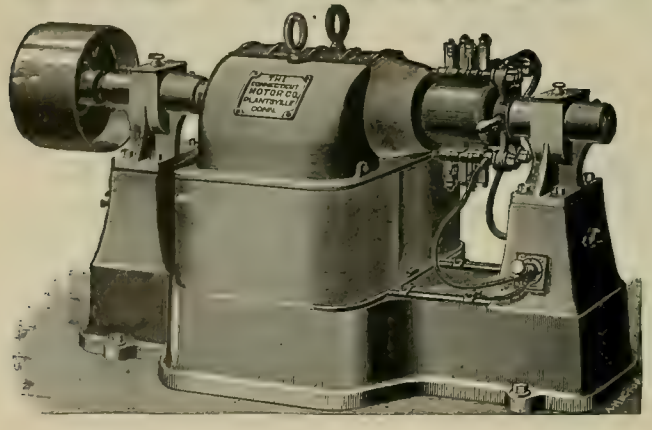
Long Life,
Good Light,
High Efficiency,
Any Candle-Power,
Made to fit any socket.

CONVERTERS
from 5 to 150 light capacity.
Sockets and Switches,
Fuse Wire,
Main & Branch Cut-outs,
Wire of all kinds,
Tin Shades, Glass Shades,
Arc Lamps for
Incandescent Circuits.
Voltmeters, Ammeters.

ALEXANDER, BARNEY & CHAPIN,
TELEPHONE BUILDING,
20 Cortlandt Street,
NEW YORK.

JOHN STEPHENSON CO.,
LIMITED,
NEW YORK.
STREET CARS
FOR
ELECTRIC MOTORS
ADAPTED TO ALL SYSTEMS.

THE CONNECTICUT MOTOR CO.,

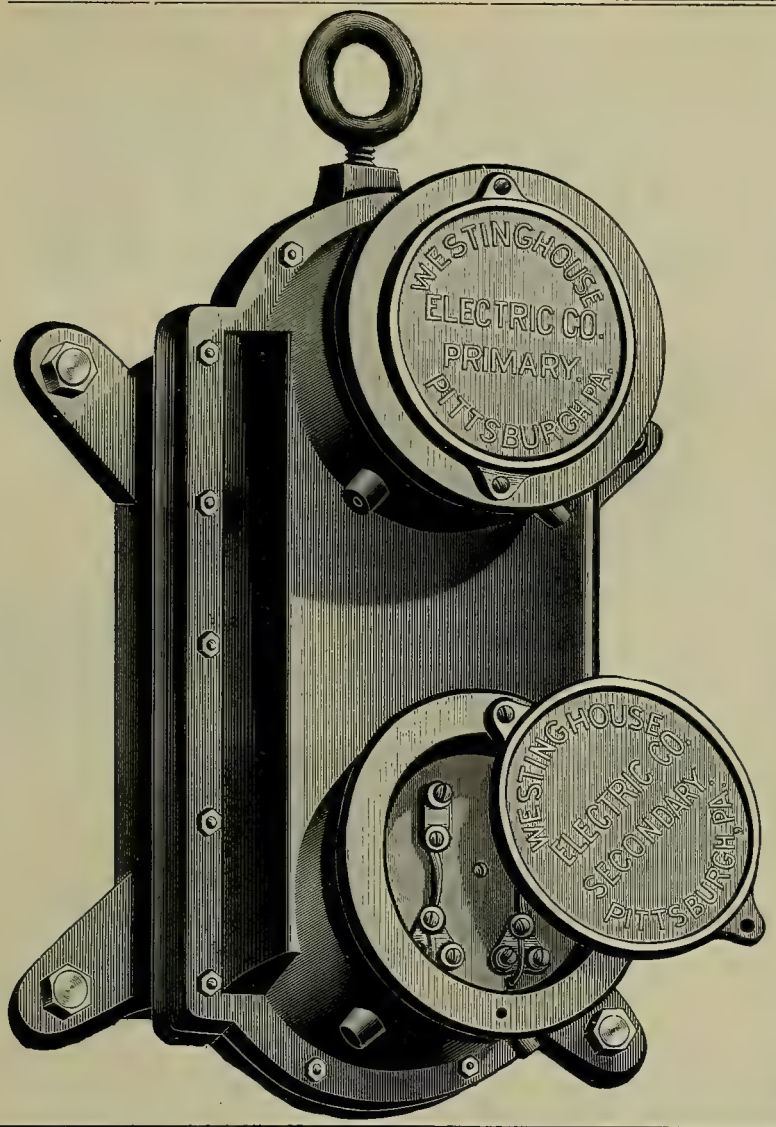


OFFICE AND WORKS:
PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL
Electric Motors and Generators
1-2 TO 50 HORSE POWER.
FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W. Sixth St.
HARTFORD, 14 State St. ST. LOUIS, 823 Locust St. CHICAGO, 302 Insurance Exchange Building.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.



CONVERTER EFFICIENCIES

It will Pay You to Throw Out Your Present Converters, and Substitute Our Make.

COMPARISON OF CONVERTERS.

	Total Efficiency.	*Converter Capacity Tested*
THOMSON-HOUSTON,	**87.50 Per Cent.**	**25.**
FT. WAYNE JENNEY,	**87.**	**25.**
NATIONAL,	**88.**	**20.**
WESTINGHOUSE,	**95.**	**20.**

The above figures speak for themselves. You can afford to throw away your inefficient converters and buy ours, which will pay for themselves within a reasonable time and permit you to carry a larger commercial load on a given dynamo.

INCANDESCENT ALTERNATING CURRENT

Dynamos, Converters, Meters, Motors.

325 CENTRAL STATIONS and 600,000 LAMPS.

Alternating Current Arc Lighting Apparatus.
Lamps burn 40 hours without renewal of carbon.
Arc Lighting revolutionized.

SEND FOR SPECIAL CIRCULAR.

55 Plants and 5,000 Lamps Sold Within a Few Months.

CORRESPONDENCE SOLICITED.

WESTINGHOUSE ELECTRIC AND MFG. COMPANY,

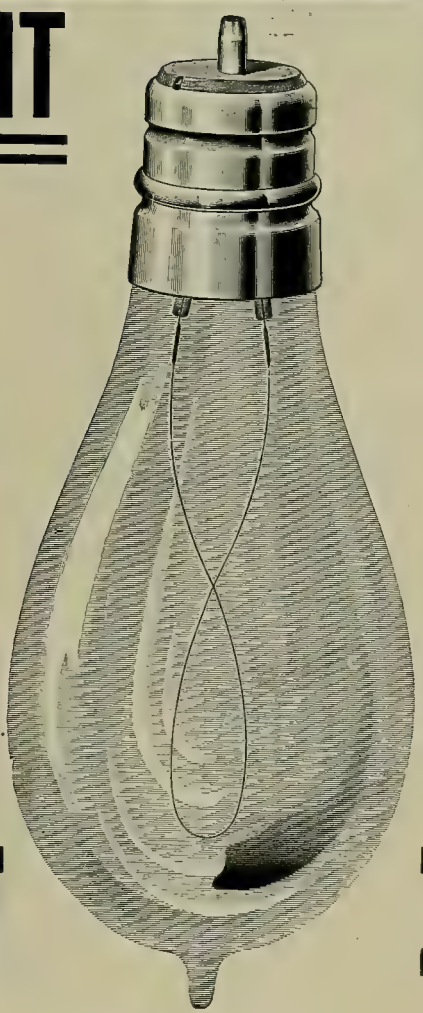
Pittsburgh, Pa., U. S. A.

Boston, New York, Chicago, Cincinnati, St. Louis, San Francisco, Portland.

INCANDESCENT LAMPS.

To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.



Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS

General Electrical Supplies of Superior Designs and Finish

THE CHEAPEST.

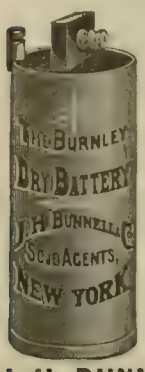
Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, **NEW YORK.**

620 Atlantic Avenue, **BOSTON, MASS.**

217 La Salle Street, **CHICAGO, ILL.**



BURNLEY DRY BATTERY

PATENTED January, 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:—Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

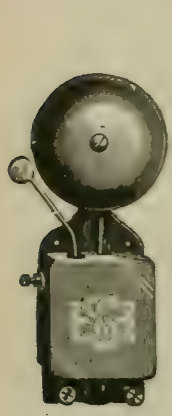
PATENT PERFORATED ELECTRIC LEATHER BELTING

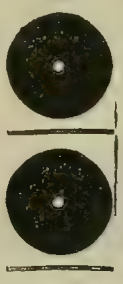
Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. } 46 SOUTH CANAL ST., CHICAGO. ILL.





DUST-PROOF BELLS.

None Genuine Without the Washer.

STANLEY & HALL,

(Formerly HAZAZER & STANLEY,)

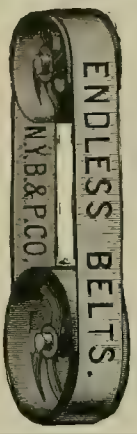
32 and 34 Frankfort St.,

NEW YORK.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 3d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
ST. LOUIS, 616 Locust St.

THE THING for Electric Railways. "CANVAS JACKET" FEEDER WIRES.

INDESTRUCTIBLE PATENT WOVEN INSULATION.

POLES. POLES.

ELECTRIC LIGHT SUPPLIES ELECTRIC RAILWAY.

Send for descriptive circulars,

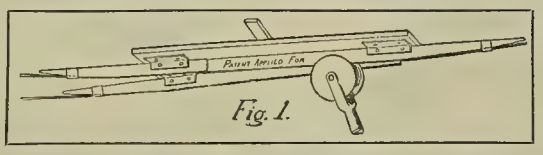


Fig. 1.

MURRAY OVERHEAD TROLLEY SWITCH.

CUSTOMERS REPORT:

"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."

THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.

Charles Munson Belting Co

MANUFACTURERS OF

EAGLE and DYNAMO BELTING.

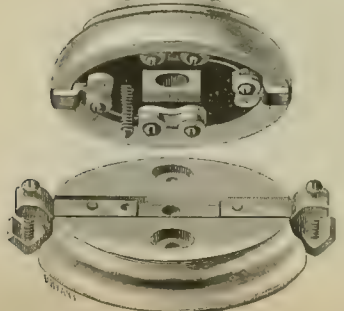
PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

28, 30, 32, 34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

5,000 PAISTE PORCELAIN CUT-OUTS

IN STOCK.



Must be sold to make room for a new line of goods.

Make us an offer on the whole or in parts.

WILL BE SOLD CHEAP.

Samples Forwarded Free.

H. T. PAISTE,

128 Market St., - - Philadelphia, Pa.

GET THE BEST!

P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co.,

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, DECEMBER 13, 1890. No. 24

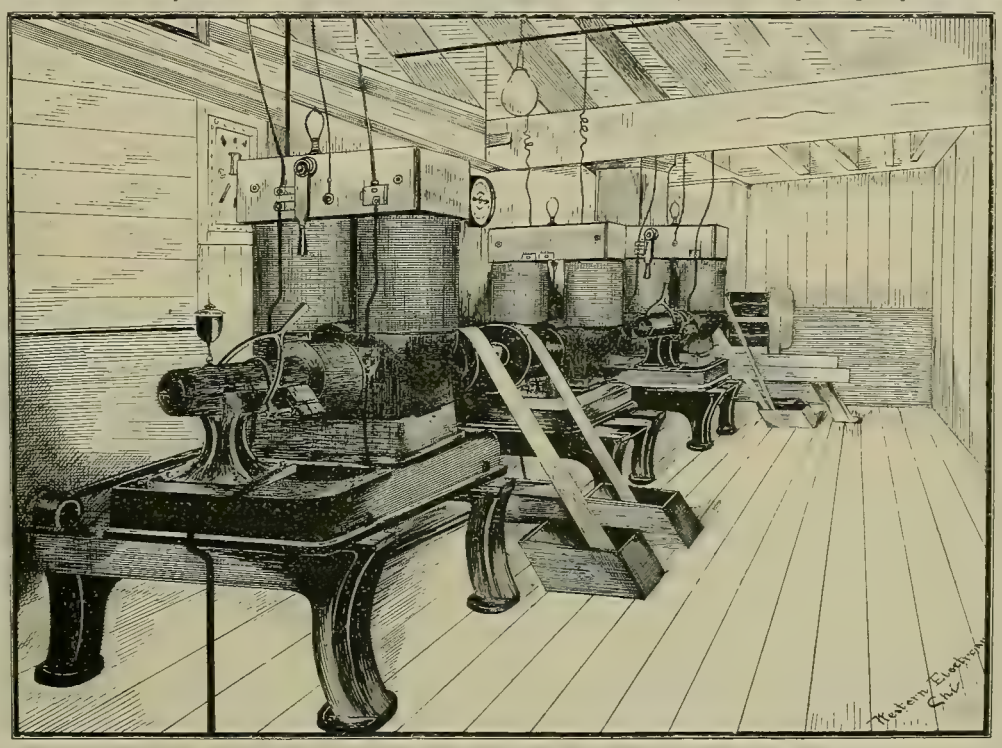
Electric Light Plant in the Pillsbury Mills, Minneapolis.

Electric lighting owes much of its popularity in the Northwest to the famous mills of Minneapolis. It was in these establishments that an improved method of illumination was first presented to public notice in that section of the country and it can be said that no better place could have been selected, as thousands of visitors are attracted to Minneapolis every year and very few fail to examine the immense milling plants that have done so much toward giving the city its national reputation. It was in one of these mills, Pillsbury A, that the first arc light plant in Minneapolis was installed. A Brush machine was introduced, and it proved more than a nine days' wonder. As soon as incandescent lighting proved commercially successful the old Brush arc machine was replaced by an incandescent plant. Once more the city people flocked to the mill, for the machines were the first of the kind installed in Minneapolis. It can readily be seen that electric lighting was well advertised by this plant. Of course many changes have since taken place, improved apparatus has been introduced, and the plant has been greatly extended.

A view of the generating plant at this time is presented in the accompanying illustration. The plant is installed in the machine shop of the Pillsbury A mill. It comprises three Edison dynamos and one United States machine. In addition to Pillsbury A mill the offices in the adjoining building are lighted from this plant. There is also a pole line across the river to the mills controlled by the Pillsbury Washburn company. Three mills on the west side of the river, an elevator and bran house are now furnished current from this plant. At present 1,000 lights are connected with the station. It is the intention of the company to continue extending its plant, until all the mills and warehouses owned by it are lighted by electricity.

Water power is utilized, but sometimes during the year there is a scarcity of water and the company has been obliged to secure its power from an old Hamilton engine.

All the construction work has been done under the direction of Thomas E. Hughes, who has been in charge of the station since the first machine was installed. Mr. Hughes has the distinction of having operated the first arc and incandescent machines in Minneapolis.



ELECTRIC LIGHT PLANT IN THE PILLSBURY MILLS, MINNEAPOLIS.

The United States Corporation Bureau reports that in Chicago during the week ending Nov. 28 there were twenty-nine light, power and transportation companies organized, their capital stock aggregating $103,350 000. The larger portion of these companies are electrical concerns.

Wisconsin Electric Club.

The annual meeting of the Wisconsin Electric club was held at Milwaukee last week. President Rogers made an interesting address in which he referred to the valuable papers that had been presented during the year, and other work of the club. He spoke of the progress made during the year in applications of electricity to telegraphy, telephony, lighting, temperature regulation, fire alarm, transmission of power, metallurgy, and its various uses in the household. President Rogers said that the telegraph, although one of the oldest specialized applications of electricity, had not yet got beyond the progressive stage. Improvements were especially marked in submarine telegraphy, and more than a quarter of a million miles of cable had been laid within the last twenty-five years. He said that this country led the world in electric lighting. The United States had in April last 235,000 arc lamps in use and 3,000,000 incandescent lamps, being ten times the number of incandescent and 100 times the number of arc lights that are in use in England. Milwaukee, he said, was not behind other American cities in taking advantage of the progress made in the development of electricity. The progress made in electric lighting and motor business in addition to the application of electricity to the street car lines of the city had greatly increased the local interest in this field.

The reports of other officers showed that the club was in excellent condition financially and had increased its membership materially. The election of officers for the ensuing year resulted as follows: President, A. J. Rogers; vice-presidents, J. D. McLeod, E. C. Wall, W. S. Johnson, George H. Benzenberg, D. J. Whittemore; secretary, H. F. Boggis; treasurer, W. H. Hyde; board of managers, P. E. Parker, A. J. Shaw, George Glässner, Henry Campbell, Jr., S. G. Coleman; committee on membership, John A. McManman, H. D. Goodwin, H. P. Andrae.

Litigation Over Electric Wires and Poles in Chicago.

The bill providing for the annexation of Hyde Park and other suburban towns has caused Chicago city officials much trouble. In no particular is this so clearly shown as in the electrical department. The companies in the suburban towns operated overhead wires and just before annexation many franchises of this character were granted. The city of course was bound to respect the provisions of these ordinances, but there has been much opposition and litigation nevertheless. The latest action is that of the Hyde Park District Telegraph & Electric company. This company last week filed a bill in the circuit court on which Judge Horton restrained the city from interfering with the placing of poles and stringing of wires. It was claimed that the city officials had stopped the work under an ordinance requiring all wires to be placed under ground. This ordinance, it was claimed, could not apply to complainant who, before annexation, secured a franchise from the Hyde Park board of trustees allowing it to set out poles and string wires in the public streets and alleys. This permission, it is alleged, could not be interfered with owing to the mere fact of annexation.

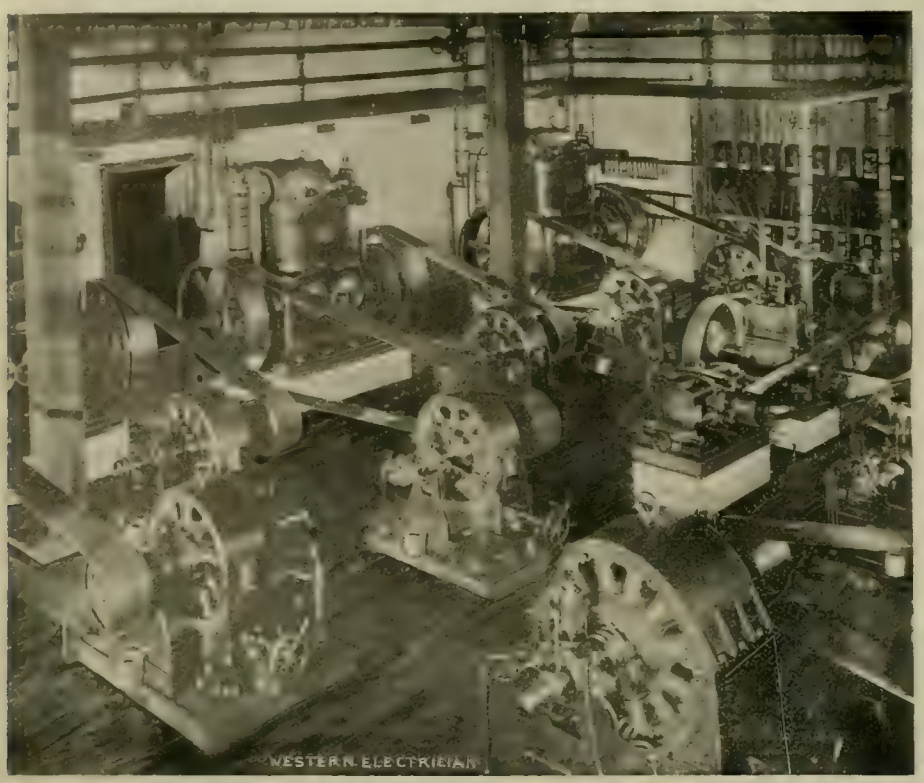
The city through its corporation counsel began a counter action against the company alleging that it had failed to comply with the provisions of the ordinance granted by the Hyde Park board. Commissioner of Public Works Purdy submitted an affidavit in which he alleged that the city refused a permit on the application of the company which was accompanied by an alleged copy of the old Hyde Park ordinance. The document, it is stated, was not a copy of the ordinance but was a garbled, misleading paper which, while pretending to quote the ordinance entirely, left out a clause which provided that no wires or poles should be placed without the consent of the village trustees, which should only be granted on petition of a majority of the property owners along the proposed route. This consent, Mr. Purdy says, was never obtained.

Upon this statement of facts the city petitioned for an injunction and Judge Horton granted a temporary restraining order.

An officer of the company states that its construction work is now completed and it does not fear therefore, any suits which may be brought against it. A part of its line is now used for the transmission of the Postal Telegraph company's business. The company has opened a number of offices for the transaction of telegraph business on the South Side of Chicago.

The pole lines of the company cover 60 miles

and about 250 miles of wire have been strung. All the wires are in the city of Chicago except at one point where the line extends 2½ feet into Indiana. The company states that it has franchises giving it the right to construct lines from 45 to 50 miles in all directions outside of Chicago.



MUNICIPAL ELECTRIC LIGHT STATION AT ALLEGHENY CITY.

Municipal Electric Light Station at Allegheny City.

There is perhaps no other electric lighting plant in this country where an equal amount of lights are operated from such a small central station building as is done in the plant of Allegheny City, Pa. Two views of the dynamo room are shown in the accompanying cuts. The electric plant is owned by the city and consists of alternating apparatus exclusively for both incandescent and arc lights. The station has a capacity of 4,000 incandescent and 540 arc lights. It was established last spring; and the contract for the installation of the electric light system was awarded to the Westinghouse Electric & Manufacturing company. The power house is a very handsome brick building situated near Braddock street and the tracks of the Pittsburg, Fort Wayne & Chicago railroad. The roof of the building is graced by a handsome tower from which the main wires are distributed.

The boiler room, which is in the rear of the building, contains a battery of six tubular boilers, each measuring 16 feet in length with a diameter of 66 inches. Slack coal is the fuel under the boilers, each one of which is fitted with a Roney stoker. The utility of this appliance has manifested itself in this plant, it is stated, to a very great extent from an economic point of view.

From the boiler room, a small door leads into the power house proper, the dimensions of which are 50x56 feet, and in this space all the engines and dynamos for the operation of the complete plant are contained as follows: There are seven 160-horse power Westinghouse compound engines, one 85-horse power compound engine, two 15-horse power automatic engines, three 1,500-light alternating current incandescent dynamos, two exciters and nine 60-light alternating current arc machines.

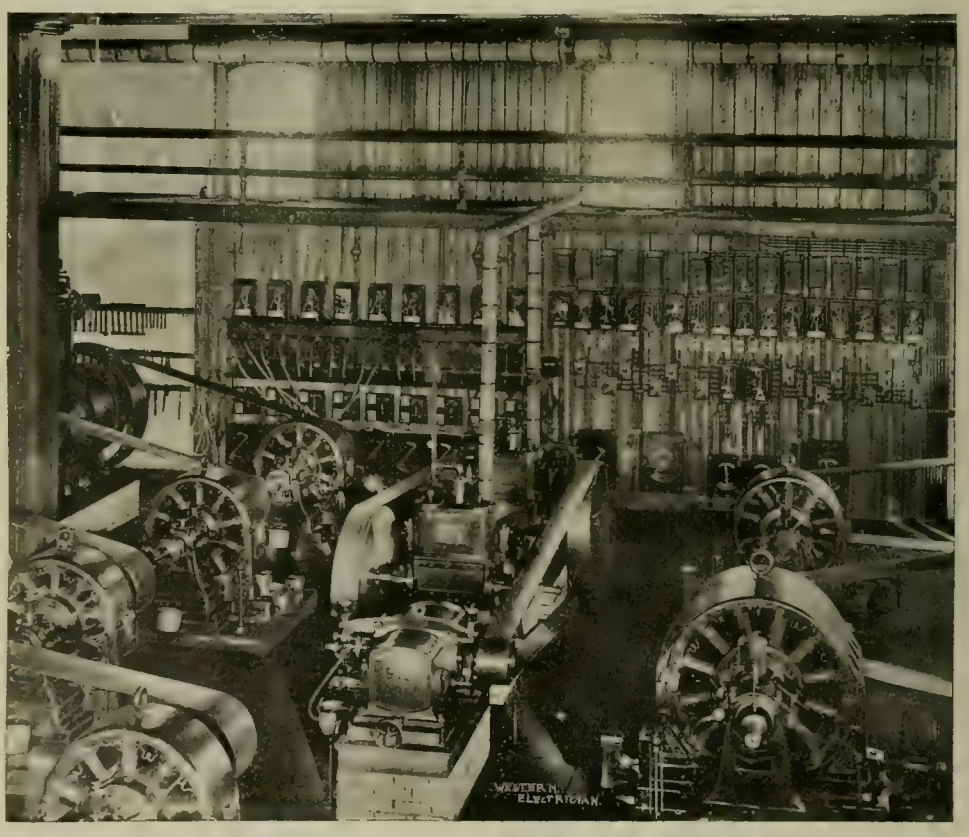
The switch-board for both the incandescent and arc light circuits occupies the greater portion of the north side wall in this room, containing all appliances used in connection with the Westinghouse system of electric lighting.

The plant has been in operation since the fifteenth day of July last and since that time there has never been any interruption in the service, either in the incandescent or arc light supply. The working of the central station is superintended by David Hunter, Jr., and W. Maurice Coster acts as chief engineer.

The arc lights are used to light up the streets of the city. All the exterior construction work was done by the North American construction company.

The lights are distributed by mast arms and towers. Of the latter the city has put up fifty-three, with five lights on each, and the rest of the lights are on mast arms.

The lights have given every satisfaction to the people of Allegheny City and the effects of the illumination from the towers is rendered very brilliant. Since the plant has been in operation the city has realized that the present capacity of the station is hardly sufficient to meet the demand of the entire place, and an extension is already contemplated.



MUNICIPAL ELECTRIC LIGHT STATION AT ALLEGHENY CITY.

Electric Wires in Paris and New York.

In the *Forum* for December Dr. Andrew D. White writes of the "Government of American Cities." He draws a very gloomy picture. He contrasts European with American cities, and finds that the former are in every way better governed and managed. Incidentally he referred to the manner of disposing of electric wires in Paris as contrasted with the New York method. He says:

During that summer of the Exposition a great increase in the number of electric lights, telephones, and the like, rendered necessary new electric cables; but instead of bribing and counter bribing in the common council, instead of injunctions and counter injunctions in the courts, instead of charges and counter charges in the newspapers, instead of votes by aldermen and vetoes by mayors, instead of sensational descriptions of men killed here and horses killed there, instead of the sudden cutting down of great masses of wires and the reckless stoppage of communication and illumination in whole districts, instead of great trenches in frequented streets kept open for weeks by aldermanic battles and judicial proceedings, the best scientific advice was taken, trenches were rapidly made, long lines of conductors were speedily laid and neatly insulated without disturbance of any kind, and the whole internal system of electric communication and electric lighting was made perfectly invisible. I have said that it was done scientifically. In our great metropolis, to grapple with a similar question, the governor of the state appointed three commissioners, no one of them having a particle of scientific or technical knowledge, no one of them having any standing in the community, to fit him for so important a trust; but in Paris the whole matter was put into the hands of competent persons, and it was decided upon and executed quietly, speedily, and effectually.

The Book Table.

BIBLIOTHECA POLYTECHNICA. Directory of Technical Literature by Fritz von Szczepanski. International News company, New York. Price 75c.

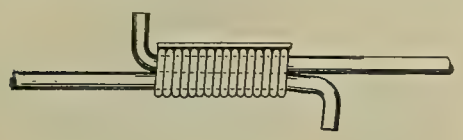
The volume is a catalogue of all technical literature including books and periodicals published in America, England, France and Germany. Catch words are printed in three languages so that the desired information is readily ascertained. For those investigating special subjects it is a handy volume.

The Denver, Colo., board of aldermen last week passed the franchises that were agreed upon by the Denver City Electric Railway company and the Tramway company, defining the rights of way.

Wire Coupling.

The accompanying cut illustrates a wire coupling invented by W. E. Banta of Springfield, O. The device consists simply of a number of elliptically shaped rings soldered or brazed to a strip as shown. In applying this coupling the ends of the line wires are bent outward, so that when drawn together the rings will bite strongly on the wires and form the joint. The outer ends of the line wire may be turned out at right angles, but in stiff wires a simple outward bend is all that is necessary to secure the coupling.

One advantage claimed for the device is that it may be removed and used again by simply straightening the bent ends of the joining line wires and removing the coupling. There is no



WIRE COUPLING.

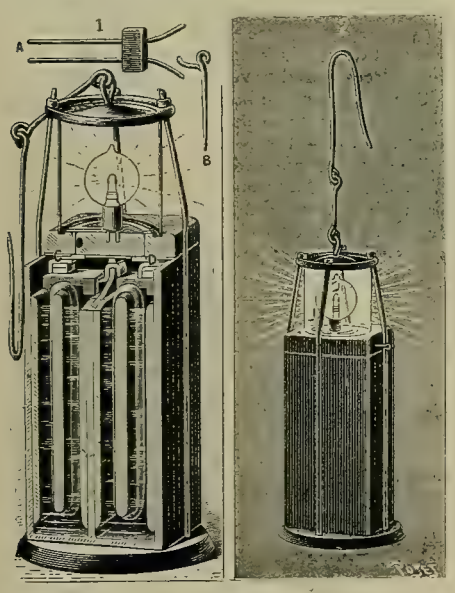
necessity of soldering the joining line wires together to secure complete electrical connection, since the greater the stress on the line wires the harder will they be drawn together by the action of the coupling.

It will be observed also that in this coupling advantage is taken of the tensile strength of the material of which the rings are composed; that is the strain is exerted in the direction in which the material is best adapted to resist stress.

Electric Lamp for Miners.

The lamp shown in the cut was designed by M. Pollak for the use of miners. To fulfill all the conditions demanded in the construction of an electric lamp for miners would be well-nigh impossible. To be entirely satisfactory the lamp must be light in weight, extremely strong, simple in construction, not liable to get out of order, inexpensive, safe and furnish light for from eight to ten hours. *La Nature* says that the Pollak lamp comes nearer to fulfilling these requirements than any lamp which has thus far been introduced for miners' use.

The lamp is made in two sizes, one weighing a little less than 5 pounds and the other a little over 6 pounds. That shown in the cut is the smaller



ELECTRIC LAMP FOR MINERS.

size. Current is supplied for the incandescent lamp by two Pollak storage batteries which are inclosed in an ebonite box. On the lid is attached the support for the incandescent lamp, which is surrounded by a cylinder of thick glass. Between the lid and the box is a ring of soft rubber so that the latter can be hermetically sealed.

The connections of the lamp can be seen by an inspection of Fig. 1. Little pins pass through the cover. That shown at *D* comes into contact with one electrode of the battery; the other only makes contact when the pin shown at *B* is thrust into the cover laterally and forces it against the pole.

The accumulators have an electromotive force of four volts and furnish sufficient current for a lamp about 5 to 8-candle power for fifteen or sixteen hours.

Registration by Telephone.

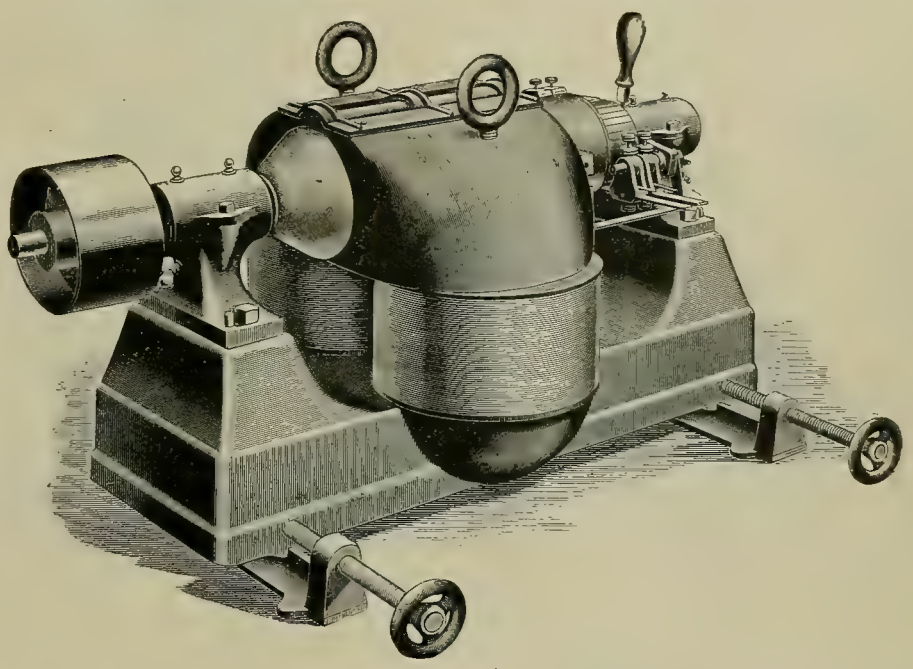
An interesting point was raised in Macon, Ga., on registration day. The law says a voter must apply in person at the office of the city clerk to register, and unless he is registered he is not entitled to vote in the city election. The question hinges on whether an application to register through the telephone is legal. Jailer Birdsong rang up the city clerk and asked to be registered. The clerk was familiar with the jailer's voice, and could have sworn that the voice was that of Mr. Birdsong. He knew more, and that was that the jailer had paid his taxes, and was clearly entitled to register; and, furthermore, it was an application in person; but there was a doubt in the clerk's mind as to the difference between an application in person in his office, and an application in person several blocks away and over a wire.

The telephone line between London and Paris will probably be put into service January 1.

The Detroit Motor Company's New Dynamo.

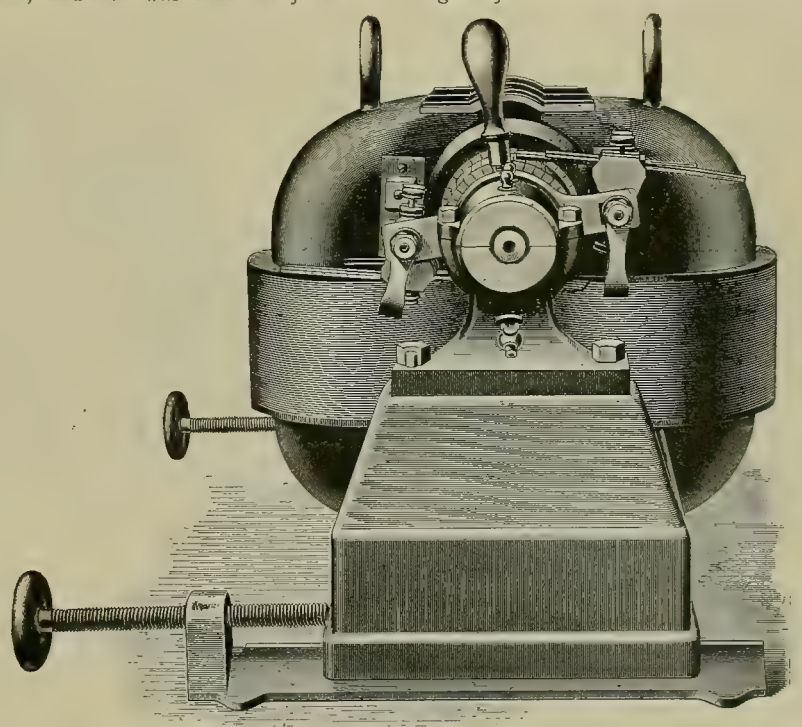
The cuts represent a dynamo for lighting and power circuits, designed by Harry H. Blades, of the Detroit Motor company.

The features of this dynamo are a long armature of small diameter, massive pole pieces and yoke, short round and massive forged iron magnets, and a very short magnetic circuit. The machine is furnished with self-oiling ball bearings and independently adjustable brush holders. The brass work and all parts of the machine are highly finished.



DETROIT MOTOR COMPANY'S NEW DYNAMO.

In machines of the horseshoe type it has been the usual practice either to place the armature below the center of gravity and have the objectionable features of a zinc, brass or wood base, or else to reverse the arrangement and place the armature shaft high above the center of gravity. It has been the aim in this machine to eliminate the zinc or wood base as well as the elevated armature and yet not sacrifice the electrical efficiency or mechanical finish of the machine.



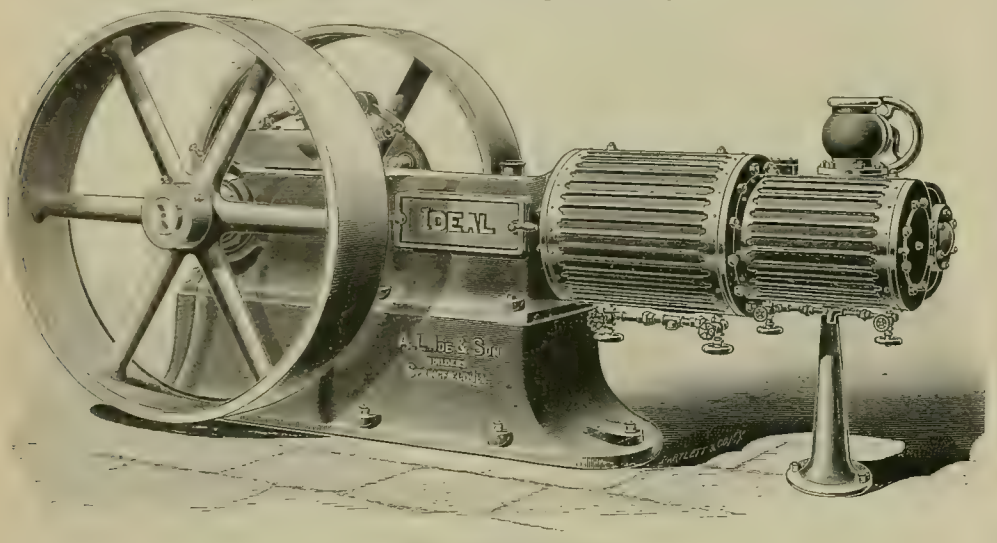
DETROIT MOTOR COMPANY'S NEW DYNAMO.

The final arrangements have been completed with eastern capitalists for the building of an electric street railway in Burlington, Ia. They filed bonds of $10,000 guaranteeing the complete equipment of the road by the first of July next.

Ideal Compound Engine.

Two views of the new Ideal compound engine are shown in the cuts The frame and general design are the same as the Ideal single expansion engine. It has the same heavy self-contained main frame with overhanging wheels; all bearings are self oiling with working parts inclosed, an arrangement which, it is claimed, insures thorough and continuous lubrication of all working parts, thus reducing the wear, preventing hot bearings and effecting a great saving of oil. The cylinders are arranged on the tandem plan. The low pressure cylinder is bolted direct to the engine bed, and to the head is stated the complication of double eccentrics, rocker-arms, slides and stuffing boxes is dispensed with.

The high pressure cylinder has a piston valve as used on all Ideal engines, but it is double ported on the compound in order to give larger areas for free admission of steam. The low pressure cylinder which has a flat balanced valve, traveling under a cover and supported on hardened steel rollers is so arranged that steam is admitted through three ports, thus giving a wide opening at the beginning of the stroke; the pressure the on exhaust end of the high pressure piston is thus reduced.



IDEAL COMPOUND ENGINE.

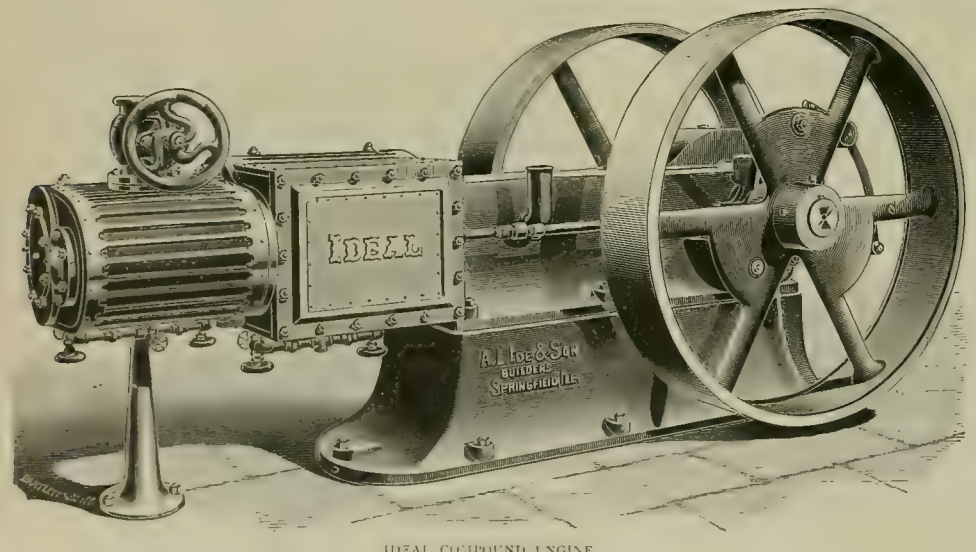
of this cylinder is cast the high pressure cylinder. By this arrangement steam from the high pressure cylinder has a short, direct passage into the low pressure cylinder without suffering loss of heat by passing through connecting pipes or receiver. On account of this construction it is claimed that the best results are obtained. Another great advantage claimed for the arrangement consists in the fact that four stuffing boxes are dispensed with on the piston and valve rods between cylinders.

The head between cylinders is cored out leaving a large space which is filled with a non-conducting compound. This disposition, it is stated, effectually prevents the escape of heat, thus securing the prime object of compounding, viz ,—a uniformly high temperature in the high pressure cylinder. Both cylinders and steam chests are encased with a handsomely finished paneled iron jacket with a two-inch space between cylinder and jacket which is filled with non-conducting material. Both cylinder heads are protected in the same manner which effectually prevents loss of heat and power.

Both valves are controlled by the governor, and they are on the same stem, moving together, and varying in stroke as the load and steam pressure vary. The great advantage of automatic cut-off in both cylinders is secured and it

The cover of this valve is held in place by a spring and will lift and prevent excessive pressure in the cylinder from water or other causes. Provision is made for conveniently adjusting the cover to take up wear so the valve will always remain steam tight, a feature of no little importance on low pressure cylinders on account of the large valve and port areas.

Both valves are perfectly balanced and with full boiler pressure, can be moved by the hand with ease. The steam ports are very large, but short and direct; the valves have a long travel giving a quick opening and closing.



IDEAL COMPOUND ENGINE

Cards taken from the engine show that full steam pressure is maintained in both cylinders up to the point of cut-off.

The standard Ide governor is used. It is susceptible of equilibrious adjustment. When so adjusted the dash-pot affords the necessary stability to insure isochronous action and a regulation of speed of engine. By recent improvements the use of oil on the governor is dispensed with. The engine is made by A. L. Ide & Son, Springfield, Ill.

The Wheaton, Ill., Electric Light & Water company was incorporated last week by Homer H. Fuller, Jordan J. Cole and C. W. Kimball. The capital stock is $20,000 and the company will furnish electric light and power at Wheaton.

Electricity in Mining.

By Frank C. Loring.

The mining and reduction of ores present one of the broadest and most varied fields for the electrical application of power. The realization of this truth taken in connection with the existence of a bountiful supply of power which nature has furnished to all of the mining sections of the Rocky mountains, has aroused in the minds of many mining men a deep interest in electrical machinery, and this interest already has developed some practical results.

The silver lead mining region of Northern Idaho, known as the Cœur D'Alenes, situated on the south fork of the Cœur D'Alene river and its tributaries, contains mines, which, during the present year will produce about eight million dollars in silver and lead, and which will double that amount within three years. These mines, which are located upon large veins of ore at present are operated mainly by means of tunnels and adit levels. In the course of a few years when the ore becomes exhausted above the creek and river beds, mining will be done by means of shafts. This modification will necessitate the use of powerful hoisting works and pumping machinery. A large part of the ore is concentrated before shipment to the smelters, which involves large concentrating mills. The foregoing, combined with the several other demands for power, such as those required for drilling, ventilation, transportation of ore, and lighting of mines, create a greatly varied and constantly increasing demand for power.

Many of the mining companies already appreciate the fact that it is folly to burn wood when they have plenty of water power at hand, and many of the mills are now run by the stream upon which they are situated. Practically all of the water power which can be applied directly is now either utilized or secured. This amount, however, bears but a small proportion to the total power needed for all of the mines at present, and the future demands will be much greater. Five years ago not a pound of machinery was erected, whereas now nearly three thousand horse power is needed to supply the demands of the mines, and this but a beginning. Mine managers appreciate the necessity for power, and there is already trouble concerning adjacent water rights.

There is however, still available at little cost within, at farthest, a distance of four or five miles from any one of the mines, plenty of water power, and more in fact than sufficient to meet all demands for some time to come. This never freezes and never fails.

Some of the mines are installing electric plants to operate drills and hoists and for lighting the mills and mines.

The Last Chance Mining company at Wardner has started a tunnel 7x10 feet, which will be about three thousand feet long. Two electric drills will be used for driving, which will be run by means of water power.

The Black Bear mine at Gem will also run electric drills and other electric appliances.

The San Francisco mine at Gem is erecting an electric power and light plant. These mines have water power in the immediate neighborhood.

The Bunker Hill and Sullivan Mining & Concentrating company will transmit power by wire a distance of two miles from its concentrator on the stream, to its mines, where it will operate its mining machinery.

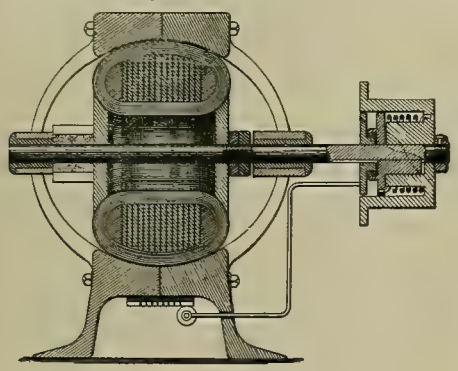
I predict that in the near future every available water right in this section will be appropriated, and the dynamos will supplant the steam engine which costs about thirty cents per horse power per day—and the incandescent lamp will largely take the place of the miner's candle which gives so feeble and uncertain a light, and drips the dollars out of the company's pockets and makes the poorly ventilated parts of the mine still almost unbearable.

The Western isolated lighting department of the Thomson-Houston Electric company has, during the past few days, closed contracts with the St. Louis Electric Railway company, of St Louis, Mo , for a 400-light incandescent plant to light the power house and car barns, and with G. F Culmer & Bros., Salt Lake City, Utah, for a 100-light incandescent dynamo to be used in connection with a complete plant sold the firm some months ago.

Governor for Constant Current Motors.

The regulating device illustrated in the cuts was designed to be operated in connection with a constant current motor to maintain a constant speed under a varying load.

An inspection of the cuts will make clear the operation of the governor: The device proper is embodied within the pulley of the motor. The pulley is loose on the shaft but is connected with it through a coil-spring and a sliding block feathered on the shaft. The pulley bears against a collar on the extreme end of the armature shaft. The sliding feathered block is provided with a cam-surface which bears against a similar surface on the pulley. The rotation of the pulley is opposed by the spring,

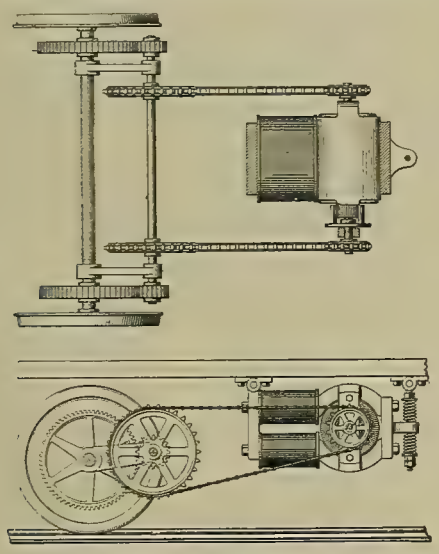


GOVERNOR FOR CONSTANT CURRENT MOTORS.

and the amount of lost twisting motion allowed by the spring in consequence of a change of load determines the distance which the sliding block moves longitudinally on the shaft. This latter motion is caused by a movement of the cam-surface of the pulley against the corresponding surface on the sliding block. The movement of the sliding block is utilized to control the field circuit. This governor is the invention of W. E. Hyer, of Newburg, N. Y.

Street Car Motor Gearing.

The armature of the street car motor, as now constructed, rotates at a high rate of speed, and as a consequence, the speed-reducing gearing between the armature shaft and the axle is constantly subjected to severe jarring and straining. To relieve the gearing of the great stress occasioned by the sudden starting of the motor,



STREET CAR MOTOR GEARING.

and to prevent the possibility of straining and stripping the gears, is the primary object of the arrangement illustrated in the cut. The chief portion of the gearing is the arrangement of the countershaft. This shaft is mounted in swinging bearings as shown. The bearings are hung upon the car-wheel axle, so as to swing about it as a center. The motor is attached directly to the car body by hinge joints and springs. By this construction the rise or fall of the oscillating drive-shaft will give the gearing a very appreciable lead and the strain of a sudden start will consequently be lessened. This gearing was designed by Frank Mansfield of New York.

Bain Insulator.

The new high resistance glass insulator shown in the cut was invented by Foree Bain, of Chicago. The insulator is made of unusual strength and is intended for heavy work, such

BAIN INSULATOR.

as carrying feeders for electric railways. The corrugations which are made both outside and inside of the apron increase the distance from the wire to the pin fully 100 per cent., and, it is claimed, that water in passing over the edges of the rings will become thin and broken, and on reaching the inside of the glass will drop off instead of creeping over the inner obstructions to the pin.

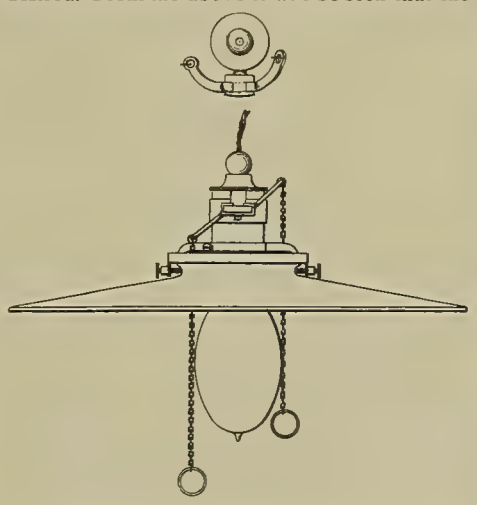
Another advantage claimed for this form of insulator is that the many surfaces will reflect the light under the glass in such a way as to keep insects out, obviating a source of much annoyance where plain dark glass is employed. The insulator is introduced by the Central Electric company of Chicago.

Attachment for Incandescent Lamp Keys.

The fixture illustrated in the cut was designed with the view of providing a simple attachment to facilitate turning on or off current from inaccessible incandescent lamps. The device is applicable in its present form to lamps fitted with the usual flat key or thumb-piece, which have been hung, say, too high or in any other manner which makes it inconvenient to reach the key.

It is hardly necessary to do more than refer the reader to the cut to make clear the construction of the attachment. The main portion from which the chains hang is secured to the key by means of a set-screw. This part might however be made of spring metal so as to be secured in place by its own elasticity.

It will be apparent that by operating one chain or the other the key may be given a quarter-turn and the current turned on or off as desired. From the above it will be seen that the



ATTACHMENT FOR INCANDESCENT LAMP KEYS.

improvement is applicable to any incandescent lamp having a flat key or thumb-piece. The device is the invention of Fred Lewis of New Haven, Conn.

The Stiger-Newhall Electric Light company has been formed at Chicago; capital stock, $20,000; incorporators, C. W. Stiger, Walter C. Newhall and Charles A. Buell.

The Bassett Combination Portable and Bracket.

The Bassett combination portable and bracket shown in the cuts is intended for either desk or table use, Fig 1; or for a wall bracket, Fig. 2. This combination is neatly and strongly made of brass, and it will be found a much more convenient and economical device in many cases

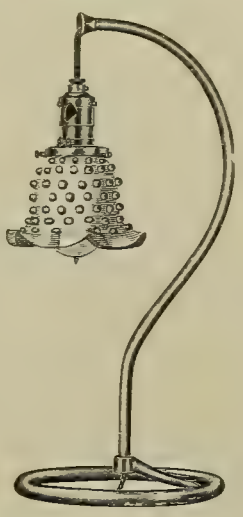


FIG. 1. COMBINATION PORTABLE AND BRACKET.

than two separate articles. The device is introduced by the Electrical Supply company, Chicago.

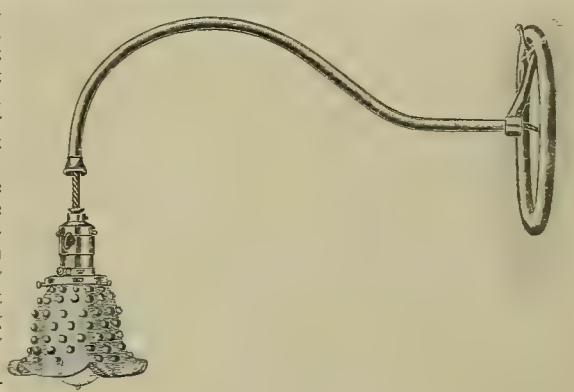


FIG. 2. COMBINATION PORTABLE AND BRACKET.

Opposed to the Postal Telegraph Scheme.

The postal telegraph scheme advocated in the annual report of the postmaster-general and commended by the president in his message to congress, is opposed by ex-Postmaster-General James of New York. In an interview last week he expressed his views on the subject as follows: "Now, as to the postal telegraph system, I must say I don't think the government should control it. The system in this country ought to profit by the experience of Great Britain, and this experience costs us nothing. The idea of the government taking possession of the telegraph lines is a great mistake. The service in England is not to be compared with the telegraph service of this country. I don't believe in the government attempting to do anything that can be done better by private enterprise."

City and South London Railway.

Industries has the following to say apropos of the City & South London railway on which electric locomotives are to be employed: "One great benefit of the electric railway remains to be mentioned. It sounds the death knell of steam locomotives on the underground. As soon as people realize that electric railways can work properly, the steam locomotive must go from all short lines. The electric and Pintsch's gas lights are already ousting the old oil lamps from our carriages, so that the new railway has little advantage over the old in this respect. The noise in the tunnels is rather serious, owing, no doubt, to the cast-iron walls. Perhaps this may some day be softened by putting a couple of broad strips of felt along the wall of the tunnels to prevent the troublesome reflection of sound."

A Los Angeles paper says 100 miles of electric railway will be constructed in that city. At present material for a six mile road has been ordered and it is probable operations will cease long before the 100 mile point is reached. The Consolidated Electric Railway company holds the franchise for the road.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted.

This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Electric Light Plant in the Pillsbury Mills, Minneapolis. Illustrated	315
Wisconsin Electric Club	315
Litigation over Electric Wires in Chicago	315, 316
Municipal Electric Light Station in Allegheny City. Illustrated	316
Electric Wires in Paris and New York	316
The Book Table	316
Wire Coupling. Illustrated	317
Electric Lamp for Miners. Illustrated	317
Registration by Telephone	317
The Detroit Motor Company's New Dynamo. Illustrated	317
Ideal Compound Engine. Illustrated	318
Electricity in Mining by Frank C. Loring	318
Governor for Constant Current Motors. Illustrated	319
Street Car Gearing Illustrated	319
Bain Insulator. Illustrated	319
Attachment for Incandescent Lamp Keys. Illustrated	319
Bassett Combination Portable and Bracket. Illustrated	319
Opposed to the Postal Telegraph Scheme	319
Editorial	320
Wood's Lightning Arrester. Illustrated	321
Speed in Railway Travel	321
Underground Electric Work by David Brooks	321, 322
Electricity in Mines and the Proposed Mining and Electrical Display at the World's Fair. Discussion of E. F. Browne's paper by Members of the Chicago Electric Club	322, 323
Ajax Dry Battery. Illustrated	323
Electric Light Plant in a Railroad Station, Chicago	323
To Utilize the Water Power of the St. Louis River	323
Unit of Self Induction	323

DEPARTMENTS.

Correspondence	323, 324
The Electric Light	325
The Electric Motor	325
The Telegraph	325
Electrical Patents	326

THE Chicago Electric club's recent discussion of the subject of underground wires, has excited no little interest. In the present issue David Brooks of Philadelphia takes a hand in the discussion, and criticises very vigorously statements which were made at the club's meeting.

IN this issue is reproduced the discussion which followed the reading of E. F. Browne's paper at the last meeting of the Chicago Electric club. The subject under discussion was that of the application of electricity to mining work, and many points of interest were brought out.

COMPLICATIONS of the most serious character have arisen in the case of one of the murderers sentenced to death under the new electrical execution law in New York. An appeal on constitutional grounds has been taken to the United States Supreme court, but no stay of proceedings has been granted. The sentence of the law may be executed; and subsequently the Supreme court may decide that the trial was not properly conducted. In that event, as one of the assistant district-attorneys is quoted as saying, his "death will be murder by the state."

THE underground electric railway in London is exciting the greatest interest in the English metropolis. If the road proves as successful in operation as those interested predict, the construction of many additional electric roads in London may soon be expected. A London contemporary says: "It will be interesting to watch the progress of the new enterprise. If electricity, as a motive power, proves a success both from an engineering and a financial point of view, it will, no doubt, be introduced on other metropolitan lines, and may expedite the construction of other much-needed arteries of communication in various parts of this far-stretching wilderness of houses." It is hard to conceive that the line can be anything but successful, assuming of course, that good management supervises its operation.

AT the meeting of the gas commission in New York last Monday it was decided to reject all bids of companies for lighting the city by electricity. Mayor Grant stated that the prices were too high. He said the city would not pay any advance for light, and if the bids were high the commission would revert to gas. The companies declare that owing to the excessive rental demanded by the subway company they were compelled to increase the rates. Truly the lot of an illuminating company in the metropolis is anything but a happy one. Forced to bury their wires in conduits for which an enormous rental is charged they are still not allowed to advance prices proportionally. No one can believe for a moment, however, that New York will go back to illumination by gas. That would be retrogression with a vengeance. New York cannot expect to pose as the great American city, if such a step is taken.

IN Dr. Andrew D. White's article on the "Government of American Cities," published in the December issue of the *Forum*, reference is made to the manner in which the Parisians handled the electric wire problem as contrasted with the proceedings in New York. An abstract from the article is given in another column. We have no desire to revive and rehearse the old story of municipal mismanagement. We cannot forbear though to mention that with all our boasted pre-eminence in electrical matters, the American who reads the few lines from Dr. White's article will experience a feeling of shame. The Frenchmen, it seems, thoroughly comprehended that scientific work should be handled by scientific men, and not by ignorant politicians. New York thought differently, to the distress alike of the local lighting companies and the long suffering public. It might be a good thing for those flourishing hamlets whose ambition it is to ape New York, to remember that city's experience, and study the methods employed by the French.

IN the Pittsburg letter this week it is mentioned that workmen employed by electrical companies propose to organize into a national association those connected with the craft. Circulars have been sent throughout the country, it is stated, asking that delegates be appointed to attend a convention to be held in Pittsburg in the spring. Of course, one can not predict what the projectors of the enterprise have in mind. Such an organization might doubtless be a means of accomplishing no little good; on the other hand it might prove to be a mighty power for evil. If it is intended to form some sort of an association which will afford employes an opportunity to meet, exchange views, and secure suggestions on practical work, the organization might be useful and valuable. If on the other hand, the scheme contemplates merely the organization of nothing better than an ordinary labor union, the employes of electrical companies will be too intelligent, we think, to have much to do with it. The experiences of the last year have not been of a character to enhance one's opinion of strictly labor associations. The electrical industry is progressive, and employes have better chances for advancement than in most other branches. Their opportunities will not be increased, or their advantages improved by joining a labor union on which employers will naturally look with suspicion.

THE question as to whether an application to register through the telephone is legal, has been raised in Macon, Ga. The courts have already decided that a contract made by telephone is legal, provided the contract can be proved. In all probability the registration question would be considered in the same manner. As it is not always an easy matter to prove a contract under the best of circumstances, it is, perhaps, needless to suggest that the good business man will utilize some other medium of communication. There are few who do not realize the difficulty of recognizing voices in telephones. Some voices are easily distinguishable, yet there are others about which there might be considerable doubt. It has always been a source of wonderment to us that a business man would trust to the uncertainty of a telephonic message relative to important business. Truly, "lazy men take the most pains," and leaving out the interesting legal question involved, it would seem as though the lazy contract maker might get his just deserts in finding it a most difficult matter in many cases to furnish proof.

A FEW months ago Frank C. Loring, of Idaho, contributed an article to the WESTERN ELECTRICIAN on "Natural Sources of Power in the Rocky Mountains." Mr. Loring referred to the abundance of rapidly running streams in the vicinity of silver mines, and pointed out the great advantage of utilizing their power as compared with the use of the steam engine. He explained that many mining companies were compelled to go farther and farther for wood as the supply of timber in the neighborhood had been exhausted. He predicted a great and speedy increase in the number of mines to which power would be transmit ed by means of electricity. In the present issue an article by Mr. Loring is presented in which it will be seen that his prediction is becoming verified. A large number of Cœur d'Alene miners in Northern Idaho have already made arrangements to utilize water and employ electrical transmission systems. He ventures this prophecy: "I predict that in the near future every available water right in this section will be appropriated, and that dynamos will supplant the steam engine."

IN a recent issue of the WESTERN ELECTRICIAN was presented an abstract of a lecture by Lieutenant Bradley A. Fiske on the subject of the "Civilian Electrician in Modern War." The lecturer advocated the organization of a special corps which should be charged with the execution of all electrical work for the army and navy. The French authorities are realizing the importance of securing a body of men thoroughly competent to perform electrical work. They have recently taken action not exactly in the line suggested by Lieutenant Fiske, but with the design of accomplishing the same result. The minister for the navy has just arranged for the instruction of the staffs of the arsenals in electrical science. He has decided that two foremen and two workmen shall be sent to Paris from each French arsenal to study the working of the electric light. Lectures on electrical theory and practice will be given to the naval officers at the observatory of Paris on and after the present date. They will last during four months.

The fact that Lieutenant Fiske's suggestion has received the approval of electricians generally, is referred to in the New York letter. Secretary Tracy has commented favorably on the recommendation, and it is stated that Governor Hill's attention will be called to the advisability of forming an electrical corps, which shall be a part of the National Guard of the state of New York.

Wood's Lightning Arrester.

In using the ordinary forms of comb lightning arresters on circuits carrying currents of high voltage, such for instance as those for arc lighting, it frequently occurs that the static discharge between the points of the plates of the arrester, will cause the starting of an arc from one comb to the other. This arc will continue as long as the current is on the circuit, unless it be in some way ruptured or extinguished. A number of devices have been invented for the purpose of extinguishing automatically such arcs, and restoring the lightning arrester to its operative condition ready to conduct away the next static discharge.

The accompanying cuts illustrates a form of arrester recently devised by J. J. Wood, through

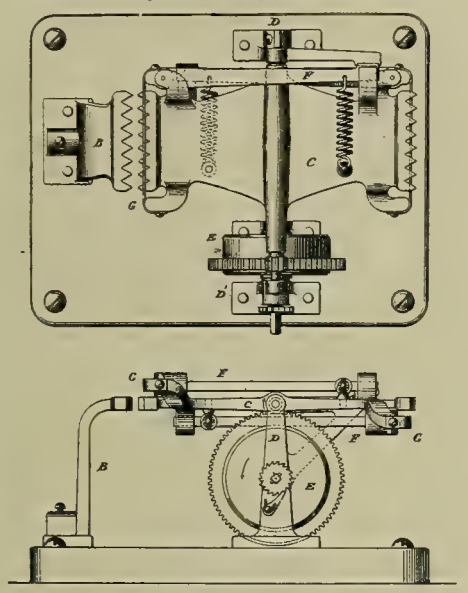


FIG. 1. WOOD'S LIGHTNING ARRESTER.

the use of which, it is claimed, the troubles just mentioned are overcome.

In his arrester Mr. Wood employs a thermic device for bringing into play arc-rupturing mechanism. The thermic device consists of a strip of metal stretched along one of the serrated plates close enough to be heated by an arc between them, but out of the path of the lightning discharge. The metal strip is stretched between a fixed support and the arm of a lever constituting a detent. A spring is arranged to exert continually a stretching tension against the strip. When an arc occurs following a lightning discharge, the strip is heated by the arc and elongates, relaxing the spring and enabling the latter to withdraw a detent. A motive device now becomes effective, and the movable plate is rotated far enough from the fixed plate to sever the arc. Mr. Wood has designed on this principle a number of forms of lightning

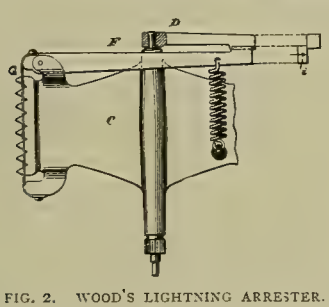


FIG. 2. WOOD'S LIGHTNING ARRESTER.

arresters. In the illustration a plan and side view of the most improved form are given.

Referring to the cut the details of the mechanism will be understood: All the parts are mounted on a slate base-plate. A metal standard *B* is fixed to this plate, and its end is serrated as shown. In front of the standard *B* is a rotatable part *C*, constructed of a flat plate extending on opposite sides and carrying serrated plates, as represented, at its opposite sides. This plate revolves on a shaft, the opposite ends of which are journaled in bearings *DD'*. The upper one, *D*, of these frames is connected with the earth. Standard *B* connects with the line. A motor *E*, is provided to impart to the rotatable part *C* a normal tendency to move in the direction, say, of the arrow. The part *C*, however, is prevented from revolving by the end of the lever *F*. This lever *F* is pivoted, as indicated, to one side of the plate *C*, and its short arm is fastened to one end of the thermic device *G*. This latter part consists of a strip of copper, platina, or other metal. The other end of the strip is fastened to an arm on the plate *C*. The strip *G* is thus extended parallel with and only slightly removed from, the teeth on the rotatable part *C*. It is close enough, however, to be expanded by radiation of heat from an arc between the plates *B* and *C*, but is out of the path of the lightning discharge, so that it is not liable to be injured by the passage of the fluid to earth. The lever *F* receives the tension of a spring, which tends both to elongate the thermic strip *G* and to withdraw the lever end from engagement with its detent. This construction is clearly shown in Fig. 2. The operation of the arrester will now be understood. When the strip *G* is heated by an arc across the air gap between the combs its expansion permits the spring to operate the lever *F* and disengage its end from the stop. This action releases the part *C*, and the motor *E* becomes effective to rotate it, thus separating the two combs and rupturing the arc. As will be seen, the rotatable plate *C* carries a duplicate set of the thermic and detent devices. When, therefore, the plate has executed half a revolution it is arrested by the end of the second lever *F* striking against the stop. The other comb is thus brought into operative position in proximity to the fixed plate ready for the next operation. The strip of the comb which has just received the arc quickly cools and restores its lever *F* to the normal position, ready upon the next operation to rearrest the rotatable plate. This plate, with the parts which it carries, thus executes a half revolution each time that an arc is formed by a lightning discharge. The occasional rewinding of the motor *E*—say, for example, every few weeks or months, or even as often as after each prolonged thunderstorm—is all the attention that the instrument will ordinarily require. Mr. Wood claims as a particularly novel feature of the arrester, the use of a thermic device which is arranged entirely out of the path of the lightning discharge, so that it is not liable to injury by the discharge, yet in position to be heated by the earth-current resulting from the discharge.

Speed in Railway Travel.

In his article on "Speed in Railway Travel," Dr. R. H. Thurston in the December *Forum* has the following to say relative to the possibility of increased speed of trains:

"What obstacles prevent us from advancing in the next generation, to a speed of 100, or even to one of 200 miles an hour? Why may we not anticipate, at the same time, a degree of safety that shall as much surpass that of to-day as the safety of the best railways of our time exceeds that of the old stage coach? Such questions often seem absurd to the engineer, and are much more easily asked than answered; but the general reply may be given that the obstacle, for a long time to come, is likely to remain precisely what it is now, namely, a disproportionately small return on the capital required to insure conjoined speed and safety. Roads may be improved; rails may be made heavier, more rigid, more absolutely rectilinear; engines may be given more power, and may be adapted more precisely in their construction to higher speeds; still better materials, better design, more perfect workmanship, and more skillful operation may give increased immunity from accident. There seems to be no serious difficulty on the engineering side in securing and maintaining a speed of 100 miles an hour, or probably more; but the capitalist is here intimidated. Higher speeds cost money for initial and operative expenses in vastly higher ratio than either increase of speed or the returns to be expected on capital so invested. Our fastest trains do not directly pay, even now, when the wear and tear of engines, cars, roadbed, and bridges are considered. When the people want higher speeds, and need them so greatly as to be able and willing to pay for them, the engineers will construct, and the railroads will furnish, trains of still higher velocity and of still greater safety.

"The attainment of 200 miles an hour, however, does not seem likely to prove practicable with the machinery of our day. At such a rate, the 'head resistance' would be about 200 pounds per square foot of section of the train, or not far from ten tons in all. This, at the assumed speed, means the requirement from the engine of somewhere about 500-horse power. The other resistances to its motion would be probably as much more, at the very least, and the concentration of so much power in the locomotive would be considered impracticable by the majority of engineers. To reach such a speed, or anything approaching it, very probably the iron horse must be unharnessed and his task must be given to new forms of motor. He could not attain such a velocity, even entirely without a load; far less could he draw a heavy train at such a speed. Were it practicable, even as a matter of construction and of invention, the engineer would be compelled to take the engine from the head of such a train on account of the relatively high and absolutely exorbitant cost of its own transportation. He could not afford to add superfluous weight to that of the train.

"Thus the assumptions seem fair that the locomotive engine will have been superseded when we have doubled our speeds, and that we must find ways to utilize the weights of the cars themselves for adhesion, and to make each carry its own motor. This evidently points to electric traction, the only method as yet discovered of making the horse do his work without taxing us for his carriage. I have very little question that, where railways are carrying large numbers of passengers on short routes, as on our systems of elevated road, the electric motor, or some advance on that marvel of invention and engineering, must come into use. Heat, light, and electricity will then conspire in that coming revolution which shall combine for us the speed of the bird, the comforts of home, and the safety of the dwelling. Through the action of such forces, steam will probably continue even then to 'compel other devils,' to 'lengthen and shorten space' between cities and towns and to create new and brilliant, though still evanescent, 'foam bells along thought's causing stream.'"

Underground Electric Work.

BY DAVID BROOKS.

While looking over the proceedings of the Chicago Electric Club, as printed in your paper, I was preparing myself to walk into that concern and make a disturbance, when I found Herbert Laws Webb had forestalled me, and taken a portion of the wind out of my sails. Still there is a good deal that is left undone. Mr. Degenhardt states "The insulation resistance should not be less than 500 megohms per mile, and the insulation should not materially deteriorate for the space of two years after being in service on an electric light circuit, having a voltage of from 2,500 to 3,000 volts, and a current of from nine to twelve amperes, or a voltage of from 900 to 1,200 volts, and a current of from eighteen to twenty amperes." A galvanometrical test of this nature for an electric light conductor I consider of no earthly use, but agree with Wm. Maver, Jr., in an article published in the WESTERN ELECTRICIAN of March 1st, 8th and 5th, of the present year, that a cable measuring 20,000 megohms per mile for insulation in the factory, was broken down by a dynamo current of 600 volts after being drawn into a conduit. In speaking of all these tests Mr. Degenhardt makes no reference to temperature, although in a Chicago atmosphere the insulation resistance is certainly ten times as high at the temperature of freezing as at the temperature of 80.

As Mr. Webb states, the cable should be immersed in water, but even that is not satisfactory if the cables are to be used for electric lighting purposes. The method employed by Johnson & Phillips of London is spoken of as follows, in a letter under date of November 4, last, referring to a line laid at Charlton: "We have at last had Ferranti, Dr. Fleming, Gordon and others down to see it. Yesterday we had a current of about 14,000 volts on this line for about five hours, and it stood it perfectly; we took the current from a 2,000 volt Kapp alternator and transformed up to 14 000 volts to the line. At the distant end we had another transformer and converted it to 2,000 volts again, and lighted twenty 100-volt 16-candle power lamps in series, and I am writing to Ferranti and others to come and see the test repeated."

Cables that may test enormously high with a galvanometer often break down and disrupt with currents of high voltage, and especially is this the case with lead encased cables; the coiling and uncoiling of this class opens spaces in the insulation which are nothing more than vacuum tubes or Geisler tubes. Varley made use of these years ago to protect ocean cables from atmospheric electricity. Last winter I laid an electric light cable in Gloucester, a No. 0 conductor; the insulation resistance of that cable at 32° Fahr. is 1,000 megohms per mile; but in August last when the temperature of water from the hydrant was at 81 the insulation dropped to 3 megohms per mile. This cable stood the current of a 2,000 volt alternating current, but as an experiment we heated a portion of the cable up to 150° Fahr., and brought the insulation up to 5,000 megohms per mile, and tried to break or disrupt the insulation without any effect whatever. It was then tested with a Holtz machine, which produced a spark 6 inches in length to ascertain whether the insulation could be punctured, but without effect. Five thousand megohms per mile does not sound very high, but if the conductor was a No. 3 instead of a No. 0, only one part of the current would go to the earth, while 5,000 parts would keep to the wire.

Currents of great intensity center upon weak spots and develop them into perfect grounds. Culley speaks of this fact and it is for that reason chiefly that the Atlantic cables are worked with only two cells and nothing can be more absurd than the statement, "Electrical currents of infinitesimal potential are no more easily conducted than are those electrical giants of four or five thousand volts." It has especial bearing upon lead covered cables with inside textile covering; coiling and uncoiling is liable to open pores admitting moisture, especially so, when laid under water.

Mr. Sunny says: "In arc light service if we get one megohm to the mile we are perfectly contented." Mr. Sunny, speaking of telephone cables, says: "The company also put down what was known as the Brooks cable, in a 3-inch iron pipe filled with resinous oil. It extended from the business part of the city to Twenty-second street, and never gave satisfaction from the outset. I believe it is still working in some sections, but not in a satisfactory manner." In this connection I quote from Prof. Barrett: "Now then, the question of insulation is another thing, you can get all the insulation you want and a good deal more. I recollect a short time ago that a cable was aban-

[illegible] the insulation was so high that they [illegible] use. Gentlemen in the room know that to be a fact. They had to reduce the insulation so that the cable would work." A few days ago I was in Chicago and Prof. Barrett said the words just quoted had reference to the Brooks' cable in that city laid four years since. When the cable was first laid, Mr. Sunny wrote that it was a perfect success, in the next letter he stated there was a great deal of retardation on the Brooks cable. When an overhead cable was connected into it at Twenty-second street, and when it was still lengthened by connecting in another cable at LaSalle street, the Brooks cable as a trunk line was nearly worthless; but taking the poorest insulated wire, they could use it fairly well.

I got Geo. H. Bliss to try the cable himself, and he wrote as follows: "Scarcely any cross-talk or induction sounds could be heard by me on the Brooks cable wires in any of these tests. Pronunciation of difficult names was tried on all the Brooks wires with success, except in those cases especially difficult for telephone transmission. This afternoon I went, at Mr. Brooks' request, to the Chicago Avenue exchange, where conversation was carried on through a wire in a Patterson cable to the LaSalle street exchange, about one mile distant. The cross-talk and induction were much more pronounced than on the Brooks cable wires used in the morning, although the distance was only one-third as great."

History has record of the better working of ocean cables by putting in leaks. Culley speaks of it in the cables that are laid from island to island in the Mediterranean. Sabins in his work published in 1867, states that Kramer improved the insulation of the underground wires in Germany by reducing the insulation, so there is nothing wonderful in the statement of Mr. Sunny that the poorest insulated worked the best. The great fault with the cable is that the conductors were too large, No. 16; if they had been No. 22 the inductive disturbance would not have been more than half as great. I protested against the use of such heavy conductors, there being 510 in a 3-inch pipe What is needed in telephone service is not so much volume as distinctness of articulation. Since then I laid a cable of 53 conductors for the Pennsylvania Railroad company of Philadelphia, and one of them was a very small wire, No. 22, laid for the purpose of a test wire; this cable is used for both telephonic and telegraphic purposes, and it has been found that the small wire serves much better than any of the others for telephone uses, for the reason that it occupies no more than half the space in the inductive field. Using the No. 16 wire you do not reduce the resistance of the circuit, which includes telephones and transmitters, 1 per cent., but you increase the inductive disturbance 50 per cent.

As an experiment we connected in as many as ten of the No. 16 wires, using them in parallel, and thereby reducing the resistance to merely nothing, or next to nothing, and then listened to the noise. We were enabled to hear the hum of the electric light dynamos. The amount of this is to show that there has been a great deal of copper wasted in telephone cables of short length, but in long distance telephoning where the circuit is double in length, to make it metallic, then conductivity becomes essential.

Mr. Sunny, referring to electric light cables, makes the following statement: "In the electric lighting business I claim that the underground work is not a complete success for the reason that the lights are apt to go out once a week from some underground defect. The insulation is liable to run down so low on short notice as to require the shutting down the circuit for repairs." Now, with the Brooks' system, patented in 1887, an entirely different state of affairs exists. With nine installations working, most of them upward of a year, not a single interruption has occurred. Prof. Barrett states: "It is a fact, with the underground system of Chicago to-day, that you deliver more of your product at the lamp than you did with the overhead system." At Gloucester we used Johnson & Phillips' method of insulating the lamps, and with 22 terminals exposed to the rain, we got a much higher insulation than on a clear day at the same temperature, because some of the pipes and lamp posts are exposed to the rays of the sun. An ordinary glass insulator exposed to the smoke and soot, will not show in Chicago in the rain an insulation of over a megohm, and there is a great deal in this particular point of carrying the full current to the lamps as pointed out by Prof. Barrett. There is much said about subways, and conduits. I consider the best of them an unmitigated nuisance, and of no earthly use. Nineteen No. 4 electric light conductors can be drawn into a 5-inch diameter pipe, the conductors not costing over five cents a foot. Think of what Mr. Laws says, a good electric light conductor can be had for $1,250 per mile, and that Mr Degenhardt says the rental of a duct is $1,000 a mile per annum. If electric light companies must pay these figures they should never be obliged to go underground. Mr. Kempt says: "I think in this discussion a comparison of the cost ought to be mentioned for good reasons. So if any gentleman is prepared to give us some figures, showing the difference in cost between aerial and underground construction, I should like to hear them." I would very much like to go into figures, but it is impossible to do so, unless one knows what is wanted; if a person should ask me how much it costs to build houses, I should state it depends very much on the kind of a house you want, and if any one will specify what is required, I will at once estimate for the work and promise that it doesn't cost one-sixth of any other underground system, and but little or if any more than an overhead system.

Two years since a wood conduit was laid on Chestnut street, Philadelphia, and the street being narrow, the traffic was incommoded by immense heaps of earth that were thrown out. Some electric light wires have been drawn into them, and the conduit has taken fire twice between Seventh and Eighth streets, destroying all the conductors and a portion of the conduit had to be rebuilt. There have been several other fires that have come under my notice, one at Fourth and Chestnut and another at Eleventh and Chestnut; there the conduit had to be rebuilt for half a square. Not more than a couple of weeks since an explosion occurred at Ninth and Chestnut streets, breaking every window upon one side of a street car.

There are four conduits in Chestnut street. In this same locality, but on the south side of the street, a manhole blew up, and sent up the cover through the window, which consisted of a large French plate glass into the store of Porter & Coates. Between pumping water out and fanning fresh air into these conduits, there is quite a new industry established.

The idea that you can pull in and pull out in making repairs is popular, and that you have spare ducts to put in more conductors when needed, is also popular; but in practice here the first thing necessary after you pull in a cable, is to pull it out again and repair damages. Rubber and gutta percha are soon destroyed when exposed to the atmosphere of a wood conduit. Lead is turned into white lead. Prof. Marks calls wood conduits white lead factories. To preserve the white lead they cover it with a braid saturated with black paint. When drawn into the conduit the paint is as dry as any other paint after it is exposed to the air, and does not adhere to the hand, but after it has been in the conduit a week, this paint becomes liquid, thinned, and leaves a black mark on your hand if you touch it. Illuminating gas is only another form of hydrocarbon or fatty matter, and acts as a solvent, like benzine upon grease spots. The paint and braid preserve the lead for a while, but are not lasting. About a month since they undertook to draw in some electric light conductors in this wood conduit at Broad and Chestnut streets, and after punching with their iron rods to get a passage for pulling in rope, they found the conduit was rotten, and the whole thing for 60 feet or more across Broad street, the widest street in Philadelphia, had to be dug up, and a new conduit laid. Broad street at this place is paved with asphalt, and the gang of men were making repairs there for about ten days. Broad street is Fourteenth street if numbered. When they got as far as Fifteenth street they had another circus of the same nature and had to put in a new duct. It seems to me that anybody that would spend money for a conduit at this time must be demented, yet another company is now laying in this same Broad street a wood conduit. I consider this a case of aggravated dementation: "If the blind lead the blind, both fall into the ditch," which is the scripture name for conduit. I must quote a scrap from an author of the twelfth century, Mr. Dante: "These may be called flocks of sheep, and not men; for if one sheep should throw himself down a precipice of a thousand feet, all the rest would follow; and if one for any cause in passing a road should leap, all the rest would do the same, though they saw nothing to leap over."

Electricity in Mines and the Proposed Mining and Electrical Display at the World's Fair.

At the last meeting of the Chicago Electric club E. F. Browne read a paper on "Electricity in Mines and the Proposed Mining and Electrical Display at the World's Fair" The article appeared in the last issue of the WESTERN ELECTRICIAN. After the presentation of the paper the following discussion took place:

MR. BAIN: "I would like to ask Mr. Browne how much water it is necessary to pump out of a mine?

MR. BROWNE: Pumps in coal mines, especially those in Ohio, and in this state, are required only to throw the water 300 feet; that is not difficult to accomplish; but in a silver mine the pump should be able to handle a column of water four to six inches in diameter at the rate of say, 1,000 gallons a minute. When you get a column of water of 500 feet, that would be equivalent to a weight of 250 pounds to the square inch. A rotary pump will throw water to a certain distance, say 150 feet, but when you come to put a pressure of 250 pounds to the square inch at the end of the rotary, you must have great force to make it do the work. I do not think you could make the iron so that it will stand the pressure; it would strip. The pressure of a column of water of over 500 feet is so strong that although you make the valves out of a peculiar kind of rubber which is constructed for that purpose, and is as hard as iron, still when a little air gets into the water column it sets back on the valve and it gives just exactly the same sound as if you struck the pump with a heavy sledge hammer. I think in any sort of a rotary pump the fans, or whatever you have for throwing the water, would be broken. You take the Cameron pumps, and all the deep sinking pumps that we have, the pressure is so great that the plungers are made solid. Piston heads are not used in mining pumps, but the plunger is solid and fills the full size of the pump, and the steam works right on that solid piston. Possibly something might be accomplished with gearing and a spindle, giving it the necessary motion, as it goes by a heavy dead center. At the necessary depth in a silver mine a pump will only suck the water up from sixteen to eighteen feet, and the water has to be forced the balance of the distance. You see it is a hard problem to be worked out by electricity, but it is one that everybody would like to see solved.

The pump that they have put in the Virginius mine I am told has a system of three plungers. I have not seen the plans. Such an arrangement would take up the entire shaft; consequently it occupies too much room.

THE CHAIRMAN, F. B. BADT: There is an invention worked out to-day that I think will accomplish just exactly what is required in a sinking pump, and do away with gearing. I am speaking of Mr. Vandepoele's reciprocating electric engine I suppose you have seen the description of it in the electrical papers It is simply an electric machine that works on the principle of a solenoid; it has an iron core to push it out. You can very easily imagine how such a motion can be utilized for operating a sinking pump. All that is necessary is to connect the piston rod of your pump to the iron core. It may be put above the pump itself, and you have the reciprocating motion of the pump right in the core, without any gearing whatever. The same motion has been used for coal cutting machines. Mr. Sperry's machine is a reciprocating drill At the same time he does not use this reciprocating electric engine. He uses, I believe, an electric motor to convert the rotary motion into a reciprocating motion, does he not?

MR. BAIN: Yes, he uses a spring.

MR. BROWNE: For coal work that is a perfect machine.

MR. BAIN: For some cases. The reciprocating machine is better for shearing and better for certain classes of coal.

MR. BROWNE: It has been found that the drill with a spring does not give it the force that it ought to have; it is not positive enough.

THE CHAIRMAN: Mr. Browne was speaking of pumping a great quantity of water against a head I believe, of 1,000 feet. The mining department of the Thomson-Houston company, with which I am connected, is at present constructing for mines a pump in connection with an electric motor which will pump 500 gallons per minute against a head of 1,500 feet. I figured out the other day how many horse power would be required in the electric motor, and found it will be in the neighborhood of 260 to pump 500 gallons per minute against 1,500 feet pressure, about 650 pounds per square inch. In a pump there are quite a number of parts that cannot stand a very high pressure unless they are properly built; and as a matter of fact there are not many pump builders in the United States to-day who are willing to build such a pump and guarantee it.

Mr. Browne very properly remarked also that the electric hoist—and we might say electric elevator, which is nothing but a hoist—is not quite what it ought to be, for the reason that too much gearing is required to transmit the fast rotary motion to the drum of the hoist or elevator. I don't know whether Mr. Browne has heard about it, but electricians have been hard at work for over a year to construct what we call a multipolar motor, which will run at a very slow rate of speed with direct gearing to the drum.

Now about the second part of the paper. I have read and studied Mr. Browne's scheme very thoroughly, and it is true, as he said, that the more you study it the more the project strikes you. I am enthusiastic about it, and I hope we will have this mine at the World's Fair in Chicago, and I hope we will have plenty of electricity in it.

MR. BAIN: I believe I was the first to make an electric mining machine that went into a mine and staid a year and cut coal without seeing the light of day. I can remember very distinctly the first day I ever saw it cut coal. I did not know whether it was going to do it or not. I put my hand on the lever two or three times and jerked it back. I didn't know whether to turn it on or not. I put in the first motor in the fall of 1878, and I don't believe it saw the light of day for a year, and it cut coal every day. Finally the miners went on a strike, and then we took two men from the country who had never seen a coal mine and put them at work, and the results were entirely satisfactory. What we need in coal mining is a good shearing machine. In Iowa they have a Stein Smith machine and the current used in the machine is also employed for blasting.

MR. GOODMAN: I would like to ask Mr. Browne what the effect would be after the World's Fair mine is abandoned?

MR. BROWNE: In case it would have to be abandoned and we took the center out it would have to be filled. Situated as this is, with that solid core, it would not show any effect on the surface, being 500 feet in depth. That is one of the objects in having it so deep.

MR. CUTTER: I feel at a loss to undertake to say much on this question after what Mr. Browne has said; but he mentioned one thing that is of considerable importance to electricians, the matter of insulation. The problem is an interesting one, especially in the mines Mr. Browne spoke of, where the water contains so much metallic salt and where they want portables to carry the lamps around with them. The cable sustains rough usage in those mines, and at the same time it must resist the action of the metallic salts in the water. I fixed up one wire, duplicates, No. 14 twisting two, the first being insulated with a good grade of rubber insulation, after which we covered them with some good weather-proof material, seven different layers, and then we wound a steel wire outside of that and covered that insulating material, and found that the mules could step on it without damaging it. I would say, however, it would make a wire about half an inch in diameter. When you come to stretch it about 100 or 200 feet it makes too much of a load for the men to carry about in the mines.

MR. BROWNE: I can say to you, gentlemen, that it is a great problem in mines We have a great deal of trouble with cable. They keep turning us out a new wire every now and then, and it is being tried all the while. Some of it is very good; some of the rubber insulation is executed very nicely, but it doesn't stand the rough usage connected with moving it about.

MR. BAIN: I have put in two coal mine installations without any insulation whatever, but just the naked copper wire; but I think I have put in my last one of that kind.

MR. BROWNE: We do not use them in silver mines without insulation.

MR. BAIN: This was in a coal mine; there are a great many things to interfere with the insulation. We found the fungus growth a bad thing. In three or four days we would find a great long damp fungus growth, and the insulation would be so very low that we could hardly operate with it. In a mine in Iowa they had to have boys take sticks and knock it off. We tried to run incandescent lamps on the same circuit, but we could not hang them to the wall at all, and they came very near taking out the entire circuit and putting in insulated wire. I have not had any trouble about laying the better quality of insulated wire right down in the mud, and running the mining machines from 150 to 175 feet deep. The great trouble is

that the miners won't coil up the cable and take care of it. It is a great job to put a circuit in a coal mine properly.

MR. BROWNE; It is still a bigger one in a silver mine.

MR. BAIN: I have noticed that in very dry mines where the dust flies the insulation is as hard to keep up as it is in a damp one. In fact I would rather put a circuit in a wet than a dry mine. Coal dust is a very good conductor. In putting in electric locomotives for hauling coal they always use a metallic circuit. I don't believe it would be possible to use the ground for either machines or for the motor cars.

MR. BROWNE: We have never attempted to use that.

MR. GOODMAN: I want to ask Mr. Browne if the use of the percussion drill, or a drill operated by a spring, in the West is not much more limited than it is here in the coal mines?

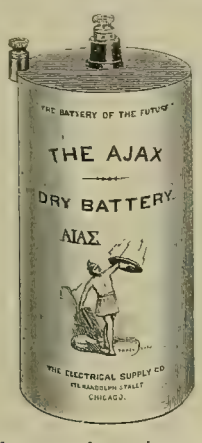
MR. BROWNE: Yes.

MR. GOODMAN: I don't think there is any difficulty about getting the required amount of power from the spring if you use one of sufficient diameter and length. I find in tests that if you take a spring of sufficient diameter and suitable length and compress it by an electric motor, you get almost any amount of power that you require.

MR. BROWNE: The sinking pump, gentlemen, is the problem for you to solve. If you work that out you will make a fortune.

Ajax Dry Battery.

The Ajax dry battery shown in the cut, although it has been on the market for some time, has been recently greatly improved. This cell is a combination of a chemical and sal-ammoniac battery, the several ingredients be-



ing combined to such a nice point that they yield the most energy for a long period of time. All danger of creeping of salts is ingeniously obviated and it is claimed that corrosion of the binding posts is impossible. The initial voltage of the Ajax cell is stated to be about 1½ volts, but the internal resistance is so small that it yields a large amount of current. The cell is hermetically sealed and the life for that reason is thereby rendered exceptionally long. This battery is manufactured by the Electrical Supply company, Chicago.

Electric Light Plant in a Railroad Station, Chicago.

The event of the week in railroad circles was the formal opening of the Grand Central Passenger station, Chicago, last Monday. Ground was broken for the foundations for this structure in October, 1887, when it was decided to establish the Wisconsin Central headquarters there, but the plans have been materially changed several times—the enterprise assuming greater proportions on each occasion, until today provision is made for the Chicago & Northern Pacific, Chicago, St. Paul & Kansas City, and the Baltimore & Ohio railroads, as well as the Wisconsin Central. The structure is probably the finest appointed building of the kind in the country.

Among its attractive features is the electric light plant. Both arc and incandescent lights are used. Two 30-light arc dynamos of the Sperry type and five Edison machines have been installed. Four of these incandescent dynamos are 800-light machines, the other a 650-lighter. Eleven of the arc lamps are arranged about the entrances in front of the building, and six are distributed about the train shed. There are also 700 16-candle power incandescent lamps in the train shed, 600 in the freight department, 200 in the express offices and 3,500 in the railroad offices and waiting rooms.

The dynamo room is in the basement, and like all other parts of the building is a model in itself. The dynamos are driven by three McIntosh & Seymour engines. One arc machine and one 650-light incandescent dynamo are connected with a 150-horse power engine; two 800-light generators are driven by a 200-horse power engine and the remaining machines, one arc and two 800-light incandescent generators, are belted directly to a 250-horse power engine.

The plant was installed by the Edison General Electric company and the formal opening on Monday partook of the nature of a celebration by the local Edison men. Many representatives of the Edison interests were present and Henry Villard, president of the Edison General Electric company, traveled from New York to Chicago to be present at the opening. He made a speech on the occasion.

The plant was installed under the personal supervision of L. C. Gavitt of the Chicago office of the Edison General Electric company.

To Utilize the Water Power of the St. Louis River.

The official announcement has been made of the transfer of the entire stock of the St. Louis Water Power company, which owns the great water power of the St. Louis river above Duluth, Minn., to a syndicate composed of Duluth, Eastern and English capitalists. The purchase price is $1,000,000, it is announced, and the new company will expend, it is said, another million in building dams and otherwise improving the power so it can be utilized. The capacity of the water power is estimated at 65,000 horse power. The improvements in the main will consist of a series of dams, the first at Fond du Lac. One of the plans of the company is to supply electric power to Duluth, Superior, and all the manufacturing suburbs of those places.

Unit of Self-Induction.

At the last meeting of the American Institute of Electrical Engineers in New York November 18th, Francis B. Crocker of the committee on the unit of self-induction, made the following report: "The committee on the value of the unit of self-induction—the henry—has held one or two meetings but is hardly yet able to report. We find that the ordinary practical values of self induction vary from about one one-hundredth to ten quadrants, therefore the average value is a little less than one quadrant. This means that in order to express self-induction in quadrants within one per cent. you have got to go to the second or third decimal place. Therefore in order to express all common values in whole numbers, which is desirable, it will be necessary to fix the henry at about one-thousandth of the quadrant. Then we should very seldom have to use decimal fractions in expressing the value of self-induction. I merely state these points in order that the institute may be informed as to progress of our work and the general facts of the case. I think the matter better lie over until the next meeting when we expect to be able to report."

Heisler Electric Light Company.

The proprietors of the Heisler system of long distance series incandescent electric lighting have found it necessary to transfer the manufacturing of their apparatus from St. Louis to their new and commodious works located at Gloucester, New Jersey, where with enlarged space at their command and increased facilities, they will be enabled in the future to meet the constantly increasing demand for their apparatus. The extensive introduction and adoption of this system within the past two years for commercial, street and alley lighting, has made it necessary to increase the manufacturing facilities. By the Heisler system the company claims it is possible to distribute any number of lights, from 160 thirty-two candle power lamps to the full capacity of the largest dynamos, over an area of territory that could only be covered by fifty miles of No. 8 B & S. gauge wire, and suffer no drop in the candle power of the lights, the lamps furthest away burning as brightly as those nearest the dynamo, and the loss due to the resistance of the line being equal only to one 32-candle power lamp per mile. The efficiency of the dynamo under these conditions makes it possible the company claims, to obtain six and one-half 32-candle power lights per mechanical horse power expended, less the friction load of the dynamo. The company states that the improved automatic regulator used in connection with this system controls and maintains a steady and uniform light, and at the same time dispenses with all translating devices in the station and upon the circuits. The only device, other than the dynamo, used in the installation of the Heisler light is the improved combined automatic cut-out and lamp socket, which is adapted to hold any sized lamp from 10 up to 150-candle power containing no parts liable to get out of adjustment. The cut-out feature is always accessible for removal without the liability of interrupting the circuit while manipulating the same. The housing of the socket is composed of insulating material and the cut out can be renewed at a cost of less than one cent.

A St. Louis agency will be maintained where there will be kept on hand a supply of lamps and materials for repairs, as well as emergency experts, whose duty it will be to look after the various installations west of the Mississippi river.

CORRESPONDENCE.

New York Notes.

NEW YORK, Dec. 6.—Additional complications have developed in the cases of Wood and Jugiro, the murderers awaiting execution under the new law. Wood was to have been executed this week and an application in his behalf for a habeas corpus was denied, yet the judge granted an appeal. When this was served upon the warden he did not know what to do. Assistant District Attorney Goff says: "This terrible jumble is pretty certain to lead to a strange state of affairs. Judge Brown's order not being recognized as a stay of proceedings, Wood must die, under the state court's decision. If after his death the United States Supreme Court should decide that Wood was not justly tried his death will be a murder by the State."

The warden decided to recognize the order of appeal as a stay of proceedings.

Jugiro's case was called and the Jap was resentenced. His attorney objected on the ground that the defendant had already paid a portion of the penalty—that of solitary confinement in Sing Sing for eight weeks—and could not be made to undergo that portion of it again for the same offense, and he asked the court to make a ruling on that point. Mr. Goff objected, saying that it would be extremely hazardous at this time to make any such ruling and might lead to serious complications. Col. Fellows suggested that any longer period of solitary confinement was brought about by himself in appealing the case and the people should not suffer embarrassment because of it. The judge refused to make a formal ruling and then Lawyer Sherman called attention to the fact that the United States Supreme Court still held the papers and records in the habeas corpus proceedings and could, up to May, order a rehearing of the case. Of this point Judge Brady said he would take no notice.

"The sentence heretofore pronounced," said Judge Brady, "for murder in the first degree and the time fixed for your execution having passed by reason of your appeal, it becomes the duty of this court to name a week in which the judgment shall be carried out according to law. The court names the week commencing Jan. 19, 1891. You are therefore remanded to the custody of the warden of the state prison at Sing Sing, there to be executed according to law."

The Jap was immediately hurried off to Sing Sing where he will be closely confined until the day of his execution. He did not appear to realize his position.

Lawson N. Fuller is endeavoring to reclaim the $6,500 which he invested in the electric sugar scheme. The late Prof. Friend's right hand man, the Rev. William E. Howard, is serving a ten-year term in state prison for his share in the swindle. Mr. Fuller said that the evidence on Howard's trial showed that Howard received the identical money that he (Fuller) paid to President Cottrell and Treasurer Robertson of the company, and that Howard went the same day to Ann Arbor and bought real estate with the money. Cottrell and Robertson, for the defunct company, attached the real estate, and the suit to determine whether it shall become an asset for the receiver to dispose of, will be tried to-day. Mr. Fuller wanted Col. Fellows to suggest some way in which he (Mr. Fuller) could get the whole or part of the real estate that his money paid for.

John K. Smith, an electrician of this city, died Wednesday of congestion of the brain. He was twenty-five years of age and a widower. He was well known in electrical circles.

The latest development in the subway matter was made public at a meeting of the Board of Electrical Control in the mayor's office Thursday. Edward Lauterbach, the president of the Consolidated Telegraph & Electrical Subway company, said that the persons interested in the various telegraph and telephone companies had organized a company under the title of the Empire City Subway company. He said the object of this company was to take charge of all the low tension subways in the city. Mr. Lauterbach mentioned the efforts made by the Standard company to get part of the subways, and the failure of the company to comply with the conditions imposed by the Supreme Court. He promised that the new company would work legally and properly. He said that the business had grown so that it was now too large for one company to manage, and that the company he represented was willing that the new company should take charge of the low tension subways, while the arc light subways should be controlled by the old consolidated company. Mr. Lauterbach asked the board to give its consent to the scheme of surrendering the control of the low tension subways to the new company under proper restrictions and guarantees.

No action has yet been taken on the question of the bids for lighting this city by electricity during the ensuing year. At the meeting of the Gas Commission on Wednesday

when the bids were opened, there were six bidders, as follows: Brush Electric Illuminating company 299 lamps at 43 cents and 45 cents; United States Illuminating company 309 lamps at 43 cents; East River Lighting company 247 lamps at 44½ cents; Mount Morris Electric Lighting company 171 lamps at 43 cents; Harlem Lighting company 211 lamps at 43 cents and 50 cents and the North New York Lighting company 28 lamps at 50 cents. The bids will be tabulated before any action will be taken. All the bids received are from two to three cents higher than last year.

The Westinghouse Electric & Manufacturing company will consider the advisability of exercising the power conferred by its charter to issue preferred shares. A proposition will be submitted to the stockholders at an early meeting to authorize the directors to issue the remaining $2,000,000 of authorized increase, and to convert a total of $3,000,000 of the $10,000,000 into preferred stock to be entitled to a dividend of 6 per cent. in preference to the common stock, and this dividend to be accumulated; and these shares to share equally in the profits when the dividends are more than 6 per cent. on both the common and preferred stock. It is believed that these shares will find a ready market and that the extinguishment of the debt of the company by the issue of the preferred shares will at once advance all of the shares of the company to the position which they should occupy by reason of the very large business, which the company is doing. These preferred shares are to be sold at par, and it is proposed to have the interest payable July and January. The meeting of the stockholders of the company to vote on this question has been called for December 10th, 1890.

An interesting case is now before Judge Lawrence and a jury of the Supreme Court. The Mutual Telegraph company is being sued by Mrs. Emily C. Berthet for $5,150 damages for not transferring to her two certificates, each for 100 shares of its capital stock. The defense, which is being made principally on behalf of the estate of John N. Rickins, is that she is not the owner of the certificates Prior to 1887, Mrs. Berthet, who was then Emily C. Cortwright, says, that she had business relations with Rickins, who was cashier of H. B. Claflin & Co., and that he transferred the certificates to her, but the company refused to recognize her ownership. Rickins died in 1887, and the public administrator took charge of his estate. The company was unable to recognize Mrs. Berthet's right to the certificates, as notice was served on it that they were claimed on behalf of Rickins' estate.

It is gratifying to see that the suggestion brought before the New York Electrical society by Lieutenant Bradley A. Fiske with reference to the formation of military and naval electrical corps for service in time of war, has not only been received enthusiastically by electricians generally, but has been favorably commented on by Secretary Tracy, who has called attention to the increasing employment of electricity on shipboard, and the necessity for the acquirement by naval officers of a certain amount of electrical knowledge. Secretary Tracy says, however, that it is impossible for all, or even any great number of them, to become expert electricians; nor is it desirable that they should do so at the expense of other branches of their profession of more pressing importance. He suggests that a corps of naval electricians be established in the several states that have created a naval militia to be attached to this militia, and to receive the naval training which it is the object of the militia to give. Such a corps would be especially valuable in fitting out new vessels with electrical apparatus, and in taking charge of the electrical plants on board ships in commission. It is understood that a presentation has been made to Governor Hill having in view the early formation of such a corps as this, which it is proposed to make a part of the National Guard of the State of New York.

The Telephone company contemplates introducing dime-in the-slot telephones in an extensive scale in this city. It has one on trial in the Barclay street ferry house, which is mostly used by New Jersey people, who come to the city on business. Thus far the device has given satisfaction, but little experience has been had with it as yet. W. H. T.

Pittsburg, Pa.

PITTSBURG, Dec. 6.—The Pennsylvania Railroad company has lately inaugurated the scheme of illuminating certain portions of its railroad system, where traffic is particularly heavy, by electric lights. The start has been made at Frankford creek on the south to Poquessing creek on the north, at Torresdale a distance of nearly eleven miles. The railroad management in referring to the fact that such a contract for lighting had been given out by them, stated that the idea had been suggested to them to render as far as possible security to the lives of the traveling public, and to the lives of the employes of the road. There is no doubt however, that the light will greatly tend to avoid loss by the smashing up of freight trains, in fact if a general adoption of this system of lighting up the tracks by electricity were made by all railroad companies throughout the country, the benefits to be derived therefrom in the saving of human lives and the avoidance of freight wrecks would be incalculable, and the expense which might be involved in the erection of lighting plants for the purpose would soon be made up by the absence of accidents.

This particular district above referred to is especially noted for the frequency of accidents. It is expected that the Pennsylvania Railroad company will shortly commence to light up its entire track from Philadelphia to New York City.

The Pittsburg electrical workers intend to form a national organization of all electrically employed workmen throughout the country. For this purpose the secretary of the local electrical union, composed of linemen and carbon setters, has sent circulars to every city in the country where electric light companies are organized, asking for the appointment of delegates to be present at a convention to be held in Pittsburg sometime in the spring.

The Secretary of the Treasury has recommended an expenditure of $15,000 for the construction of an electric lighting plant to be used in the illumination of the new custom house and postoffice building in the city of Pittsburg. This structure will soon be completed, having been under way for the last dozen years. E. H. H.

Kansas City, Mo.

KANSAS CITY, Dec. 6.—Work on the West Side electric line in Kansas City, Kan., began last Monday. The Rae overhead system will be used. The company says it hopes to eventually introduce storage batteries.

The Board of Public Works has approved of Chief Hale's plan to light the engine houses of the city by incandescent lights. The system will be so arranged that the houses and the horses will be in darkness until an alarm rings, when the men on watch will instantly turn on the lights. They will save something in the cost, as oil lamps and gas are now burned steadily all night, and will be much more healthful for horses and men. Chief Hale is perfecting his large lamp and storage batteries for the carts, but is not yet ready to present it to the board of public works.

The city council of Kansas City, Kan., met this week. The Gamewell Police, Telephone & Signal company of Chicago, petitioned for a franchise to furnish the city their "combined fire and police telephone and signal system."

P.

Topeka, Kan.

TOPEKA, Dec. 6—At the meeting of the city council this week, Mayor Cofran again vetoed the ordinance granting the right of way on Kansas avenue to the Rapid Transit railway. It was then passed over the veto. The ordinance grants to the Rapid Transit Railway company the right to maintain and operate a single or double track railway on Kansas avenue, and provides that horses are to be used on the Kansas avenue bridge. The tracks of the company on Kansas avenue between Eighth avenue and the north line of the city are to be constructed under direction of the city engineer. The company may use the tracks of the Topeka City Railway company upon paying such compensation as may be reasonable and just. The ordinance also provides for the lighting of Kansas avenue and strengthening the Kansas avenue bridge at the expense of the company.

The City railway ordinance which was passed some time ago and which granted to the Topeka City railway the right to use electric cars on Kansas avenue, was reconsidered. The ordinance was again passed with a few amendments.

R.

Ithaca, N. Y.

ITHACA, Dec. 6.—At the meeting of the Senior Electrical association recently, Instructor Saunders described his method of determining the direction in which lines of force circulate about a wire in which a current is flowing; the basis of his methods was to assign to the line of force the quality of elasticity.

On the 17th Mr. Lindsay, '91, described the Wenstrom dynamo. The remarkable feature of this machine is its low speed.

A new belt-testing apparatus has been added to the equipment of Sibley College through the kindness of Wm. Sellers & Co. The principal feature of this apparatus is a costly dynamometer which is peculiarly adapted to practical belt-testing.

On the 21st ult. Wm. L. Launders of the Ingersoll-Sergeant Drill Co., lectured before Sibley college on the "Production, Transmission and Use of Compressed Air." Mr. Launders was very impartial in describing the various air compressing machines now in the market, giving due praise to the excellent features of those in competition with his own. But with all his impartiality he seemed to dwell with more pleasure upon the indicated efficiency of the generator; that is, the efficiency of "production," which was as high as 96 per cent., than upon the efficiency at the point of application, which is but 32 per cent. This low efficiency is due to the loss of heat during transmission. Surely electricity has not a very formidable rival in compressed air.

Herschel of '90 is in the employ of the Thomson-Houston company at Boston, as draughtsman.

R. G. Thompson, is making an investigation of the Thomson-Houston arc machine, similar to the one made of the Stanley dynamo by Tobey & Walbridge. P.

Indianapolis, Ind.

INDIANAPOLIS, Dec. 6.—The long talked-of electric street railway line to Broad Ripple begins to show some signs of life under the name of the Broad Ripple Rapid Transit company. The contract for building and equipping the line has been let to the United States Electric Street Railway company of Chicago. The cars are to be supplied with an improved motor and storage battery owned by that company. Joseph S. Qualey of Chicago, is here in charge of the work.

Ground has been secured at Broad Ripple for power house and the work of grading has begun. It is the intention of the company to reach Union Station by some route. They will probably have a fight in the courts before they secure a right of way in the city. M.

Memphis, Tenn.

MEMPHIS, Dec. 6.—Memphis is perturbed just now over the question of the extent to which a member of the municipal council may be interested in corporations that exist or operate by virtue of a contract with the city. The charter of Memphis, in common with the charters of most other cities, provides that it shall be a felony for any member of the council to become interested, remotely or directly, in any contract with the city. President Betholl of the Memphis council, is a wealthy man, and owns stocks in nearly every enterprise in Memphis. When he entered the office he disposed of his interest in the gas and water companies, and other corporations that were under contract with the city, or liable to become so, to supply it with any commodity, such as gas, water or other commodity, for a moneyed consideration. He retained his interests in divers railroad companies and similar establishments that have received franchises from the city, some for a moneyed consideration and some as a gift.

Among other corporations he is a stockholder in the City & Suburban Railway company, an electric street railroad to which the council recently granted the right to occupy certain streets in consideration of the payment to the city of a sum of money. Attorney-General Peters, holding that Mr. Betholl's action in assisting to sell a right of way to a company in which he was interested was a violation of the law, presented a bill of indictment. The grand jury ignored the bill. The attorney-general will probably have recourse to a chancery suit.

Memphis will have electricity as its motive power for its street cars as soon as the change can be made. For more than a year the syndicate, at the head of which stands C. B. Holmes of Chicago, has been dickering with the council, and at times during the struggle both sides became decidedly pugnacious. A special session of the council was called in consideration of the presence of Mr. Holmes in this city for the purpose of bringing matters to a crisis. The basis of consummation entails upon the railroad company an outlay of some $150,000 in street paving in lieu of the 5 per cent. of gross earnings per annum, as proposed by city authorities. There is still a slight hitch.

At the same session the council formally ratified the consolidation of the two systems. This action finally disposed of perhaps the most disturbing element in the whole matter, since Holmes and his associates made the purchase upon condition that this be done. There is an intense feeling of relief with the entire public over the solution. Holmes gives assurances that the work of changing the systew will commence at once. W. A. Billings, a Chicago capitalist interested with the syndicate, has been here for two days. He promises speedy work in the equipment of the road with electric apparatus. St. Louis is also financially interested in the matter. K. M.

Council Bluffs, Ia.

COUNCIL BLUFFS, Dec. 6.—The Inter-state Bridge & Street Railway company has been incorporated. The incorporators are John A Creighton, A. J. Poppleton, Henry W. Yates, Richard C. Cushing, James M, Woolworth and Arthur S. Potter. The capital stock is placed at $2,500,000, divided into 2,500 shares of $100 each. The term of

the incorporation is ninety-nine years. The general object of the incorporation is "to construct, maintain and operate a bridge across the Missouri river at and near the lands of the East Omaha Land company; and also to construct, maintain and operate a steam, electric motor, horse, elevated, cable or other line of railway, and a public way across said bridge between Douglass county, Neb., and Pottawatamie county, Ia." The company will petition the city council to grant it a franchise. It will adopt storage batteries, it is claimed. D.

THE ELECTRIC LIGHT.

A new electric lighting company, the Electric Contract company, has been established in Philadelphia and has contracted with the Westinghouse Electric company for the installation of 750 incandescent and 300 arc lights.

Storage battery plants appear to be popular on the coast. The Pacific Electrical Storage company announces that it has closed contracts for one 400-light plant for a California residence, one 180-light plant for Los Gatos and several smaller plants in San Francisco and vicinity.

When the new Mary Houston arrived at port at Memphis, Tenn., early last week from Cincinnati, she was equipped with an electric search light, one of the first instruments of the kind to appear on the Western rivers. It was made by the Thomson-Houston Electric company, Boston, Mass. It had not been received when the boat left Cincinnati, but was forwarded to her at Cairo.

The Westinghouse Electric Manufacturing company completed during November a month of business which has been the largest in the history of that corporation. The company shipped incandescent alternating light machines with an aggregate capacity of 30,000 16-candle power lamps. Among the places where the Westinghouse system has been installed are Philadelphia, Pa , 750 incandescent and 300 arc lamps; South Omaha, 750 lights; Ballston, N. Y., 750 lights; Lima, O., 1,500; Aspen, Colo., 750; Wellsburg, W. Va., 500 incandescent and 25 arc; Charlestown, W. Va., 750 increase; Portland, Ore., 100 arcs.

The Willamette Falls Electric company of Portland, Ore., is making some additions to the capacity of its electric lighting plant. The central station was put up somewhat more than a year ago and was installed with Westinghouse alternating current apparatus of a capacity of 600 incandescent and 200 arc lamps. The plant is situated at Willamette, where the water power of the falls is utilized in the generation of the electric current. From the generating station to Portland, is twelve miles and for the purpose of transmitting the current over this distance, the installation consists of 3,000-volt dynamos. The light and the plant in general have given great satisfaction. The demand has increaeed and the company has given the Westinghouse Electric & Manufacturing company the contract for an apparatus to furnish an additional 100 arc lamps.

The following sales are reported by the Thomson-Houston Electric company central station lighting department, Chicago, Ill., for the month of November: Marmon & Perry Light company, Indianapolis, Ind., 2,000 incandescent; C. W. Kimball, Maywood, Ill., 500 incandescent; Alpena Electric company, Alpena, Mich., 1,300 incandescent; Gilchrist & Dresie, Seneca, Kan., 500 incandescent; J. R. Hamacher & Bro., Richmond, Mo., 650 incandescent; Mt. Pleasant Electric company, Mt. Pleasant, Mich., 650 incandescent; Lansing Gas company, Lansing, Mich., 650 incandescent; Pierce City Water company, Pierce City, Mo., 300 incandescent; Lamar Water & Electric Light company, Lamar, Mo., 650 incandescent and 50 arc; Oakland Gas Light & Heat company, Oakland, Cal , 50 arc; Owasso Electric Light company, Owasso, Mich., 60 arc; Badger Illuminating company, Milwaukee, Wis., 100 arc; Vivian, Stribling & Co. Norborne, Mo., 30 arc.

The Westinghouse Electric Manufacturing company has just completed the installation of an electric light plant in one of the iron mines of the Lake Superior district. The mine is called the Ashland, owned by the Ashland Iron Mining compauy of Ironwood, Mich. There are over two thousand people employed in the mine, which is one of the oldest and richest in the Ironwood mining district. Like most of the mines in Lake Superior iron ore belt the Ashland is in some portions damp, and the installation of an electric lighting plant presented therefore a great many difficulties, owing to the trouble of accomplishing a thorough insulation of the wires. The m'ne is 720 feet deep and has eight layers. The descent to the mine is made by means of a number of ladders, each of them being 75 feet in length. The dampness in some parts of the mine was extraordinary and to succeed in making the insulation perfect, the wire had to be drawn through simplex insulating paint, and only the best okonite was used in the entire plant. The work could only proceed very slowly owing to these obstacles, and it took four months to finish the wiring. The generating station of the plant is situated in the pump house. The plant has a capacity of two 300-light Westinghouse machines. The switch-board is very artistically arranged, and is made of a beaten board of white and brown birch wood.

Following is a list of apparatus shipped by the Thomson-Houston Electric company, Chicago office, during November: Arc—Yazoo, Miss., Water Works & Electric Light company, 50 lights; Western Electric Construction company, Denver, Colo., 300 lights; Ogden City, U. T., Electric Light company, 100 lights La Porte, Ind., Electric Light company, 50 lights; Rogers & Stevens, Beloit, Kan., 30 lights; Cherokee, Ia., Electric Light & Power company, 30 lights; Ft. Scott, Kan., Electric Light & Power company, 60 lights; Wyoming Pacific Improvement company, O'Neil, Neb , 30 lights; People's Electric Light & Power company, South Chicago, Ill., 150 lights; Missouri Car & Foundry company, St. Louis, Mo., 12 lights; Thomson Houston Electric company, Charleston, Ill., 30 lights; Dixon, Ill., Electric Light & Power company, 35 lights; Langford, Henderson & Larkins, Paxton, Ill., 30 lights; Chicago Anderson Common Brick company, Lyons, Ill., 48 lights; Atlantic Mining company, Houghton, Mich , 9 lights; Badger Illuminating company, Milwaukee, Wis., 50 lights; Vivian & Stribling, Norborne, Mo., 30 lights; L. E. White, Greenwood, Cal., 30 lights. Incandescent—D. D. Wilder, Santa Cruz, Cal., 100 lights; A H. Andrews & Co., Chicago, Ill., 600 lights; C. T. Roenitz Leather company, Sheboygan, Wis , 150 lights; Huntington & Hopkins Manufacturing company, San Francisco, Cal., 200 lights; East St. Louis Packing & Provision company, East St. Louis, Ill., 250 lights; Hansen Furniture company, Janesville, Wis., 75 lights; Montgomery, Ward & Co., Chicago, Ill., 400 lights; Schneidewend & Lee, Chicago, Ill , 300 lights; Alpena, Mich., Electric company, 1,300 lights; H. H. Shufeldt, Chicago, Ill , 400 lights; Weisel & Vilter Manufacturing company, Milwaukee, Wis., 200 lights; J. R. Hamacher & Bros., Richmond, Mo., 650 lights; Mt. Pleasant, Mich , Electric company, 650 lights; G. F. Culmer & Co., Salt Lake, Utah, 100 lights; St Louis Railroad company, 400 lights; Salt Lake Power, Light & Heat company, 1,300 lights; Hyde Park Thomson-Houston Light company, Hyde Park, Ill., 1,300 lights; C. C Travis, Owasso, Mich., 650 lights; Southwestern Light & Power company, Joplin, Mo., 1,300 lights; Gogebic Electric company, Bessemer, Mich., 1,950 lights; Capital Electric company, Nashville, Tenn., 1,000 lights; Cicero Water, Gas & Electric Light company, Oak Park, Ill., 1,300 lights; Yazoo, Miss., Water Works & Electric Light company, 650 lights; Springfield, Ill., Electric Light & Power company, 1,300 lights; Excelsior Electric company, Port Huron, Mich., 1,300 lights; Peninsula Electric Light & Power company, Houghton, Mich., 650 lights; H. A. Foster & Co., Fairbury, Ill., 500 lights; Langford, Henderson & Larkins, Paxton, Ill., 500 lights; H. Siegert, Dwight, Ill., 300 lights; Ft. Atkinson, Wis., Electric Light & Power company, 650 lights; Mord Roberts De Soto, Mo., 1,300 lights; Dixon, Ill., Electric Light & Power company, 650 lights; Rogers & Stevens, Beloit, Kan., 500 lights; Paddock & Henderson, Mason, Mich., 650 lights; Cherokee Electric Light & Power company, Cherokee, Ia., 650 lights. Motor—F. S. Sargent, Omaha, Neb., one 1½-horse power; John Campbell & Co., Detroit, Mich., one 1½-horse power; A. F. Walker, Grand Rapids, Mich., one 1½ horse power; A. F. Walker, Grand Rapids, Mich., one 5-horse power; L. M. Hodges, Chicago, Ill., one 10-horse power; Union Depot Railway company, St. Louis, Mo , one 20 horse power; A. F. Walker, Grand Rapids, Mich., one 1½-horse power.

THE ELECTRIC MOTOR.

Trouble is anticipated in the Sedalia, Mo., Electric railway owing to the opposition of the employes to the rules formulated by the company.

The West Street and North End Electric road at Seattle, Wash., was opened some time ago and Dec. 1st a schedule was adopted providing that cars to Ballard and Queen Annes Town run every twenty minutes.

The Little Rock & Argenta Street railroad has been sold to Captain W. H. Wight of the Little Rock Oil company. The road traverses the principal streets of Argenta. The road will be operated by electricity.

The Joplin, Mo., Electric Street Railway line is most completed and cars run on regular trips. The roadbed is well made, the rails are steel. The cars are both heated and lighted by electricity. The company is using the Thomson-Houston system. The line is about two miles long. Orders were given for a survey of the route to Webb City. The company will extend the line to that place next spring.

The introduction of electric motors in the down town districts in Chicago has done much toward relieving the city of the smoke nuisance, yet there still remains much cause for complaint, as the occasional "dark days" in Chicago show. An ordinance has been passed by the city council granting the Chicago Gas Fuel company the franchise for introducing natural gas. Between the electric motor and natural gas Chicago should be relieved of the nuisance attending the burning of soft coal.

The Cream City Railway company, Milwaukee, has established shops at Bay View. A number of new cars recently put on the line were built there. Several motors, which will be used when the Cream City lines are equipped, will also be built. It appears that it was the intention of the Villard syndicate to establish a plant in the city for the manufacture of motors and electric railway supplies, but the obstructive policy of the common council has discouraged this enterprise, according to Henry C. Payne.

Another victory for electric railways is reported from Los Angeles, Cal. An exchange says: "The Pacific Railway company that operates the cable roads in Los Angeles has decided to abandon cables and operate the road by electricity. The power will be generated at the power house on Seventh street. At first only the branch lines will be operated by electricity, but later it is expected to introduce electricity on all the cable lines in Los Angeles. It will involve a very heavy expenditure, but the operating expenses will be reduced so much that the improvement will soon pay for itself."

A new snow plow, to be utilized upon electric street railways, is now being manufactured by the Westinghouse Electric Manufacturing company. The appliance differs in a good many respects from the old fashioned, cylindrically-shaped broom, revolving beneath the body of a truck and throwing the snow and dirt in all directions. The Westinghouse snow plow consists of an ordinary car truck equipped with two motors, one of which performs the propulsion of the car, while the other is used to revolve two sets of shovels. These shovels are incased in a circular box, which is so attached to the front of the truck and so designed that it glides closely over the track and the rails of the railway line. As the snow plow moves along all the snow on the rails is picked up by the circular box. The revolving of the shovels brings the snow to the top of the case, where it is thrown out through a spout. This spout can be adjusted with the opening turned toward either side of the car. The snow plow can be operated night or day, because it is without the objectionable features it is claimed of the ordinary snow sweeper, which makes a great deal of noise and interferes with the regular traffic upon the streets.

A large electrical plant operated by water power has been nearly completed at Veazie, Me., four miles above Bangor. The power house is 240x52 feet, and contains fifteen Holmes turbines of 150-horse power each, so arranged that they can be run separately or in groups. These wheels supply power to two alternating dynamos of 1,800 incandescent lamps, capacity each, four arc and three power machines. The plant will supply the lights of Bangor and Brewer, power to the Bangor & Brewer Electric railway, and also the power to the waterworks of Brewer and Veazie.

The snowstorms last week found many of the electric street railway companies unprepared according to the reports in the daily newspapers. These companies had failed to provide suitable snow plows and snow sweepers, and as a result their tracks were covered with snow, making it almost impossible to operate the electric cars. Of course the same trouble was experienced on cable and horse car lines, but with proper management this should not occur on electric lines. Just at present the manufacturing companies are overwhelmed with orders for electric snow plows and sweepers.

The Springfield, Mo., electric street railway will be equipped by the Detroit Electrical Works. Work will be begun on the power house within a week or ten days and the contract provides for the completion of the work on the entire system within six months. The power house will be a two story brick structure. The electrical equipment will consist of three 80-horse power dynamos, and three 80-horse power steam engines with boiler capacity sufficient to run the engines at their maximum power. The Rae single motor system is the one adopted. About five miles of track have already been laid, the greater part of which is now operated by horses. Five miles more remain to be laid. The projectors of the enterprise were E. B. Shamos, T. D. Ball, J. B. Kenner, J. J. Coffman and W. T. Davis. They began operations about six months ago, contenting themselves at first with a plan for a belt line. The opportunities of their scheme became so enlarged, however, that they made great changes and applied for and obtained additions to their charter privileges until the present extensive system is the result. The company has been reorganized with W. L. Challis at its head. The following is the new board of officers: W. L. Challis, Atchison, president; W. T. Davis, Springfield, vice-president; W. L. Bailey, Springfield, secretary; Paul Challis, Atchison, treasurer. The capital stock of the company is $400,000.

THE TELEGRAPH.

The Western Union Telegraph company has petitioned the executive board of Rochester, N. Y., for permission to bury its wires on Mill street, from the company's office to Central avenue, a distance of about a quarter of a mile.

All the details have been completed for the establishment of the Sedalia, Mo., District telegraph, and it will be in operation within two weeks. The managers and owners of the enterprise are F. W. Mackey, local manager of the Missouri and Kansas Telephone company, and W. F. Logan, local manager of the Postal Telegraph company. They will begin putting up the wires at once.

It is announced by telegraph from Baltimore that a deed has been filed for record in the superior court from William M. Armstrong, referee, to John W. Mackey of Virginia City, conveying all the property and franchises of the Bankers & Merchants' Telegraph company, in New York, New Jersey, Pennsylvania and Maryland, to the United Lines Telegraph company, and the Postal Telegraph & Cable company, in consideration of $390,000. Col. Robert G. Ingersoll bought the properties for Mr. Mackey at a recent sale in New York, made under order of the court in the case of the Farmers' Loan and Trust company against the telegraph companies.

Miscellaneous Notes.

The San Francisco Board of Supervisors has passed an order prohibiting the "suspension of wires from the roofs of buildings."

The Hercules Electric company has been formed at Chicago to manufacture electrical apparatus; capital stock $25,000; incorporators, Calvin N. Souther, Phineas L. Hanscom, and Hiram F. Smiley.

Eugene H. Cowles, president of the Cowles Electric Smelting Aluminum company of Lockport, N. Y., makes the following statement regarding the outlook in his field: "We now expect to offer a superior article of pure metal in the very near future, made by a new process, that is radically different from anything yet known to the metallurgical world, a process that is almost theoretically perfect. By reason of the two unique and beautiful chemical discoveries it is found that the pure metal can be extracted direct from the clay. This can be done without the use of electrical aid when operated on as large a scale as that in which iron is produced. Aluminum will be produced at a cost permitting it to sell at $200 per ton, a price less than the present price of copper. Alterations will immediately be made in our works here to make the metal on a large scale. Capitalists in New York are pre-

paring to build immense new works, of probably twenty times the capacity of Lockport's works. One of the large plants will undoubtedly be located at Niagara Falls, where 10,000 to 12,000-horse power will be required to operate it. As soon as the plant at Niagara Falls is in operation, say by July, 1892, the world can expect a supply of aluminum at least 99 per cent. fine, at prices not to exceed 50 cents per pound, as methods have lately been discovered by which the metal can be hardened and its strength greatly increased without interfering materially with its toughness and great lightness."

Personal Mention.

J. W. Godfrey, of the New York Insulated Wire company, reached Chicago on a business trip last Tuesday.

J. C. Hobart, secretary of the Triumph Compound Engine company of Cincinnati, was in Chicago this week.

Capt. Willard L. Candee of the Okonite company, New York, was a visitor at the Chicago Electric Club this week.

C. H. Decker, general manager of the Detroit Electrical Manufacturing company, was in Chicago the first part of the week.

P. H. Alexander of Alexander, Barney & Chapin, New York, and F. E. Pettingell, of Pettingell, Andrews & Co., Boston, were in the city the first of the week.

William B. Knight, of Kansas City, died last Saturday from injuries received in the railroad accident at Jacksonville, Ill., last week. Mr. Knight was born in New York City in 1847. He was well known as an engineer and was the Kansas City representative of the National Society of Civil Engineers. Mr. Knight took up his residence in Kansas City in 1879 and had been engaged in many engineering projects in the South and West. At the time of his death he was engineer of a number of electrical railways. He held the position of city engineer of Kansas City four years and conducted many extensive public improvements during that time. He was general manager of the Patton Street Car company, Chicago, at the time of his death.

Business Mention.

The Electrical Supply company has just issued a new catalogue descriptive of Edison incandescent special ties.

The Crosby Electric company of New York announces that it received the highest award given by the American Institute Fair, just closed, for all the batteries manufactured by the company.

Milliken Bros., 55 Liberty street, New York, manufacturers of the Milliken iron pole for electric street railways, have just completed a new factory to be used exclusively for this branch of their trade, and are now prepared to fill promptly any orders that may be filed with them. The firm is represented in Chicago by D. Forsythe Morris, 59 Dearborn street.

The offices of the Continental Dynamo company have been removed to No. 45 Broadway, New York. William D. Perry, vice president of the Easton Electric company, has been elected to the office of general manager of the Continental company and its business will be carried on under his guidance. The facilities of the large newly equipped factory at Dover, N. J., will be again increased.

Charles A. Schieren & Co. have received an order from the Louisiana Electric Light company of New Orleans for a 72-inch belt 150 feet long. The company recently supplied a 71-inch belt 160 feet long to the same electric light company. Both belts, which by the way, are the heaviest ever made, will be used in the power house at New Orleans which is now being overhauled by the Ft. Wayne Jenney company.

The Leffel Water-Wheel & Engine company of Springfield, O., has just issued a very complete catalogue in which is described very much in detail all of its apparatus for the utilization of water power. A chapter on the "Application of Electricity for Transmitting Water Power," from the pen of Lieut. F. B Badt, of the mining department of the Thomson Houston company. Chicago, appears in the catalogue.

M. C. Chase, manufacturer of hard rubber goods at 43-49 South Canal street, Chicago, reports a very encouraging outlook for the introduction of the Claghorn insulated binding post that was recently illustrated in the WESTERN ELECTRICIAN. This little device is made in various sizes to meet the requirements of the different lighting currents, and from the letters that Mr. Chase is daily receiving there would appear to be an active demand for his invention.

The Clark Electric company, Corbin building, 192 Broadway, New York, have received a special silver medal for their automatic safety device from the American Institute Fair which has just closed. The judges on electricity visited the factory of the Clark company and tested the safety device by cutting the electric wires and allowing them to fall on other wires and in every instance the device, it is stated, proved its efficiency by removing all danger. The judges also awarded the Clark Electric company a medal of superiority for an arc lamp run from incandescent circuit This lamp was beautifully mounted in an ornamental fixture and was much admired by the visitors at the fair. The company are introducing this style of fixture for interior lighting, for stores, theaters, public halls, etc. One of the lamps is operaied in the company's office, 192 Broadway. Mr. Clark, the electrician of the company, is an indefatigable worker, and is constantly inventing new and useful electrical apparatus.

The WESTERN ELECTRICIAN has just received from Carl Kammeyer, superintendent of the National Electrical Manufacturing company of Eau Claire, Wis., a handsome catalogue devoted to a description of the "National Transformer System." In the introduction the following appears: "The marked success which has attended the installation of our electric plants has gained for the National Transformer System an enviable reputation. Painstaking electrical engineering, punctilious attention to all details of mechanical construction, the use of the finest grades of all metals and materials entering into the construction of our electrical apparatus, and the employment of a liberal factor of safety in rating capacity, have placed the National Transformer System in the front rank of modern electrical machinery," The catalogue is profusely illustrated, and all the details of the system are shown. The little publication contains too, matter in the form of practical hints which are well worth reading.

The Eureka Tempered Copper company of North East, Pa., was awarded the John Scott medal by the Franklin Institute of Philadelphia at the November meeting. The company reports large orders for its goods for electrical purposes and for bearings and has been compelled recently to double the capacity of its plant. The company reports large shipments of commutator segments in November to the Edison General Electric company, the Westinghouse Electric company, the Brush Electric company, the Wenstrom Consolidated Dynamo & Motor company, the Electro Dynamic company, and nearly all the large manufacturers of motors in the United States. At a meeting of the Northwest Railroad club held at Union Depot, St. Paul, Nov. 7, C. F. Ward, of the St. Paul & Duluth road, in the discussion of the best methods of making locomotive side rods, said that he wished some member would try tempered copper as a substitute for brass with solid rods. He had used the copper on some cross heads; the engine was turned out last June, and had been running ever since without any perceptible wear on the gibs.

The new factory of the International Okonite company at Passaic, N. J., being practically finished, the company has turned its attention to improving the New York headquarters, 13 Park Row, both in facilities, appurtenances and appearance. By the acquisition of three or four more rooms in addition to those formerly occupied, it has acquired every facility for the systematic and expeditious conduct of its immense business. As one steps from the elevator at the fourth floor of the building, 13 Park Row, he is landed immediately in front of the entrance to the company's quarters. The reception room is artistically and comfortably furnished. In the center is an immense table of finely carved and polished oak, on which are scattered the latest issues of the electrical journals. Comfortable, leather cushioned oak chairs and an oaken settee, a very artistic piece of work, complete the furnishing. The offices of the Okonite company comprise six sections or departments, formed by partitions and artistic oak railings. These partitions are in themselves the main decorative features of the suite of offices, being of highly polished carved oak, the upper portion of dull glass, and surmounted with a decorative miniature railing or cornice. All the woodwork and furniture is of oak. The private offices of Capt. Willard L. Candee, George T. Manson, H. Durant Cheever, and sales agents' quarters are at the farther end of the reception room and on the left. The general sales agents, T. McCoubray and assistants, occupy an oblong room which forms a sort of hall between the private and general offices. To the left of this department, and facing the busy thoroughfare, Park Row, are the private offices of Capt. Candee. Mr. Manson and Mr. Cheever They comprise most of the space occupied by the old quarters of the company.

Electrical Patents.

Issued December 2, 1890.

441,665. Regulator for Electric Motors. Walter E. Hyer, Newburg, N. Y.

441,695. Brush Holder for Electric Motors or Dynamos. William S. Patterson, Allegheny, Pa.

441,703. Electric Signaling System. Joseph W. Riggs, Minneapolis, Minn.

441,745. Apparatus for Regulating Steam in Boilers. Albert M. Butz, Chicago, Ill.

441,753. Trolley Stand. William L. Emmet, East Rockaway, N. Y.

441,764. Trolley Covering for Electric Railways. Hiram Jones, Detroit, Mich.

441,771. Gearing and Motor Supporting Mechanism for Electric Locomotives. Frank Mansfield, New York, N. Y.

441,773. Automatic Electric Railway Signal. Robert O. Owen, Lynchburg, Va.

441,793. Dynamo Electric Machine. Walter K. Freeman, Brooklyn, N. Y.

441,794 Regulator for Dynamo Electric Machines. Walter K. Freeman, Brooklyn, N. Y.

441,800. Trolley Wire Hanger or Support. Edward H. Kitfield, Lynn, Mass.

441,807. Motor Regulator. David Pepper, Jr., Philadelphia, Pa.

441,817. Electro-Thermostatic Valve. Louis Bell and Frank H. Root, Chicago, Ill.

441,818. Electrode for Secondary Batteries. Joseph Y. Bradbury and Frank J. Stone, Lowell, Mass.

The invention consists of a plate made up of strips of supporting material arranged edge to edge and each offset alternately in opposite directions, and pencils or bars of active material inserted in said offsets.

441,828. Electro Magnetic Traction Increasing System. Mark W. Dewey, Syracuse, N. Y.

Claim eleven reads as follows:

"The combination in an apparatus for electrically increasing the traction of a vehicle moving upon a railway, of a source of electricity, stationary means to magnetize the rails of the railway connected to the source, and magnetizable wheels for the vehicle."

441,837. Conduit for Electric Conductors. Edwin T. Greenfield, New York, N. Y.

The invention consists in combining with a body of insulating material in the form of a tube a thin skin of a material of lower inflammability than the insulating material.

441,838. Attaching Device for Electric Conductors. Edwin T. Greenfield, New York, N. Y.

441,840. Underground Conduit for Electric Wires. Edwin T. Greenfield, New York, N. Y.

This invention embodies a casing or conduit for electric conductors and manholes located at suitable distances apart for the purpose of obtaining access to, laying and connecting the conductors, handholes interspersed in the length of the conduit for the purpose of aiding or assisting the laying of the wire, and junction boxes such that leads may be connected with the mains without disturbing the main casing or conduit.

441,843. Galvanic Battery. Albert H. Hoy, Racine, Wis.

The main object of the invention is to provide means for ventilating batteries by allowing air to enter at the bottom and the gases formed by the chemical action to escape at the top, thus preventing polarization and insuring the continuous action of the battery.

441,847. Telegraph Circuit. Francis W. Jones, New York, N. Y.

441,849. Electric Line Hook. Fred M. Locke, Victor, and John Lapp, Rochester, N. Y.

441,877. Incandescent Lamp Fixture. Frederick Lewis, New Haven, Conn.

441,892. Apparatus for Electroplating. William J. Possons, Cleveland, Ohio.

441,893 Apparatus for Electroplating. William J. Possons, Cleveland, Ohio

441,894. Apparatus for Electroplating Carbons or Other Articles. William J. Possons, Cleveland, Ohio.

The first claim follows:

"In an electroplating apparatus, a charging apparatus comprising a series of tubular holders."

441,908. Electric Clock Alarm. Matthias W. Tiedemann, Brooklyn, N. Y.

441,918. Rheostat. Timothy K. Ames, Wilmington, Del.

441,919. Electric Wire Coupling. William E Banta, Springfield, Ohio.

441,920. Electrotype. William T Barnum, New Haven, Conn.

441,933. Thermal Cut Out. David J. Cartwright, Boston, Mass.

441 953. Electric Motor. Henry Groswith, Philadelphia, Pa.

441,954. Method of Operating Electric Motors. Henry Groswith, Philadelphia, Pa.

Claim two is given:

"An electric motor having a set of field coils, armature coils, and commutator in one circuit, a duplicate set of elements, a common external connection to one brush of each commutator, and a pair of contacts or binding-posts connected, respectively, to the two other brushes for external connection."

441,958. Secondary Battery. Charles W. Kennedy and Henry Groswith, Philadelphia, Pa.

441,959 Electrode for Secondary Batteries. Charles W. Kennedy, Philadelphia, Pa.

441,967. Galvanic Battery. Candido G. de Peralta Havana, Cuba.

441,972. Electrical Indicating Apparatus for Linear Measure. John Rapieff, New York, N. Y.

441,973. Electrical Location and Range Finding Instrument. John Rapieff, New York, N. Y.

441,974. Method of Finding the Range of Distant Objects. John Rapieff, New York, N Y.

441,975. Indicator for Range Finders. John Rapieff, New York, N. Y.

441,982. High Water Alarm. Isaiah H Simpson, Brunswick, Me.

441,999. Lightning Arrester. James J. Wood, Brooklyn, N. Y.

442 002 Moving Contact for Electric Railways. Arthur W. Adams, Kansas City, Mo.

442,018. Electric Arc Lamp. Thomas P. C. Crampton, London, England.

The second claim is:

"In an electric arc lamp, the combination, with the outer tube carrying adjustable stops, of the inner carbon holding tube carrying pivoted spring clutches having tail pieces acted on by the adjustable stops to swing the clutches on their pivots and release the carbon."

442,029. Annunciator. Frank E. Fisher, Detroit, Mich.

Claim one reads:

"In combination with two electro magnets and an armature adapted to vibrate between them, a pointer pivoted on said armature."

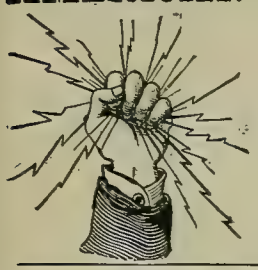
442,030. Electric Switch. Frank E. Fisher, Detroit, Mich.

442,053. Apparatus for Controlling and Registering Liquids Drawn Through Cocks. Robert Jewell, London, England.

442,071. Guard for Incandescent Electric Light Globes. Joseph Mino, Denver, Colo.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

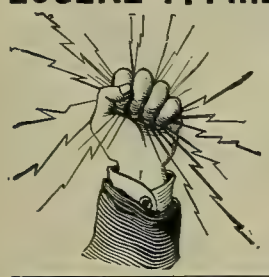
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, } St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS

MAKE ANYTHING IN BRASS.

4 LASALLE AVE CHICAGO.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS: W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

Pittsburgh Sheet Metal Tool Co.,

H. H. HIPWELL, Prop.

Mfrs. of Electric Specialties of Every Variety.

TOOLS, DIES, Etc.

202, 204 & 206 Robinson St., - - Allegheny, Pa.

FOR SALE.

VERY CHEAP.

Several 10, 15, 25 and 50-H. P. Van Depoele Electric Motors, made for Street Cars; also Gear and Attachments for same; also one 150-H. P. Van Depoele Electric Generator; also two Street Car Trucks, with 4½-inch Axles and Bemis Gear; also a lot of Pulleys and Hangers

For particulars address

W. A. STILES,

Room 1028, 112 CLARK ST., CHICAGO.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2.00 Dry Batteries, large size, $0.83; $2.00 Iron Box Bells, 3-inch, 49c.; 75c. Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 7c.; 50c. Switches, one point, 10c.; 40c. Bell Hangers' Staples, per lb. 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 3 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 6.

Fletcher & Fletcher Electric Co., Cleveland, O.

Binders FOR THE Western Electrician $1.00.

EDISON LAMPS REDUCED TO 44 CTS.

16 CANDLE POWER LAMPS.

Lots of 25 to 150 ..... 44 cents each.
Lots of 150 to 500 ..... 42 cents each.
Lots of 500 ..... 40 cents each.

Other sizes in proportion. All sizes in stock, with bases to fit any make of lamps or sockets.

Full Line OKONITE WIRES in Stock. Safest and best wire made.
Full Line of Edison Sockets and Appliances.

STANDARD ELECTRICAL WORKS, CINCINNATI, OHIO.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

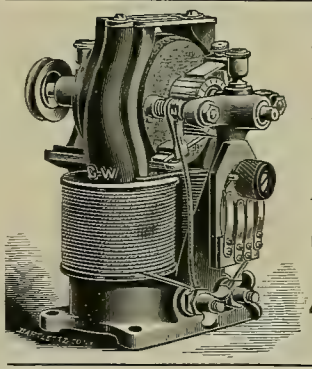
Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.



THE CROCKER-WHEELER

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base-Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies o be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

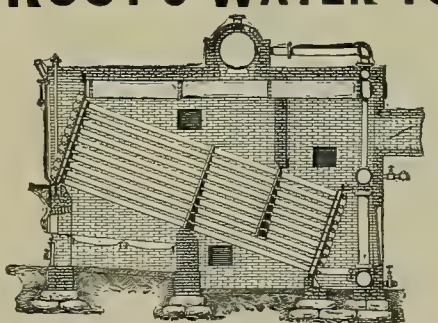
CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

INSULATED WIRES AND CABLES,

OKONITE TRADE MARK

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL **OKONITE COMPANY,** Limited, - - 13 Park Row, NEW YORK.

BRANCHES Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

NOTICE TO CONTRACTORS

OFFICE OF CITY CIVIL ENGINEER, INDIANAPOLIS, IND., Dec. 4, 1890.

Notice is hereby given that sealed proposals will be received by the Common Council of the city of Indianapolis, on Monday evening, Jan. 5, 1891, for lighting the city of Indianapolis, Ind.

FOR ELECTRIC LIGHTS.

Proposition to be for 400 lights; for 500 lights; for 600 lights, for 700 lights; and for 800 lights, all to be 2,000 standard candle power arc lights, suspended on mast arms.

All bids to be made to comply with provisions of general ordinance No. 41, 1885, of this city, providing for the placing of all electric-light wires within North, South, East and West streets to be laid under ground, outside of which boundaries wires may be strung on poles.

The contractor to furnish all necessary material, and do all the work of whatever kind necessary to construct, equip and maintain in good and substantial electric installation, complete and ready for operation, for lighting the city, and when the same is completed, shall operate the same in its entirety, for a trial period of Sixty (60) days.

The lights furnished shall be as good as the best standard 2,000 candle-power lights used in any city of the United States.

At the end of the trial period, if the lights are as good as above specified, and should the performance of the entire plant prove satisfactory, the city will accept the same, and the rental shall date from the beginning of the trial period. But should the performance of the entire plant not be satisfactory to said city, the plant will not be accepted, and no rent will be paid until said plant is made, in its entirety, perfectly satisfactory to said city.

The equipment must in all respects be of the best manufacture, and of the latest and most improved design.

Bidders to make their propositions upon the basis of an all-night lighting schedule, beginning one-half hour after sunset and ending one-half hour before sunrise; also on a basis of a five years' and also on a ten years' contract. Lights to be located under the direction of the committee on public light of the Common Council and Board of Aldermen and city civil engineer.

The plant will consist of an equipment capable of operating and sustaining circuits upon which to operate arc lights of 2,000 standard candle power each.

Not more than 50 lamps to be lighted by any one circuit.

The mean photometric candle-power of the lights, measured at an angle of 45 degrees from a horizontal, shall be as great as that shown by the best standard 2,000-candle-power arc light now in use in the United States.

All intermediate poles shall be straight, five white cedar, shaved and not less than six inches in diameter at the top, and shall not be less than thirty (30) feet in length, to be set five (5) feet in the ground.

All poles, including all cross-arms, pins and brackets, to be painted two coats of good paint of such color as the city engineer may designate.

All poles to be set plumb, true to line, and guyed whenever direction changes, or otherwise necessary.

Poles to be set not more than 140 feet apart in any case, and estimated at the rate of 40 poles per mile.

All wires must be thoroughly insulated with some good material, not easily annealed and impervious to moisture, and the insulation to be guaranteed water and weather-proof for three years. All joints to be soldered, and covered with at least five layers of Kerite tape, or some other non-conducting material equally as good.

When the direction changes an insulated loop-guard shall be attached to the pole to hold the wire, in case of breaking of pin or bracket. Wires must, in all cases, clear the ground at least twenty-five feet, and must be kept clear of contact with any adjacent lines or wires. Insulation from grounding from outside contacts must be perfect.

All wiring and other work shall, in addition to the above, be done according to the rules and regulations of the National Board of Fire Underwriters.

The contractor will be required to enter into a written contract, agreeing to perform the whole work according to the true intent of the above specifications, and shall state the time within which he will do the whole of said work, and have the plant in operation; said time shall not exceed six months after the date of signing the contract.

The contractor shall be required to furnish a bond, with satisfactory sureties, protecting the city from liability on account of infringements of patents or otherwise, and also from all damages and costs of suits that may arise on account of construction, maintenance, rental, use or ownership by the city, and guaranteeing the full and faithful compliance with the terms of this contract with the city.

All work to be done under the direction and supervision of the city civil engineer, and any points omitted in the above specifications shall be subject to directions given by him from time to time during the progress of the work.

The contractor will be required to accompany his bid with a certified check for five thousand dollars ($5,000) payable to the Mayor of said city of Indianapolis, Indiana, for said city, and the amount thereof shall be retained by said city of Indianapolis as liquidated damages in the event of his failing to enter into a contract and file proper bond within ten (10) days from date of award of contract, and to be returned to said contractor upon his filing a good and sufficient bond within such time for the faithful performance of the contract. The contractor to erect the plant as above, furnishing all the necessary appliances, and doing all the work of constructing, and operating and maintaining the same, and to furnish lights as above specified, for a given sum per light per annum.

The rental to be paid monthly.

The city shall be granted the option of purchasing, at the expiration of the contract period, the entire plant of any contracting company, at a price that shall be fixed by a board consisting of five members, two to be selected by each of the contracting parties, and the fifth to be selected by said four members so selected by said contracting parties. The city shall give to said contracting company six months' notice immediately prior to the expiration of any such contract, of the city's intention to purchase such plant.

The Common Council and Board of Aldermen reserve the right to reject any and all bids.

FOR GAS LIGHTS.

For bids to furnish gas lights as follows: 500 lights, 1 000 lights, 2,000 lights, 3,000 lights and 4,000 lights.

FOR VAPOR LIGHTS.

For vapor lights as follows: 300 lights, 400 lights and 500 lights.

Bidders for furnishing gas or vapor lights, or both, to bid on a basis of one, two and three years' contracts, and shall each submit with their bids certified checks for $2,000, guaranteeing faithful compliance of their contracts. All bidders for electric, gas or vapor lights shall bid on a basis of an all-night lighting schedule, and for the lighting, cleaning and repairing of their respective lights. All additional lights to be provided at the contract price. The city reserves the right to reject any and all bids.

A. P. SHAWVER, City Civil Engineer.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,
FITCHBURG, MASS.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Old Cars Withdrawn, and New Pullman Dining Cars now Running on the Pennsylvania Lines.

The old "diners" are abandoned and entirely new Dining Cars, embodying the latest improvements, equipped with every convenience, finished in exquisite taste and fully up to the incomparable standard of excellence constantly maintained by the famous Pullman company, have been placed in service upon the Pennsylvania Lines between Chicago, Columbus, Pittsburgh and New York, on those quick and popular trains, numbers four, eight and twenty, leaving Chicago at 10:30 A. M., 3:15 P. M. and 11:30 P. M. daily.

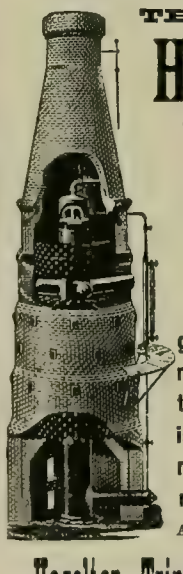
This service is in addition to the Dining Car running on number two, the PENNSYLVANIA LIMITED, a solid Pullman Vestibule train, composed of Dining, Sleeping, Smoking and Observation Cars, on which an extra fare is charged.

No more brief stops for indifferent meals! You can "fare sumptuously every day" at your leisure and in comfort while rolling across the country at forty miles an hour upon the Vestibule trains of the Pennsylvania Lines, in the new and luxurious Dining Cars of the Pullman Company.

By a recent decision of the United States Court the patent Vestibule cannot be used on other than Pullman cars. Particular attention is therefore invited to the fact that the Pennsylvania Lines are operating PULLMAN Sleeping and Dining Cars which are properly fitted with that convenient and appreciable device—the PULLMAN perfected safety Vestibule.

For special information call upon, or address,
J. H. LUCE, A. G. P. A.,
65 Clark St., Chicago, Ill.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.

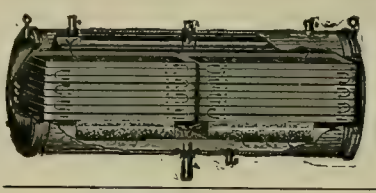


THE
Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS
Hazelton Tripod Boiler Co.,
170 TWENTY-SECOND ST.,
CHICAGO, ILL.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES, SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

ELECTRIC RAILWAY LIGHT AND POWER.

JAS. McLAUGHLIN.
14 Years' Experience.
A Pioneer in the Business.
Repairs and Parts for all Systems.

48, 50 and 52 NORTH CLINTON ST.,
CHICAGO, ILL.

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acide. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

ALUMINUM ALLOY COMPOSITE. 100 lbs. (sample) containing 7½ per cent. Aluminum sent prepaid for only **$7.** We desire to establish an Agency in every large city for our Metal Alloy. For terms and city rights address **THE SCHMIEDBARENGUSS FURNACE CO., Newport, Ky.** Reduced from $2.00 to 75c. per lb. in

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

AYRTON & PERRY, AMMETERS and VOLTMETERS.

CHIEF CHARACTERISTICS:

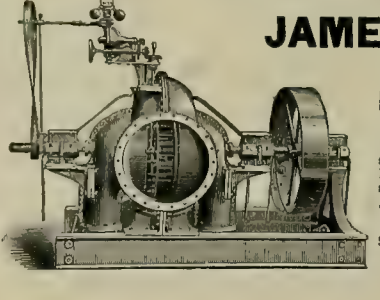
Portability. No Permanent Magnets. Direct Reading Scale. Uniform Divisions. Unaffected by Dynamos and Motors.

It makes no difference which way the current enters. The ammeters may be left in circuit continuously.
Each Voltmeter has a special contact key.

Send for Catalogue 1-66 of Electrical Test Instruments.

QUEEN & CO., PHILADELPHIA.

JAMES LEFFEL WATER WHEELS

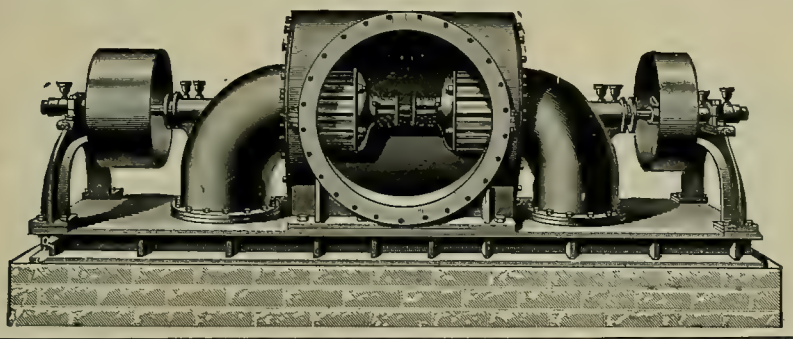


BUILT BY THE
JAMES LEFFEL & CO.
UPRIGHT AND HORIZONTAL,
FOR
ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.
SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

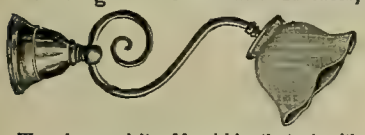
GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

24,000 SOLD TO DATE.

Everybody's Hand Book of Electricity

BY EDWARD TREVERT.

With Glossary of Electrical Terms and Tables for Incandescent Wiring. 50 Illustrations, 120 Pages.

PRICE, PAPER, 25c. POSTPAID.

SEND FOR CATALOGUE C.

BUBIER PUBLISHING AND MFG. CO., Lynn, Mass.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE ☆ MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE ☆ MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

THOS. L. SCOVILL, New York Agent,

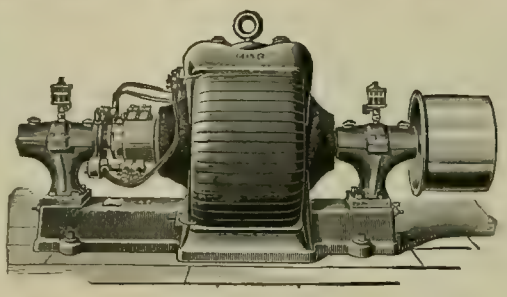
25 PARK PLACE, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

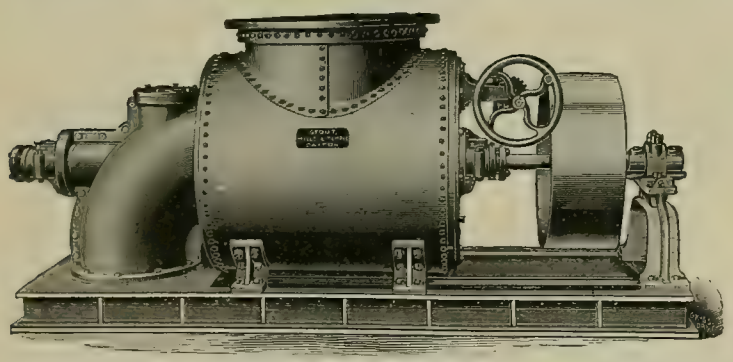
NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

Electrical Testing Apparatus manufactured to order, repaired or calibrated.

WESTERN ELECTRIC COMPANY, - - NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

THE EMPIRE CITY ELECTRIC CO.

15 Dey Street, NEW YORK.

INSULATED WIRE.

ELECTRICAL SUPPLIES

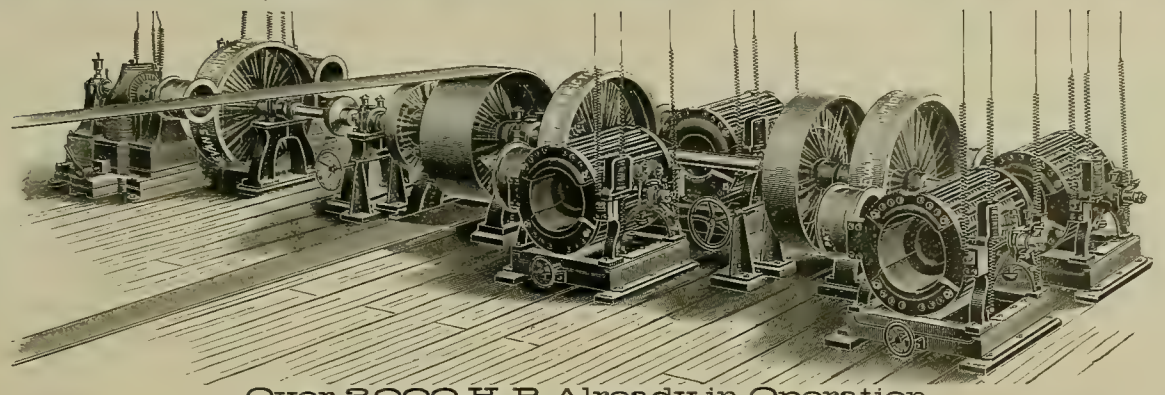
OF EVERY DESCRIPTION.

SEND FOR WIRE PRICE LIST, OR COMPLETE CATALOGUE.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

(STATION OF THE NORTH ATTLEBORO STEAM AND ELECTRIC CO.)

This Station has been in Successful Operation Since March, 1890.



Write for Full Particulars and List of Parties who are Using.

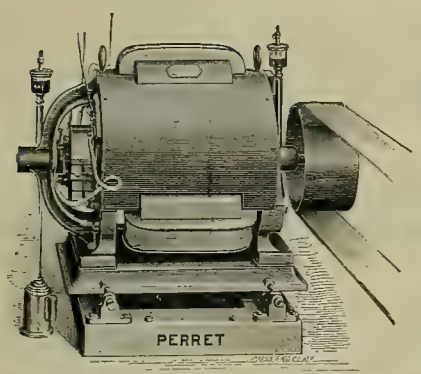
Over 3,000 H. P. Already in Operation.

Send for Catalogue "D" to THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—



Perret 20 H. P. Motor, Speed 550. Weight 1,300 lbs.

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power. Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., C. M. Barclay, 205 Canal St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
BALTIMORE, MD., W. W. Donaldson, 215 N. Calvert St.
ST. PAUL, MINN., F. J. Renz, 327 Minnesota St.
PHILADELPHIA, PA., Cleverly Electrical Works, 1018 Chestnut St.

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

—Manufactured by—

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

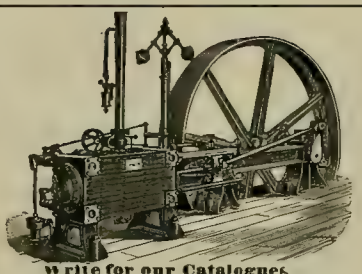
FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



Write for our Catalogues

SOLE BUILDERS

EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators. Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

ARMATURES COMMUTATORS REPAIRED and REWOUND TRUED OR RENEWED SPECIAL FACILITIES AND AGILITY DUPLICATES OF ALL KINDS GENERAL DYNAMO REPAIRING & JOBBING

The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

OKONITE TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

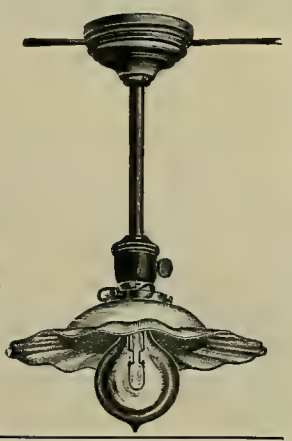
Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

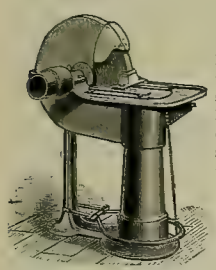
SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.

THE BARNES WATER EMERY Tool Grinder.



It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.

Sold subject to approval. Send for full description and price.

W. F. & John Barnes Co., Rockford, Ill.,
Address No. 761 Ruby Street.

Barnes' Patent
UPRIGHT DRILLS.

20 to 32 inch swing, with both worm and lever feed, self feed and back-geared.

Barnes' Patent
ENGINE LATHE,

15 inch swing, 6 foot or 8 foot bed. These machines are made a specialty in our factory.

They have advantages not found in other machines in this line. It will pay parties desiring to purchase or know more about these machines to send for full description and prices to W. F. & JOHN BARNES CO., Rockford, Ill., Address No. 761 Ruby st.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON,

MANUFACTURING ELECTRICIAN,

Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

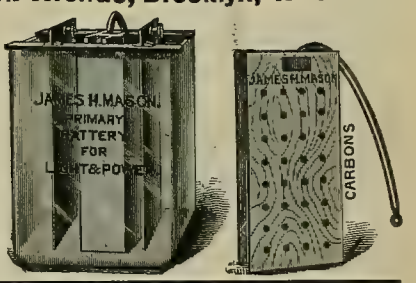
COMPLETE PLANTS FOR SMALL STORES.

Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



PRINCIPAL DEPOT:
Chestnut St., cor. Twelfth, Philadelphia.

BRANCH HOUSES.
Nos. 767 & 769 Broadway, New York.
" 1260 & 1262 Broadway, New York.
" 160 Tremont Street, Boston.
" 151 & 153 Wabash Avenue, Chicago.
" 444 Fulton Street, Brooklyn.

Cable Address: White, Philadelphia.

The S. S. White Dental Manufacturing Co.

Founded by Samuel S White in 1844.

JAMES W WHITE, President. J. CLARENCE WHITE, Secretary
HENRY M. LEWIS, General Manager. SAMUEL T. JONES, Treasurer.

Philadelphia November 4th, 1890.

Edison Mfg. Co.,

Orange, N. J.,

Gentlemen:

Yours of October 16th duly received, and sickness has caused the delay in answering it. As to the Edison Laland Battery, we have been using primary batteries to operate dental electric pluggers and motors since 1875, and am compelled to say that the Edison Laland Battery far excells all other batteries we have ever used.

Yours truly,

The S. S. White Dental Mfg. Co.

E. J. Stark

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2 000	"
" " " "	3d "	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition	2,500	Copies
Bell Hangers' " "	1st "	2,500	"
" " " "	2d "	1,000	"
Total within Eighteen months.		15.000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System,
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 73 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE OF MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane-Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

W. N. Hobart, Pres't. L. O. Maddux, Vice-Pres't and Treas. J. H. Eickershoff, Sup't.
J. C. Hobart, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.
15 TO 300 HORSE-POWER. COMPOUND AND VALVELESS.
Most perfect regulation ever obtained.
NO SMALL PARTS REQUIRING REPAIRS. NO ECCENTRICS, NO STUFFING BOXES.
NO PISTON RODS. INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

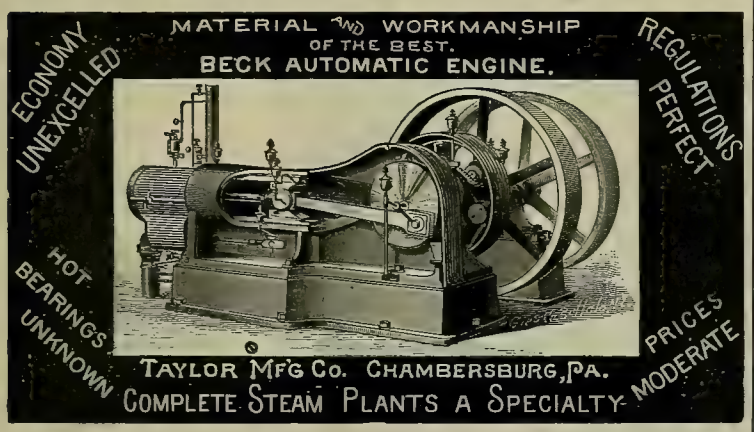
WRITE FOR CATALOGUE.

The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.
FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.



For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

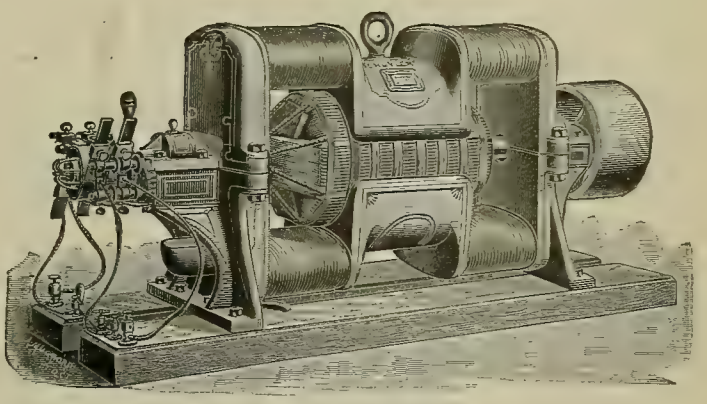
The LECLANCHE BATTERY CO., NEW YORK.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature. proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.,

UNITED

Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.

STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

THE

THOMSON-HOUSTON ELECTRIC CO.

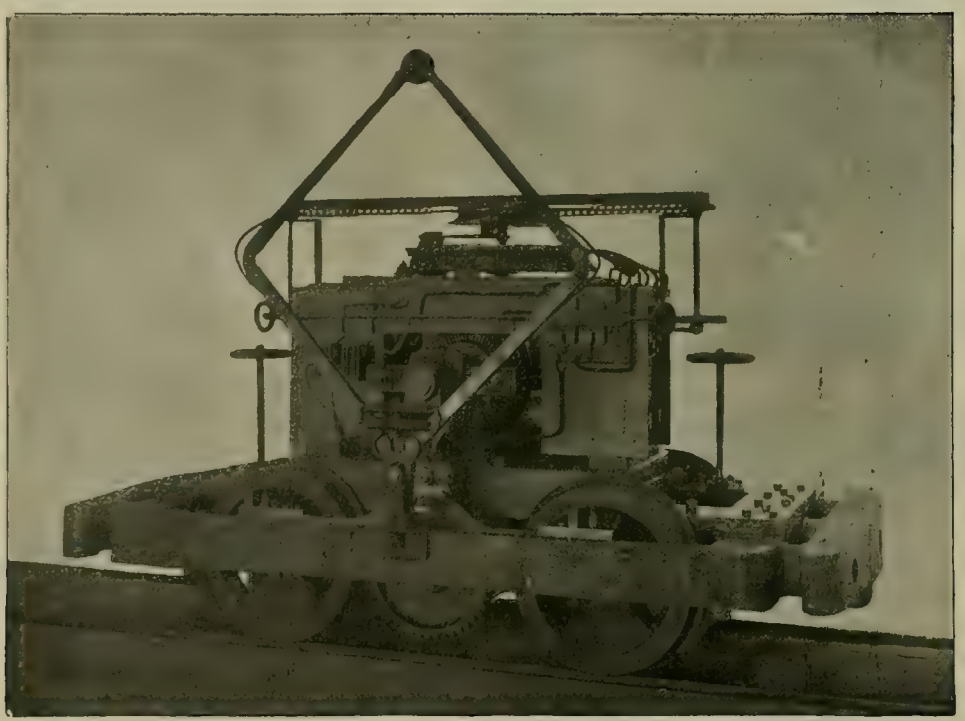
TO THE OWNERS OF WATER OR STEAM POWER:

LONG DISTANCE TRANSMISSION OF POWER
by Electricity is now successful and economical.

A greater efficiency, both as to first cost and operating expenses, is guaranteed than by any other method of power transmission.

Electric power transmitted for any purpose and to drive any class of machinery.

ELECTRICITY IN MINES may be used for Hoisting, Pumping, Tram Cars Ventilation, Drilling, and Lighting.



THOMSON-HOUSTON ELECTRIC MINING LOCOMOTIVE.

THOMSON-HOUSTON GENERATORS AND MOTORS

Cannot be Excelled for Durability and Efficiency.

We will be pleased to furnish on demand full information on our electric appliances and make estimates for transmission of power plants, and for the equipment of mines with Electric Power and Lighting Apparatus.

COMPLETE INSTALLATIONS, OR ELECTRIC MACHINERY ONLY, FOR ALL KINDS OF ELECTROLYTIC WORK, ESPECIALLY FOR THE

Electrolytic Refining of Copper.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON,
620 Atlantic Ave.

CHICAGO,
148 Michigan Ave.

ST. PAUL,
403 Sibley Street.

KNAPP ELECTRICAL WORKS,

GENERAL WESTERN AGENTS

PERKINS ELECTRIC LAMP CO.

To Fit Any Socket, Any Candle Power,
Highest Efficiency.

GRIMSHAW WHITE CORE

Wires, Cables

and Tapes.

ANNUNCIATORS,

BURGLAR ALARM BELLS, BUTTONS, ETC.

PORCELAIN CUT-OUTS,

Main and Branch Cut-Outs, Rosettes and Switches, Underwriters' Weather Proof Wires and Line Supplies.

Write for Prices on these Specialties. Our New Catalogue for 1891 Just Out.

54 & 56 FRANKLIN STREET, CHICAGO.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.

Best WEATHERPROOF LINE WIRE

LINE WIRE Only MOISTURE PROOF

HABIRSHAW

CABLES,

WIRES, CORES,

FOR

CONCEALED WIRING.

UNDERGROUND WORK. UNDERWATER WORK.

MINING WORK.

★ HABIRSHAW ★

**The Best Electric Companies,
like the Best Families,
Sometimes Make Mistakes.**

This is why all are not using **SHIELD BRAND** for Line Work, and **HABIRSHAW** for purposes specified.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.

WOOD ARC DYNAMO.

MAIN OFFICE:

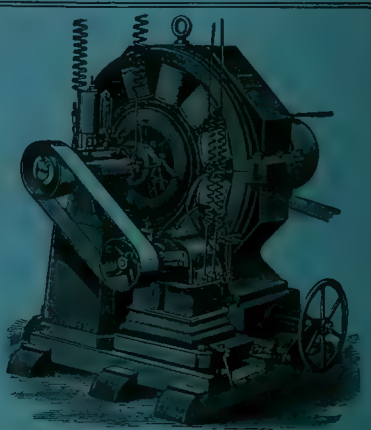
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:

FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

PHŒNIX GLASS CO

OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES **SHADES**

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

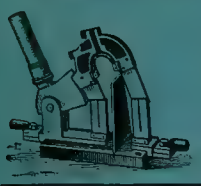
729 BROADWAY, NEW YORK.
(Cor. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, DECEMBER 20, 1890. No. 25

"AJAX SWITCHES"

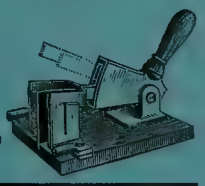


In all Sizes, for any Potential,
Single, Double and Treble Pole

SIMPLE, CHEAP, INDESTRUCTIBLE.

CORRESPONDENCE SOLICITED.

C. S. VAN NUIS,
74 Cortlandt Street, New York.



THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas.
PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin'

ELECTRIC RAILWAYS? If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

INDORSED BY THE UNITED STATES AND GERMAN GOVERNMENTS.

NEW YORK AND BROOKLYN BRIDGE, BROOKLYN, Nov. 7, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—This certifies that we have had your metal in use about six months on the crank pin of a four hundred and fifty horse power Wright engine, and also as packing rings on the piston rod of a locomotive. In both places it has given entire satisfaction, not causing the least trouble.

Yours very truly, C. C. MARTIN, Chief Engineer and Supt.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

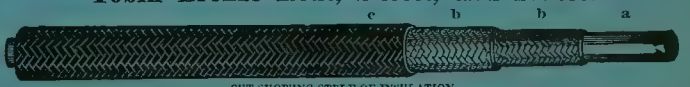
ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.



CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York.
133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

THE MILLIKEN PATENT ELECTRIC RAILWAY POLE.

—MANUFACTURED BY—

MILLIKEN BROS.,

No. 55 LIBERTY STREET, NEW YORK. | No. 59 DEARBORN STREET, CHICAGO.

Standard Side, Center and "Pull-Off" Poles. Special Attention Given to Insulation. Special Poles of any Required Length, or to Stand any Strain Made to Order.

Adopted by all the Leading Roads and Recommended by the Best Engineers.

In use in the following cities: NEWARK, BUFFALO, JERSEY CITY PATERSON, TROY, PITTSBURGH, HAMILTON, O., ETC.

Over 6,000 Ordered in the Last 3 Months.

ORDERS FOR STANDARD POLES FILLED FROM STOCK.

WRITE FOR PARTICULARS.

SHULTZ BELTING CO.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

Manufacturers of

BRANCHES: { 161 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St. Chicago. | St Louis, Mo.

CENTRAL STATION STATISTICS.

48 1/5 Per Cent.

OF THE CENTRAL STATIONS IN THE UNITED STATES.

57 3/4 Per Cent.

OF THE CENTRAL STATION ARC LIGHTS.

25 Per Cent.

OF THE CENTRAL STATION INCANDESCENT LIGHTS.

Such was our record on July 1st, 1890, as evidenced by the following figures:

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all Systems.
Central Stations, - -	1,379	666	48 1/5 per cent.
Arc Lights, - - -	137,411	79,387	57 3/4 per cent.
Incandescent Lights, -	1,590,967	398,555	25 per cent.

Additional evidence of the superiority of our system may appear to be superfluous, but will nevertheless be submitted next week.

No blame should be attached to our respected competitors, as it rests entirely on our automatically regulated dynamos; noiseless and steady arc lamps; long-lived incandescent lamps and the perfected details and economical operation of our arc, alternating incandescent, and direct current incandescent systems.

THOMSON-HOUSTON ELECTRIC CO.,

620 Atlantic Avenue, Boston, Mass.
Wall and Lloyd Streets, Atlanta, Ga.
115 Broadway, New York City.
15 First Street, San Francisco, Cal.
266 First Street, Portland, Ore.
831 New York Life Building, Kansas City, Mo.
148 Michigan Avenue, Chicago, Ill.
405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co. xxviii
Abendroth & Root Mfg. Co. .. ——
Alexander, Barney & Chapin. xii
Allis, E. P. & Co. xx
American Electrical Works. . xv
Ansonia Brass & Copper Co. . i
Automatic Switch Co. vii
Baggot, E. xvi
Bain, Foree. xvi
Ball Engine Co. xxiii
Barnes, W. F. & Jno. xxi
Barton, Geo. P. ..... ——
Baxter Electric Motor Co. xxviii
Bernstein Electric Co. ..... ——
Bleckert & Nelson. xvi
Borden & Selleck Co. xvii
Brush Electric Co. xxvii
Bubier Publishing Co. ..... ——
Buckeye Electric Co xvi
Bunnell & Co., J. H. ..... ——
Butler Hard Rubber Co. xx
C. B. & Q. R. R. ..... ——
C. & C. Electric Motor Co. .. xviii
C. & N. W. R. R. Co. ..... ——
Calkins & Son, J. W. xv
Central Electric Co. xi
Chicago Electric Club. ..... ——
Cincinnati Electric Light Co. xvi
Cleverly Electrical Works. .. iv
C. M. & St. P. R. R. Co. ..... ——
Colburn & Co., I. W. xvii
Columbia Incandescent Lamp Co xvii
Connecticut Motor Co. ..... ——
Consolidated Electric Storage Co. ..... ——
Continental Dynamo Co. iv
Cowles Electric Smelting and Aluminum Co. xvii
Crocker-Wheeler Motor Co. .. xv
Crosby Electric Co. iv
Curtis Regulator Co. ..... ——
Day s Kerite Insulation. i
Dayton Globe Iron Works Co. xviii
Delany, P. B. xv
Eastern Electric Cable Co. xv
Eddy Electric Mfg. Co. ix
Edison Mfg. Co. xxi
Edison General Electric Co.,— Lighting and Power Dept. .. viii
Edison General Electric Co.,— Lamp Dept. ..... ——
Electric Construction & Sup. Co iv
Electrician Publishing Comp'y ..... xix, xx, xxii
Electrical Supply Co. xxvi
Elektron Mfg. Co. ix
Empire City Electric Co. xviii
Empire China Works. xvi
Eureka Tempered Copper Co. . xvii
Evans Friction Cone Co. xix
Fibrone Mfg. Co. xv
Fletcher & Fletcher Electric Co xvii
Forest City Electric Works. vii
Fort Wayne Electric Co. xxviii
Gibson Co., W. D. iv
Globe Carbon Co. xvii
Great Western Electric Sup. Co. v
Greeley & Co., E. S. xiv
Harmount, G. A. vii
Hawkeye Electric Mfg. Co. .... ——
Hazelton Tripod Boiler Co. .. xvi
Heisler Electric Light Co. xii
Hill Clutch Works. xxiii
Holmes, Booth & Haydens. xvii
Holtzer-Cabot Electric Co. i
Humphrey, H. H. xiv
Illinois Electric Material Co. xiv
India Rubber & Gutta Percha Insulating Co. i
Interior Conduit & Insulation Co. xiv
Ireson, Chas. L. ..... ——
Jewell Belting Co. xv
Jones Bros. Electric Co. xx
Knapp Electrical Works xxv
Laminar Fibre Goods Co. xvii
Law Telephone Co. xv
Leclanche Battery Co. ix
Leffel & Co., Jas. xvi
McLaughlin, James. xvi
Magnolia Anti-Friction Metal Co i
Mason, James H. xxi
Milliken & Co. i
Monitor Electric Co. vii
Munsell & Co., Eug. xv
Munson Belting Co., Chas. xiv
National Carbon Co. iv
National Electric Mfg. Co. x
Northwest Thomson-Houston Co. vi
Noye Mfg. Co., Jno. T. xxiii
N. Y. Belting & Packing Co. .... ——
Okonite Co. xv
Ostrander & Co., W. R. xviii
Page Belting Co. xvi
Paiste, H. T. xiv
Peckham Street-Car Wheel & Axle Co. vii
Partrick & Carter xx
Pennsylvania Co. ..... ——
Phillips Electrical Works, E. F xv
Phoenix Glass Co. ..... ——
Pittsburgh Sheet Metal Tool Co. xiv
Pond Engineering Co. xxi
Powell Co., Wm. ..... ——
Proposals for Lighting City of Indianapolis. xvi
Queen & Co. xv
Roeblings' Sons Co., Jno. A. .. xix
Sawyer-Man Electric Co. xiii
Schieren & Co, Chas. A xiv
Schoverling, A. xxi
Schuyler Electric Co. xxiii
Shultz Belting Co. i
Southern Electrical Supply Co. xxi
Sperry Electric Co. xviii
Standard Electrical Works ... xv
Standard Paint Co. xiv
Standard Underground Cable Co. i
Standard Carbon Co. xx
Stanley & Hall. xiv
Star Electrix Co. ix
Stephenson & Co., Jno. xii
Stiff, E. D. & Co. xv
Stiles, W. A. xv
Stilwell & Bierce Mfg. Co. xvi, xvii
St. Louis Electrical Supply Co. xx
Sunbeam Incand. Lamp Co. xv
Taussig, S. xvii
Taylor Mfg. Co. xxiii
Thomson-Houston Electric Co. Lighting department. ii
Thomson-Houston Electric Co., Railway department. xxiv
Triumph Compound Engine Co xxiii
Turner Brass Works. xv
Union Hardware Co. xiv
United Electric Traction Co. ix
United States Electric Lighting Co. i
Van Nuis C. S. ..... ——
Wanted. ..... xv, xvi
Western Electric Co. xviii
Westinghouse Electric and Mfg. Co. xiii
Western Electrical Instrument Co. xiv
Wollensak, J. F. iv
Woodbridge & Turner. xvii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co

Aluminum.
Cowles Electric Smelting & Refining Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Co.
McLaughlin, Jas.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric Co.
Western Electric Co.

Batteries.
Bubier Mfg. Co.
Bunnell & Co., J. H
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer & Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
McLaughlin, Jas.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Allis & Co., E. P.
Ball Engine Co.
English Morse & Co.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.
Western Power Construction Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D.
Turner Brass Works.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Con'd
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Elektron Manufacturing Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Great Western Electric Supply Co
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Queen & Co.

Springs.
Gibson Co., W. D.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.
Writing Telegraph Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

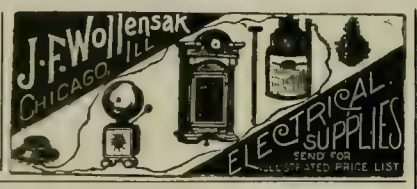
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.

—WE MAKE—

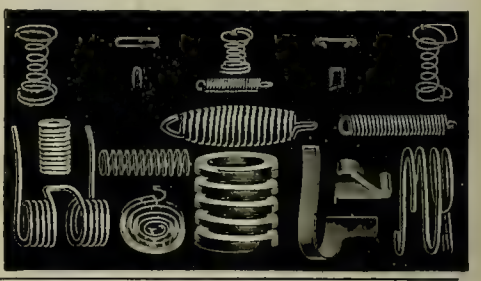
Electric Supplies Under Contract.

THE WM. D. GIBSON CO.,

65 N. Jefferson St.,
CHICAGO, ILL.

SPRINGS

FOR ELECTRICAL MACHINERY A SPECIALTY.



GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

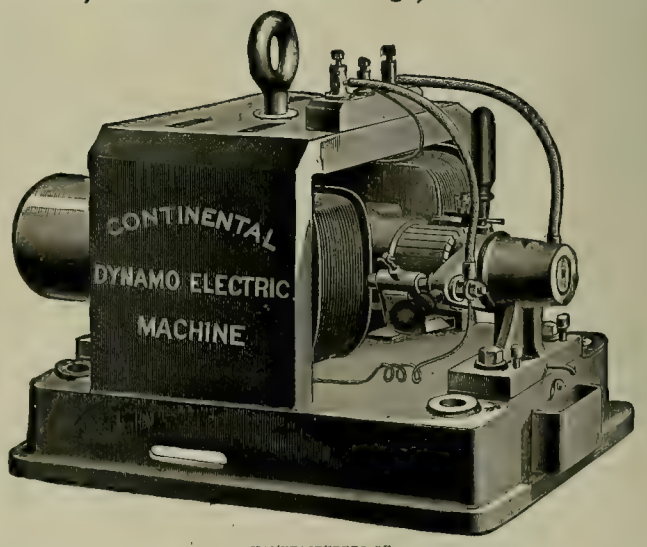
87 and 89 South Fifth Avenue, - - NEW YORK.

CONTINENTAL DYNAMO CO.

DYNAMOS AND MOTORS,

Office, 68 Broadway, New York.

Send for Illustrated Catalogue and Particulars.



Send for Illustrated Catalogue and Particulars.

MANUFACTURERS OF

Constant Potential Generators and Motors of all Sizes and Voltages for Lighting, Power and Metallurgical Purposes.

ADVANTAGES CLAIMED:—1. Solidity of Construction, together with good workmanship, therefore smooth-running and durable. **2. Covered Structure,** therefore protection from external injury. **3. Parts Constructed Separately,** therefore all easily removable and accessible for attention or repair. **4. Automatic Lubrication, Journals running in oil,** therefore wastee no oil and requires little attention. **5. Current Generated with Least Sparking,** therefore small wear of brushes and commutator. **6. No Scattering of Lines of Force,** therefore high efficiency and no attraction of pieces of iron, and no magnetizing of watches and compasses.

AGENTS: BOSTON, Mass., Holtzer-Cabot Electric Co., 111 Arch St.—**WILKESBARRE,** Pa., A. C. Robertson & Co., 51 W. Market St.—**BALTIMORE,** Md., Electric Construction & Mfg. Co., 108 N. Eutaw St.—**AUGUSTA,** Ga., W. Edward Platt, 708 Broad St.—**ATLANTA,** Ga., Jos. S. Cook & Co., 8 W. Wall St.—**FORT WORTH,** Tex., J. J. Harrell.—**CLEVELAND,** O., Cleveland Electrical Mfg. Co., 832 Sheriff St.—**DETROIT,** Mich., Markle Engineering Co., 133 Jefferson Ave.—**ST. PAUL,** Minn., C. J. Thomson, 320 Roberts St.—**NASHVILLE,** Tenn., J. W. Braid, 207 Union St. **DENVER,** Col., L. C. Rice, 1762 Blake St.

THIS SPACE RESERVED

FOR THE

Great Western

ELECTRIC SUPPLY CO.,

190-192 FIFTH AVE., CHICAGO.

LARGEST EXCLUSIVE SUPPLY HOUSE IN THE UNITED STATES.

WATCH FOR OUR "AD" NEXT WEEK.

IMMENSE STOCK!!
BOTTOM PRICES!!

Electrical Supplies

OF ALL KINDS.

NORTHWEST
THOMSON-HOUSTON
ELECTRIC CO.,

403 & 405 SIBLEY ST., · ST. PAUL.

OUR POLICY:

First Class Goods, Small Margins and Quick Delivery.

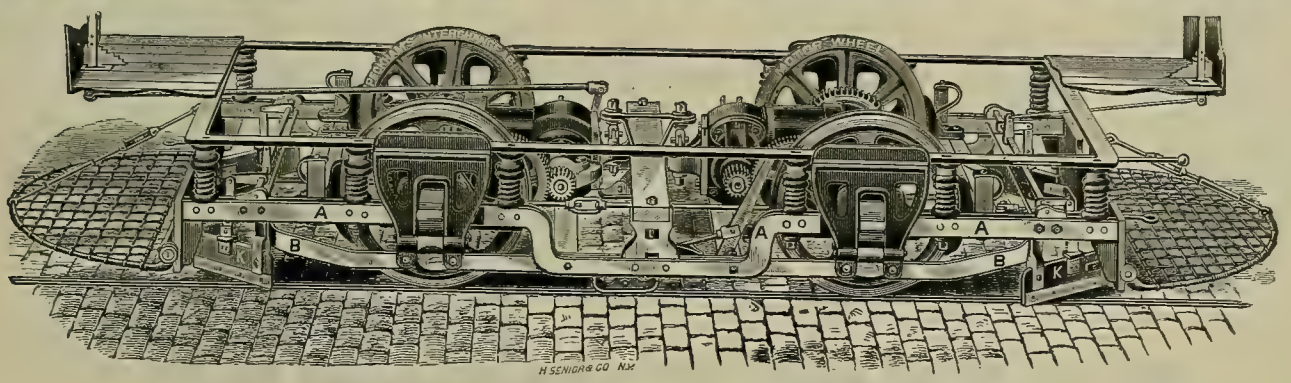
LARGE STOCK OF

Grimshaw White Core,
Holmes, Booth & Hayden's "K. K."
Underwriters' Line Wire & Magnet Wires.

FULL LINE OF PORCELAIN GOODS.

"ELECTRIC BLOCK", 403 & 405 SIBLEY STREET, ST. PAUL, MINN.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

AUTOMATIC SWITCH Co.,

No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THE FOREST LAMP HANGER.

ADVANTAGES.

Lamps when in position supported entirely by cross wire or cable.

Cord is used only when raising or lowering lamp.

Lamp insulated from hanger.

No strain on lamp connection.

No danger of lamp dropping by breaking or cutting of cord.

Ease of operation.

Low price.

MANUFACTURED BY

Forest City Electric Works.

GENEVA, O.

EDISON PATENTED APPARATUS.

For Sale to all Parties in U. S.

Except for use in certain localities already exclusively licensed, list of which will be furnished upon application.

SAMPLE PRICES.

GENERATOR.	MOTOR.	RATING.	PRICE TO PURCHASER.
5 light,	*¼ H. P.*	*.250 Kilowatts.*	*$37.84*
10 light,	*½ H. P.*	*.500 "*	*$58.76*
20 light,	*1 H. P.*	*1. "*	*$106.83*
45 light,	*2½ H. P.*	*2.5 "*	*$177.02*
90 light.	*5 H. P.*	*5. "*	*$278.77*

ARTICLES.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.	ARTICLE.	CATALOGUE NUMBERS.	PRICE TO PURCHASER 45 PER CENT. OFF LIST.
Standard Keyless Socket,	*1*	*$0.297*	*Porcelain Ceiling Cut-out,*	*397*	*$0.3575*
Standard Key Socket,	*2*	*$0.627*	*Porcelain Double Pole 10-light Switch,*	*511*	*$1.2925*
Standard Keyless Receptacle on Porcelain Base,	*3*	*$0.275*	*Pendulum Ampere Meter up to 200 Amperes,*	*377*	*$12.10*
Attaching Plug,	*V 69*	*$0.1925*	*Standard Pressure Indicator,*		*$41.25*
Two-Wire Branch Cut-out,	*1935*	*$0.44*	*Ground Detector,*	*152*	*$4.125*
Safety Plugs for Cut-outs, 1 to 30 Lights,	*181*	*$0.0715*			

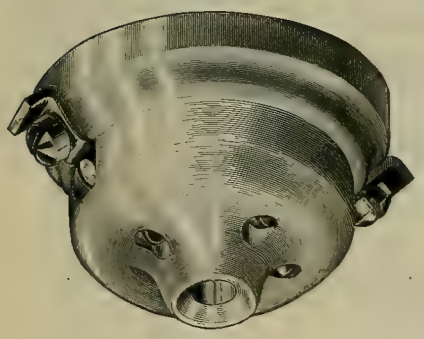
16 C. P. LAMPS {in lots of 25} 44 CENTS EACH.

Write to nearest district office, or any Electrical Supply House, or Electrical Engineering Concern.

EDISON GENERAL ELECTRIC COMPANY.

MAIN DISTRICT OFFICES:

Canadian District, Bank of Commerce Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 38 Pearl Street, Boston, Mass.
Rocky Mountain District, Masonic Building, Denver, Colo.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Southern District, Cotton Exchange Bldg., New Orleans, La.



The day is rapidly passing when Electric Light Companies will be reproached with using "cheap," "crude," "unsightly" and "bungling" devices, in the installation of plants.

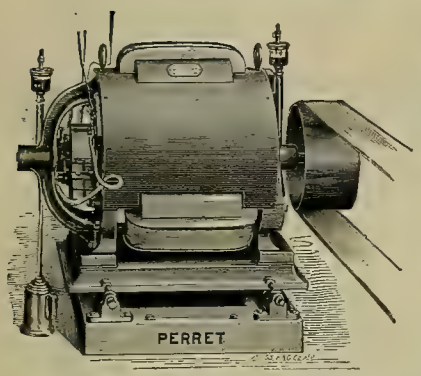
There is a demand for switches, cut-outs, etc., equal in design, workmanship and service to other hardware articles of interior finish, and this demand can now be supplied.

If your dealer does not handle this class of goods, write to us.

THE STAR ELECTRIX CO.,
1320 Wallace Street,
PHILADELPHIA, PA.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



Perret 20 H. P. Motor, Speed 550. Weight 1,300 lbs.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power.
Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., C. M. Barclay, 205 Canal St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
BALTIMORE, MD., W. W. Donaldson, 215 N. Calvert St.
ST. PAUL, MINN., F. J. Renz, 327 Minnesota St.
PHILADELPHIA, PA., Cleverly Electrical Works, 1018 Chestnut St.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago, 111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

The LECLANCHE BATTERY CO., NEW YORK.

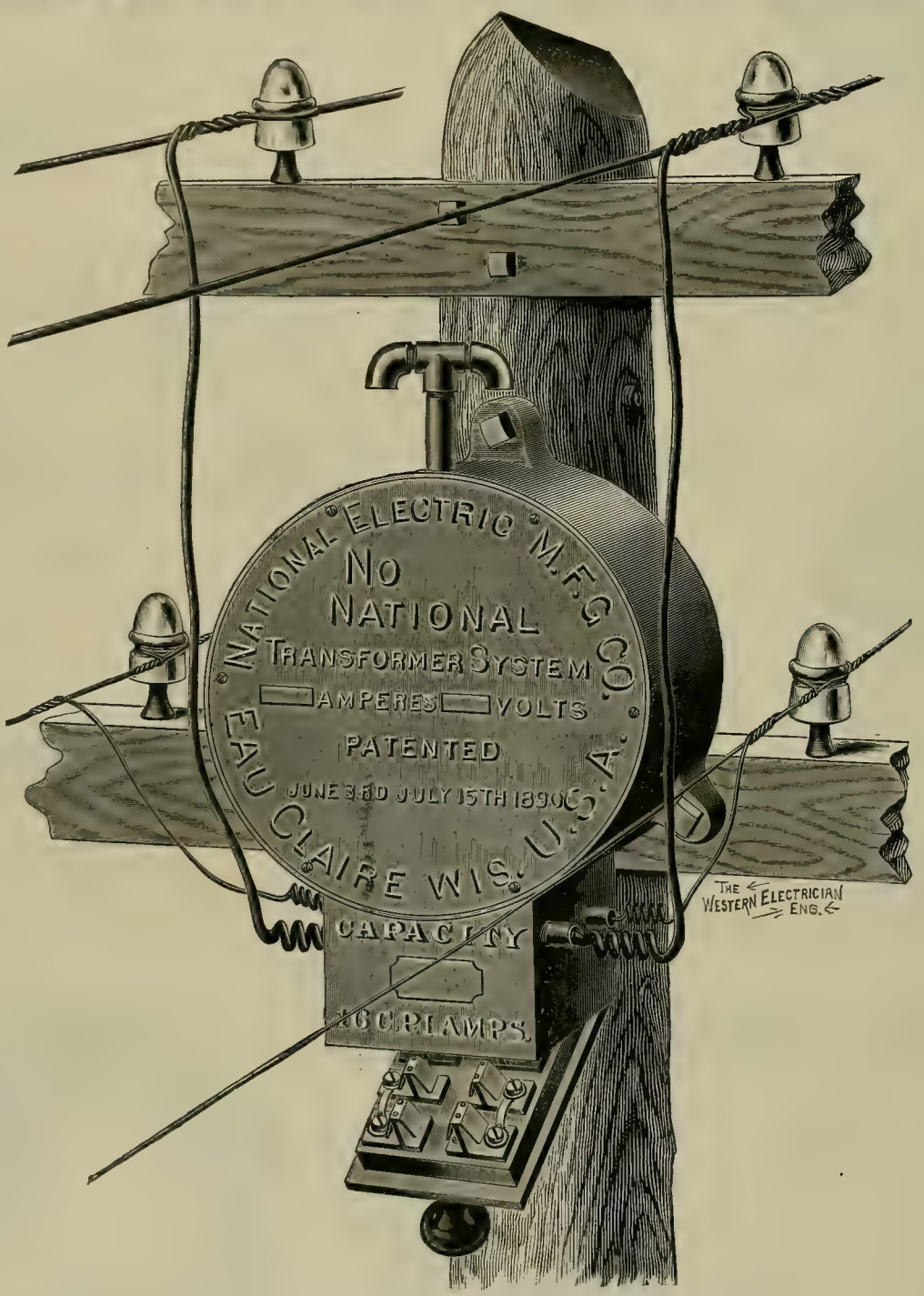
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

Transformer on Pole Showing National Safety Fuse Box.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., - - - - - - Seattle, Washington.	W. N. GRAY, Special Agt., - - Room 12, Chamber of Commerce, Cincinnati, O
THOMAS WOLFE, Southwestern Agt., - - Union Depot Hotel, Kansas City, Mo.	NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Bldg, 50 Broadway, N. Y. City.
LITTLE, McDONALD & CO., Gen l Agts., - - 141 East Seneca St., Buffalo, N. Y.	NATIONAL ELECTRIC DEVELOPMENT CO., - 314 California St., San Francisco, Cal.
METCALF, REED & CO, Western Agts., - - - 1517 Larimer St., Denver, Colo.	SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Agts., - Winnipeg, Manitoba.
CHAS. M. BLANCHARD, Agt., - - - - Girard Building, Philadelphia, Pa	A. IRVINE, Agt., - - - - - - - Emilie Building, St. Louis, Mo
L. N. COX, Agt, - - - - - - - 16 Fifth St., S. E., Washington, D. C.	

CENTRAL ELECTRIC CO.,

GENERAL DEALERS IN ELECTRICAL SUPPLIES,

INCLUDING

ELECTRICAL RAILROAD, TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT GOODS.

116 & 118 FRANKLIN STREET, - - CHICAGO.

WE ARE THE

GENERAL WESTERN AGENTS

FOR

AND

IMPROVED CANDEE WIRES.

These Wires are so well known to the trade that convincing arguments are not necessary. Everybody knows what they are. Send your orders to us when you want the greatest Moisture and Acid-proof, or the King of Weatherproof Wires.

CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company.

Has that last lot of old Lamps proven bad?

Then try

A NEW LAMP,

THE "A. B. C."

TRADE A.B.C. MARK

Long Life,
Good Light,
High Efficiency,
Any Candle-Power,
Made to fit any socket.

CONVERTERS

from 5 to 150 light capacity.

Sockets and Switches,
Fuse Wire,
Main & Branch Cut-outs,
Wire of all kinds,
Tin Shades, Glass Shades,
Arc Lamps for
Incandescent Circuits.
Voltmeters, Ammeters.

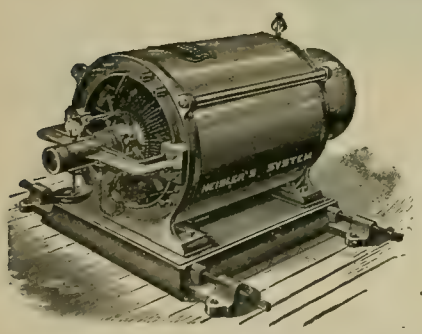
ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING,
20 Cortlandt Street,
NEW YORK.

HEISLER SYSTEM LONG DISTANCE SERIES

INCANDESCENT ELECTRIC LIGHTING.

UNEQUALED FOR DISTRIBUTION OVER WIDE AREAS.



"Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889."

Specially adapted for Street, Commercial, and General Illumination from Central Stations. Plant may be located where power can be secured cheapest, even if miles distant from the Lighting. Safety, Reliability, and Financial Success fully demonstrated. Plan of Wiring the Simplest, Cheapest and most Efficient. Strictly Series. Noted for the Brilliancy and Beauty of the Light. Lamps 10 to 100 Candle Power; Long Life without Blackening. Greatest Production of Candle Power per Horse Power. Dynamo Self-Contained and Perfectly Automatic.

SEND FOR CIRCULAR. CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO.,

DREXEL BUILDING, - - - - PHILADELPHIA, PA.

JOHN STEPHENSON CO.,

LIMITED,

NEW YORK.

STREET CARS

—FOR—

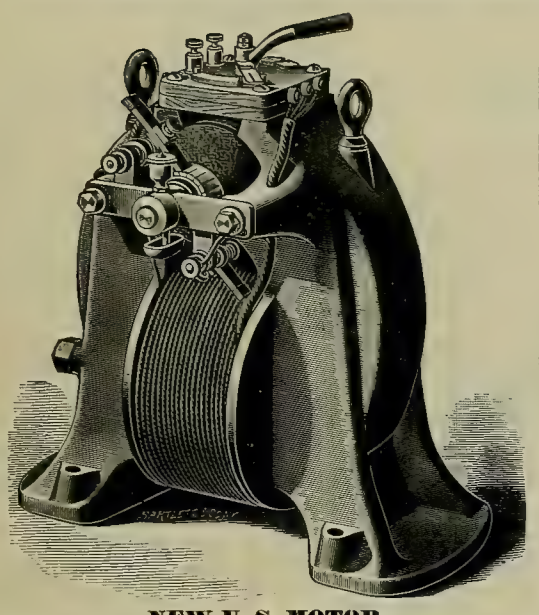
ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

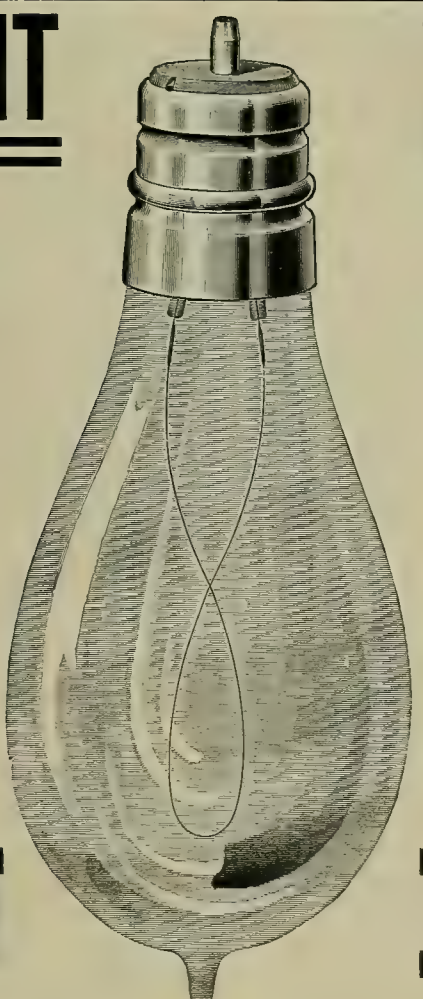
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.

INCANDESCENT LAMPS.



To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.

THE BEST IS

THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, NEW YORK.

620 Atlantic Avenue, BOSTON, MASS.

217 La Salle Street, CHICAGO, ILL.

ARC and INCANDESCENT
Isolated Electric Light Plants.
(THE U. S. SYSTEM.)
ELECTRIC MOTORS AND GENERATORS.
H. H. HUMPHREY, N. Y. Life Bldg., OMAHA, NEB.
Contracting Electrical Engineer.

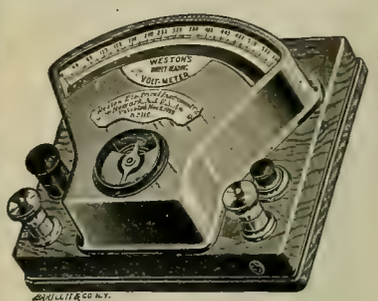
Pittsburgh Sheet Metal Tool Co.,
H. H. HIPWELL, Prop.
Mfrs. of Electric Specialties of Every Variety,
TOOLS, DIES, Etc.
202, 204 & 206 Robinson St., - - Allegheny, Pa.

THE E. S. GREELEY & CO.,
GENERAL ELECTRICAL SUPPLIES,
5 and 7 DEY ST., NEW YORK.
ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade,
Precision and Constancy, Quality and Finish, the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.
Illustrated Circular of Lamps and Lamp Novelties upon Application.
MINIATURE INCANDESCENT LAMPS.

DUST-PROOF BELLS.
None Genuine Without the Washer.
STANLEY & HALL,
(Formerly HAZAZER & STANLEY,)
32 and 34 Frankfort St.,
NEW YORK.

PATENT PERFORATED ELECTRIC LEATHER BELTING
Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,
PATENTEES AND SOLE MANUFACTURERS,
Also New York, Boston, Philadelphia,
46 SOUTH CANAL ST., CHICAGO. ILL.

THE WESTON STANDARD
Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.
Send for Illustrated Catalogue.
ADDRESS
WESTON ELECTRICAL INSTRUMENT CO.,
114 & 116 William Street, Newark, N. J.

THE THING for Electric Railways. "CANVAS JACKET" FEEDER WIRES.
INDESTRUCTIBLE PATENT WOVEN INSULATION.
POLES. POLES.
ELECTRIC LIGHT SUPPLIES ELECTRIC RAILWAY.

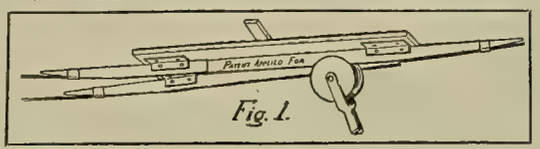



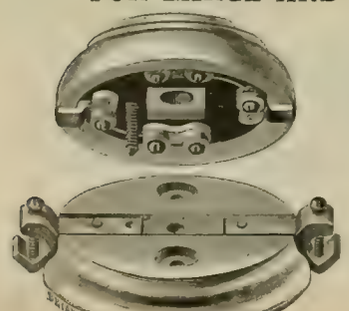
Fig. 1.
MURRAY OVERHEAD TROLLEY SWITCH.
CUSTOMERS REPORT:
"The Switch is a complete success and we cannot see where it can be improved. We have not had a trolley come off at the switch point or fail to take the right way."
Send for descriptive circulars, THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.
ARE ESPECIALLY APPLICABLE TO
ELECTRIC RAILWAY REQUIREMENTS.
A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.
INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.
UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.
For Catalogue, Price List and General Information, Address
INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.
Edw. H. Johnson, President.

THE UNION HARDWARE CO.,
PUSH-BUTTON
SHELLS.
TORRINGTON, CONN.,
—AND—
95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SEC'Y & TREAS.
Charles Munson Belting Co.
MANUFACTURERS OF
EAGLE and DYNAMO BELTING.

TRADE MARK.
PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.
28,30,32,34 & 36. S. CANAL ST.
Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

THE TIME HAS PASSED
FOR LARGE AND UNSIGHTLY GOODS.

Cut 10 Amp. Switch.—5 Amp., 1-2 Size.
The trade demands small and neat articles. The Paiste 5-Amp. Switch is just the thing with its 15 different styles of caps. Diameter only 1 1-2 in. yet will admit No. 10 wire.
H. T. PAISTE,
12th and Market, - PHILADELPHIA, PA.
Kept in Stock and for Sale by all Prominent Supply Houses.

GET THE BEST!
P. and B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE, INSULATING PAPERS, MANUFACTURED ONLY BY
The Standard Paint Co.,
NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, DECEMBER 20, 1890. No. 25

Electric Light Plant in the Midland Hotel, Kansas City, Mo.

Kansas City is well lighted by electricity. In addition to its central stations the city possesses a large number of isolated plants. Many of these have already been illustrated in the WESTERN ELECTRICIAN. In the accompanying illustration is given a view of the electric light plant in the Midland house in Kansas City. There are two United States dynamos, each of a capacity of 400 lights. Two Ide engines of 70-horse power each furnish the motive power. Steam is generated in four John Davis tubular boilers, each of 60-horse power capacity.

National Electric Light Association.

At the next convention of the National Electric Light association at Providence, Feb. 17, 18 and 19, it is proposed to hold an exhibition of electrical apparatus and appliances, especially such as are used in the business of furnishing light and power. To this exhibition all associate members are earnestly requested to contribute.

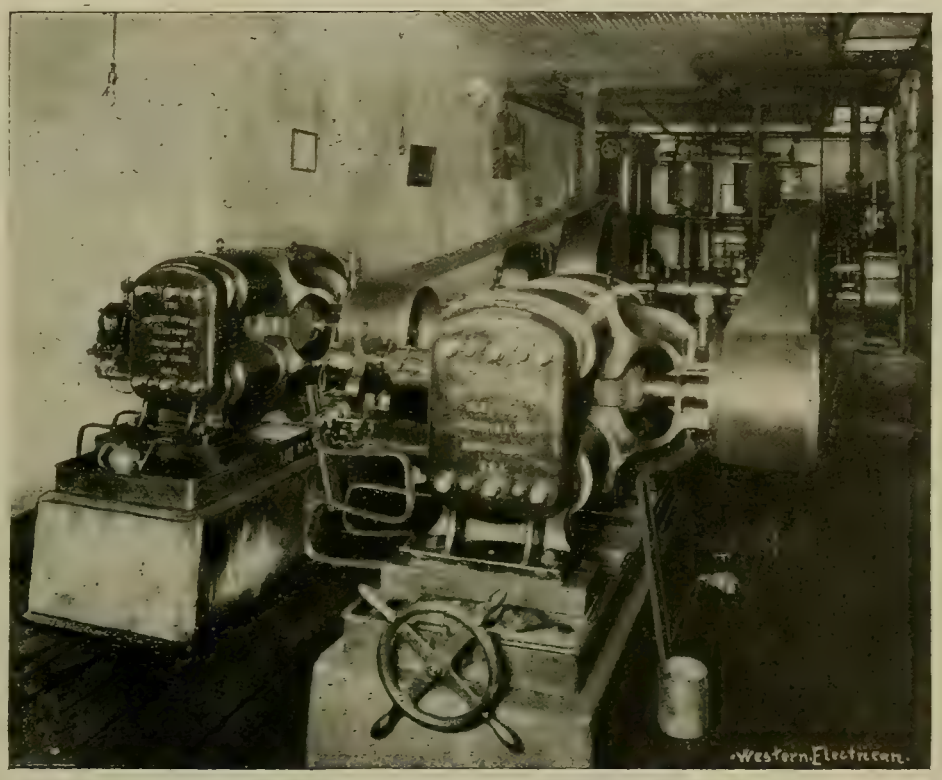
A suitable hall has been secured opposite the hotel, which will be the association headquarters, and through the courtesy of the Narragansett Electric Lighting company of Providence, all the electric current necessary will be provided. There will be run into the hall three circuits, viz.: An incandescent alternating current converted to 50 volts; a 500 volt direct current from Thomson-Houston generators; an arc current of 6 8-10 amperes.

There will be no charge for space or current to exhibitors who are associate members of the association. The installation and care of exhibits will of course be at the expense of exhibitors.

It is suggested that as far as possible, efforts be made to show the progress in the art, by exhibiting the earlier forms of apparatus and appliances, together with those embodying the latest improvements.

The exhibition will open on Tuesday, February 17th, and close on Thursday evening, February 19th, and will be open day and evening. Exhibits may be installed on the Saturday and Monday previous, and removed on the following Friday.

It is expected that the exhibition will prove very attractive to the Providence public, as well as to the members of the association. To exclude the street gamin element, a nominal admission fee, 25 cents, will be charged, but it is intended to circulate complimentary invitations freely among the representative business men of the city, and exhibitors will be supplied with as many complimentary tickets as they may desire to distribute. Space is limited and will be allotted in the order in which applications are received. The following are members of the committee on transportation and exhibits: C. H. Barney, chairman, 20 Cortlandt street, New York; Henry B. Cram, Boston; Van A. Thomas, Providence, R. I.; W. J. Hammer, New York; Geo. C. Maynard, Washington, D. C.; W. A. Kreidler, Chicago, Ill., and Luke Lilley, Cincinnati, O.



ELECTRIC LIGHT PLANT IN THE MIDLAND HOTEL, KANSAS CITY, MO.

Chicago Board of Trade Quotations.

The bucket shops constitute the greatest source of nuisance to the regular operators on the Board of Trade in Chicago. When the courts decided that the board, if it furnished quotations at all must treat all applicants alike, it decided to abolish the service altogether. This action has not disturbed the bucket shops materially. Within forty-eight hours after the time that the board ceased giving out quotations the outside commission merchants were securing the board's prices with as complete accuracy and dispatch as before. Within a minute of the time that wheat is marked 70 on the board it is so registered in all the bucket shops in Chicago How this service has been conducted has been a mystery at least until recently. It is now stated that a regular bureau was organized for running wires. The work was done by linemen who, as their work was rather illegitimate, are known as "guerillas." In utter disregard of all city ordinances relating to stringing wires, they would put such persons as were willing to pay for the privilege into telegraphic communication with a central office from which quotations were sent. This bureau was located in the immediate vicinity of the board of trade. The moment a price was determined in the board a reporter noted it and rushed to the office whence the information was flashed to all the subscribers. The solution of the mystery is very commonplace indeed.

Wisconsin Electric Club.

At the last meeting of the Wisconsin Electric club, Milwaukee, it was voted that $50 be appropriated for the purchase of additional books for the library of the club. Recommendations for books are requested from members to be forwarded to the secretary, giving the author, publisher and price. Members are also requested to loan such works upon electrical or allied subjects as they can spare. The proposed amendment to the constitution, "That the dues be reduced from twelve dollars to eight dollars per year, commencing with the first of February, 1891," will come up for consideration at the first meeting in January.

At a meeting of the Wisconsin Electric club December 11 a paper was read by Henry D. Goodwin on recent improvements to the Edison phonograph. The cutting needle and knife and the reproducing needle are now made of sapphire or diamond. A single diaphragm of glass is used, that being the most satisfactory, although diaphragms of iron, steel, aluminum and other substances answer very well. The phonograph has been greatly simplified, and is rendered very sensitive to delicate sounds, by the new sapphire needles and the new cylinders. The machine is geared so that the cylinder will hold a long dictation. The members were much entertained at the close of the reading by phonographic reproductions of selections by Clauder's band.

Reducing Aluminum.

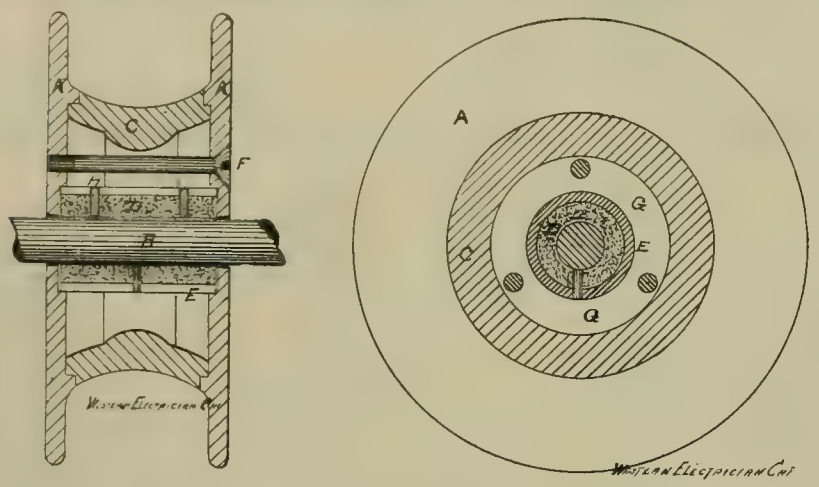
The Hirsh Aluminum Plating company of Chicago was incorporated last week by Franklin Babcock, Edward G. Fish and David H. Wilson. This is the first practical step toward testing the theories of Prof. Hirsh and giving his "discovery" a fair trial. It will be remembered that Prof. Hirsh recently announced that he had developed a new process for reducing aluminum surpassing in results the present methods and so much more economical, that competition would not be attempted. Despite these somewhat extravagant assertions it was not long before many capitalists became interested in the matter and, it is said, many were induced to lend their names and money to the project of developing the new process. Of course the projectors of the enterprise are enthusiastic and predict wonderful results, and those who have examined it appear thoroughly confident of the ultimate success of the scheme.

The Newport, Tenn., Electric Light & Power company has been incorporated.

Trolley Wheel.

When electric street cars travel at the rate of 15 to 20 miles per hour the speed of the trolley wheel is extremely rapid, and the wear on its bearings is much greater than that on the electric contact surface of the wheel. It has been a problem to construct a wheel that will run for a long period of time without attention, and so to arrange it that the wearing parts may be replaced at a slight cost.

The cut illustrates a wheel which was recently designed by Foree Bain, Chicago. The parts



TROLLEY WHEEL.

may be described as follows: The bearing *D* is made of rawhide, forced into a brass tube *E*. This tube is made of a standard size and can be replaced for a trifle. The bearing is clamped in place by means of three screws through the two side flanges *A*. These flanges are made of steel or hard bronze. The wheel turns on a steel pin *B*, which is made stationary in the harp. *C* is a wearing ring which is in contact with the trolley wire. This ring can be replaced in a few moments and costs only 25 cents. Between this ring and the tube *E* is an oil space *A*. A small quantity of the lubricant is placed in this reservoir and feeds to the pin *B*, through the small hole, *H*, which are made through tube *E* and the rawhide bearing *D*. Springs are placed to bear on the sides of the wheel and these make electric contact from the harp to the wheel. The wheel is made to fit any harp.

Chicago Electric Club Social.

The Chicago Electric club introduced an innovation at the meeting last Monday evening when an informal social gathering took the place of the regular meeting. The board of managers had appointed Fred E. Degenhardt and W. J. Buckley a committee to provide a programme for the evening's entertainment. Their efforts proved eminently successful. When Vice-President Badt called the meeting to order, the change in the regular course of the proceedings was announced. Messrs. Degenhardt and Buckley assumed the positions of chairman and secretary, and directed the entertainment. During the evening excellent music was discoursed by an orchestra. Prof. Broadfoot gave several recitations which were fully appreciated. Probably the most enjoyable feature of the evening was the presentation of a paper by Mr. Degenhardt, illustrated by Mr. Buckley. The subject of the paper was "Electricity," and it was explained that it contained "many well-known facts and other things." It is scarcely necessary to say that there was a radical departure from the well-worn path of scientific exploration, but the subject was treated in a masterly manner and "profusely illustrated." Mr. Buckley's explanations tended to increase the interest in the subject, and at the conclusion several of the members engaged in an interesting and at times animated discussion over topics alluded to in the paper. The entertainment was one of the most enjoyable the club has thus far presented, and the "socials" will no doubt prove an attractive feature of the winter meetings.

A proposition to build an electric light plant for the city of Weldon, N. C., is now under consideration.

Splicing Carbons.

The electric lighting company of Concord, N. H., is using a device by means of which, it is stated, a saving of 30 per cent. is effected in the cost of arc lamp carbons. The trimmers bring to the station all the short pieces of carbon collected on their daily rounds. These are sorted and matched together, to form a carbon about eight inches in length. These pieces are placed in a machine which forms a dowel on one piece and a socket in the other, and they are cemented at the joints. The cement with which they are joined is heat-proof and is a good conductor, so that there is no change in light indicated when the joint is reached. The spliced carbons are used only in the lower holder. Carbons thus joined have been used by the company over a year, and the process is considered entirely successful. N. P. Stevens, machinist, and W. A. Richmond, who have patented the cement and the forming machine are considering the advisability of putting the device on the market.

Electric Railway at Rochester, N. Y.

The Rochester Railway company which controls all the street railway lines of Rochester, N. Y., is substituting electricity for animal power throughout its system. Considerable progress has been made in the work of reconstructing the lines and the equipment of the power house. The Short Electric Railway company which secured the contract for equipping the system with electrical apparatus, is furnishing 204 motor cars. Electric cars have been operated on the Lake avenue line for some time and the work of construction on South avenue and Monroe avenue is completed, but the power house is not yet in readiness and the temporary arrangement for furnishing current is not sufficient to operate more than one line. When the contract of the Short company is filled, 183 cars now hauled by 849 horses will be dispensed with, and 204 electric cars substituted.

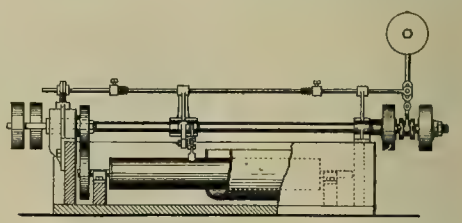
In the accompanying cut is shown a view of one of the vestibuled cars operated on the Lake avenue line of the road. The car was constructed by the Gilbert Manufacturing company, and as the illustration shows, it is unusually handsome in design. The car is mounted on the Peckham Cantilever trucks, which are designed for heavy cars. The construction is such that the trucks support the extreme ends of the cars in order to prevent oscillation. Recent improvements in the trucks consist in the construction of the center side bars to facilitate the removal of armatures, and the addition of track cleaners, track brakes, compound rubber and steel springs.

It is expected that three lines at least will be in operation January 15, when the power house will be completed.

ELECTRIC RAILWAY AT ROCHESTER, N. Y.

Process of Making Metal Tubes by Electro-Deposition.

To reduce the cost of the manufacture of tubes, cylinders, rings, etc., formed by electrolysis, is the object of this process. In carrying out the improvement impure copper is cast into a convenient size and shape to serve as anodes in the depositing tank in which the electrodes will be hung. The electrolyte in the tank should be such that the impurities contained in the anode are either practically insoluble or that they shall, by secondary or other action or reaction, be prevented from being electrically deposited at the cathode. For example, in a solution of sulphate of copper containing free sulphuric acid used with a copper anode containing bismuth, antimony and tin or other



PROCESS OF MAKING TUBES BY ELECTRO-DEPOSITION.

foreign metals, on passing a current from the anode through the solution, the copper of the anode is converted into copper sulphate, which is dissolved. The bismuth, antimony and tin are principally left at the anode as sulphates and oxysulphates of bismuth, antimony or tin, and eventually fall to the bottom of the tank. A small quantity only is dissolved. This by the action of the atmosphere on the bismuth, antimony or tin in solution, is converted into basic or oxy salts of these metals. The copper will be deposited at the cathode and the other foreign metals which may be combined with the copper in the anode, such as gold, silver, lead and sulphur, will fall to the bottom of the tank. The core or other object to receive the deposit is connected to the negative pole of the dynamo and this cathode is placed in the tank, as shown in the figure, and there kept revolving during the whole time that the current is passing. During the time the core is in motion a

burnishing implement is kept pressed against the surface which is receiving the deposit.

In burnishing the surface of the deposited article during the time at which the deposit is going on in the tank, the mould or mandrel is mounted in the tank on a shaft, as represented in the figure. Upon the side of the bath are mounted guides, and a traveler fitted with a worm is provided so that the burnishers will run to and fro over the article. The traveler has a carrier attached, upon which is mounted the burnishing-surfaces, such as agates, bloodstones, flints, or glass having a highly polished surface —that is, a non-conducting substance capable of burnishing and which is not acted upon by the electrolyte. This process is the invention of F. E. Elmore, of Cockermouth, England.

The Wood Meter.

The meter illustrated in the cut belongs to that class in which the current to be measured is caused to heat intermittently a thermo-expansible wire or strip. The current is automatically switched around this strip when it has expanded to a certain degree. The current is again directed through the strip when the latter has cooled. The successive heatings of the thermic body are counted by a totalizing device and indicate the amount of the current passed through the meter.

The Wood meter contains two expansible strips which are heated alternately. One is cooling while the other is heating.

The device is illustrated in its most improved form by two views in Fig. 1, but will be better understood by first glancing over Fig. 2. The arrangement of parts in Fig. 2 differs somewhat from that shown in Fig. 1, but the principle governing the action is the same.

Referring to the diagram, *A* and *A* are two very thin metal strips or fine wires fastened at their upper ends to unyielding supports *S* and *S*, and at their lower ends to the head piece or boss

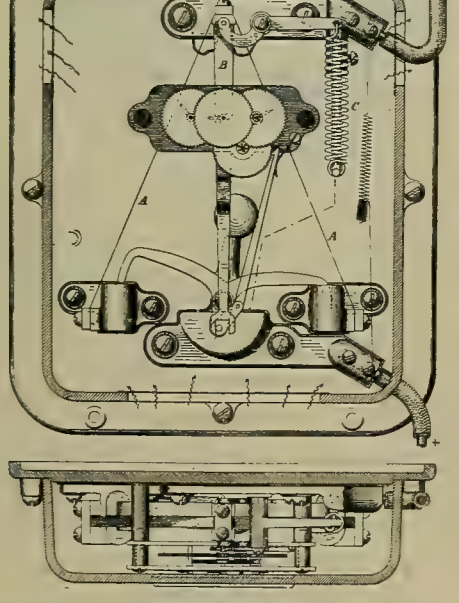


FIG. 1. WOOD METER.

of a lever *B*. This lever has a long arm which terminates, as shown, in a fork. Beneath the lever *B* is a spring *C* which pulls against the knife-edge fulcrum of the lever in such a manner as to stretch the strips *A* and *A*. The metal strips *A*, *A* constitute high-resistance conductors for the electrical current, and are also thermo-expansion devices. These strips by their differential expansion or contraction, impart motion to the lever *B*. Thus if an electric current of sufficient volume be sent through one of the strips, that strip will be heated by the current and will expand. The strip not being heated will remain unchanged in length. The elongation of, say, the strip on the left will relax the left-hand short arm of the lever, so that the tension of the spring *C*, acting against the middle of this boss, will tilt the lever and carry its long arm toward the left. The deflection of the lever will be directly proportional to the elongation of the strip heated by the current. It will be noted that one strip is exposed to the same surrounding temperature as the other. Whatever is the expansion or contraction therefore due to variations of external temperature both strips are equally affected. One strip becomes a compensating thermo-expansible support for receiving the reaction of the lever. Now if one strip expands to a certain elongation the electric current is shunted through the second strip and cut off from the first strip. The second strip, therefore, will become heated by the

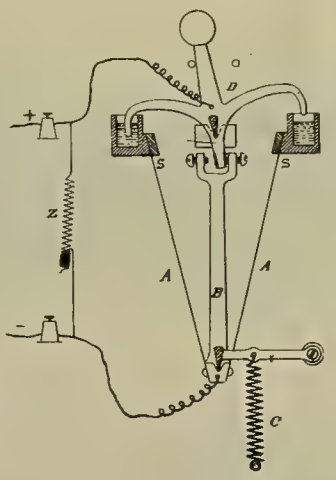


FIG. 2. WOOD METER.

passage of the current and the first strip will simultaneously cool by radiation. The resulting expansion and contraction of the strips will effect an oscillation of the lever *B*. In other words, there will then result from these alternations in the path of the current, a back-and-forth vibration of the lever *B*. This vibration is utilized for imparting motion to a switch by which the alternate shunting of the current is effected. Since these vibrations of the lever *B* occur with a frequency approximately proportional to the varying strength of the current, they are utilized for the purpose of operating a registering mechanism, which affords an approximately correct indication of the total current which has traversed the instrument during a certain time.

An essential feature of the meter is the switch for effecting the necessary alternations in the current. This device should be of the character known as a "quick-action switch." That is, one in which the first part of the throwing movement, in either direction, is employed to store up power, and this power, at the end of the movement is made effective to suddenly make or break the electrical connection. Such switches operate usually either by gravity or by the tension of a spring. The switch employed in this meter is one of the simplest forms of quick-action switches. It consists of a tilting lever, having laterally-extending arms and terminating in fingers arranged to dip alternately in two mercury cups. The lever is pivoted on a knife-edge and has an upwardly projecting arm carrying a weight. The lever may tilt to either side between stops. When tilted, one of its fingers is immersed in a mercury cup, while the other finger is lifted entirely out of its cup.

Volta's Poverty.

In the discussion of Edward P. Thompson's paper on "How to Make Great Inventions" at the late meeting of the New York Electrical society, W. J. Hammer spoke of the encouragement which could be derived by young and struggling inventors from a study of the life and experience of some of the prominent inventors of the day. He referred to the obstacles encountered by Morse, Bell, Edison, Weston, Brush and others. In connection with a remark made by the lecturer that in the various classes of inventors, there are those who, while receiving practically no financial benefit from their work, have achieved undying fame, Mr. Hammer quoted the instance of Alexander Volta, who died in great poverty. Mr. Hammer at the same time submitted for the inspection of the members of the society, a photographic facsimile of a document of historical interest which he had just received from Italy. This was a declaration made by Volta in support of an application he had made for a pension from the Austrian government. The translation reads as follows:

"I, the undersigned, declare under my solemn oath that I do not possess other revenue or pension from the state outside of that which I receive as a member of the Institute of Arts and Sciences.

"Como, July 2, 1820.

"(Signed): ALESSANDRO VOLTA."

Mr. Hammer stated that action on this application was delayed by the Austrian government, and in the meantime, Volta died. At the date of this document Como, as well as the whole of Lombardy, was under the Austrian rule.

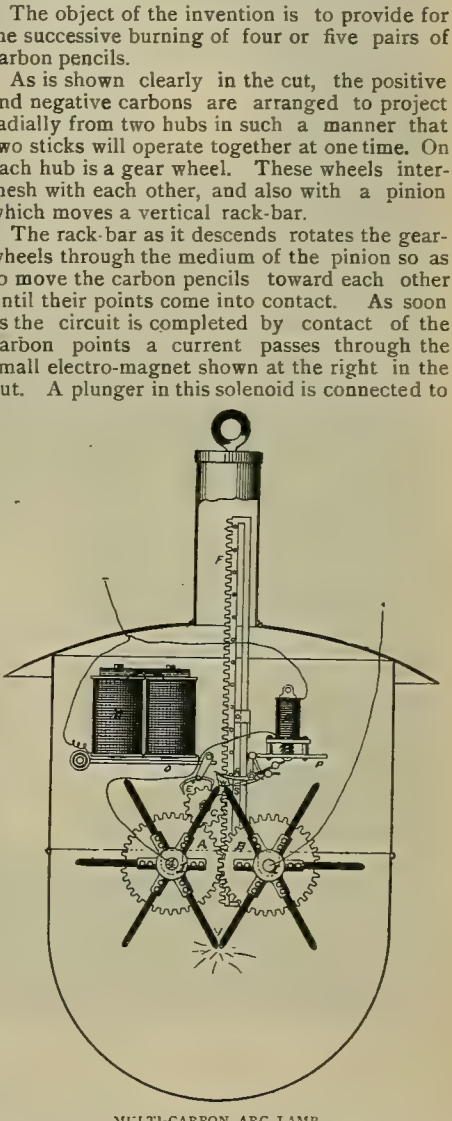
Multi-Carbon Arc Lamp.

The accompanying cut illustrates diagrammatically one of the latest attempts at the production of an arc lamp which will burn for a long time after one trimming. The reader is left to judge for himself as to the practicability of the mechanism.

The object of the invention is to provide for the successive burning of four or five pairs of carbon pencils.

As is shown clearly in the cut, the positive and negative carbons are arranged to project radially from two hubs in such a manner that two sticks will operate together at one time. On each hub is a gear wheel. These wheels intermesh with each other, and also with a pinion which moves a vertical rack-bar.

The rack-bar as it descends rotates the gear-wheels through the medium of the pinion so as to move the carbon pencils toward each other until their points come into contact. As soon as the circuit is completed by contact of the carbon points a current passes through the small electro-magnet shown at the right in the cut. A plunger in this solenoid is connected to



MULTI-CARBON ARC LAMP.

a plate beneath which is guided in its vertical movements by pins. The plunger and plate are moved away from the solenoid when demagnetized, by a spring surrounding the plunger. On the end of the plate adjacent to the rack-bar are pivoted arms having fingers adapted to engage pins arranged alternately on opposite sides of the rack-bar. These fingers are provided with weights adapted to swing the fingers forward to the left, so that their ends may rest upon an inclined abutment or fulcrum. By the magnetization of the solenoid the finger, whose forward end rests upon the abutment and is also beneath a pin on the rack-bar is raised. This action moves the points of the carbons slightly apart, so as to form an arc between them. As the plate or armature above referred to moves up as described, the point of the finger slides down

the inclined face of the abutment, and at the end of the upward movement of the plate armature moves entirely off from the abutment and is held away from it by the weight of the rack-bar. Simultaneous with the release of the rack-bar from this finger an escapement is brought into engagement with the pinion by the magnetization of the large electro-magnet at the left. This escapement is intended to regulate the speed of the pinion as propelled by the weight of the rack-bar. The upward movement of the armature of the small solenoid raises a second finger at the back of the rack-bar so that its forward end will be above the abutment. This swings the finger forward, so that, when the plate descends, as it will when the carbon points are separated, the current being cut out from the solenoid at that time, the front end of the finger will rest upon the abutment and the second finger will be in readiness to engage a pin on the rear side of the rack-bar.

As soon as the carbon points have burned a certain distance apart the large magnet is demagnetized and its armature drops. The pinion can then revolve freely until one of the pins on the rear side of the rack-bar engages its finger. The pins are set along the bar in such positions that when they engage either of the fingers the carbons will be in contact.

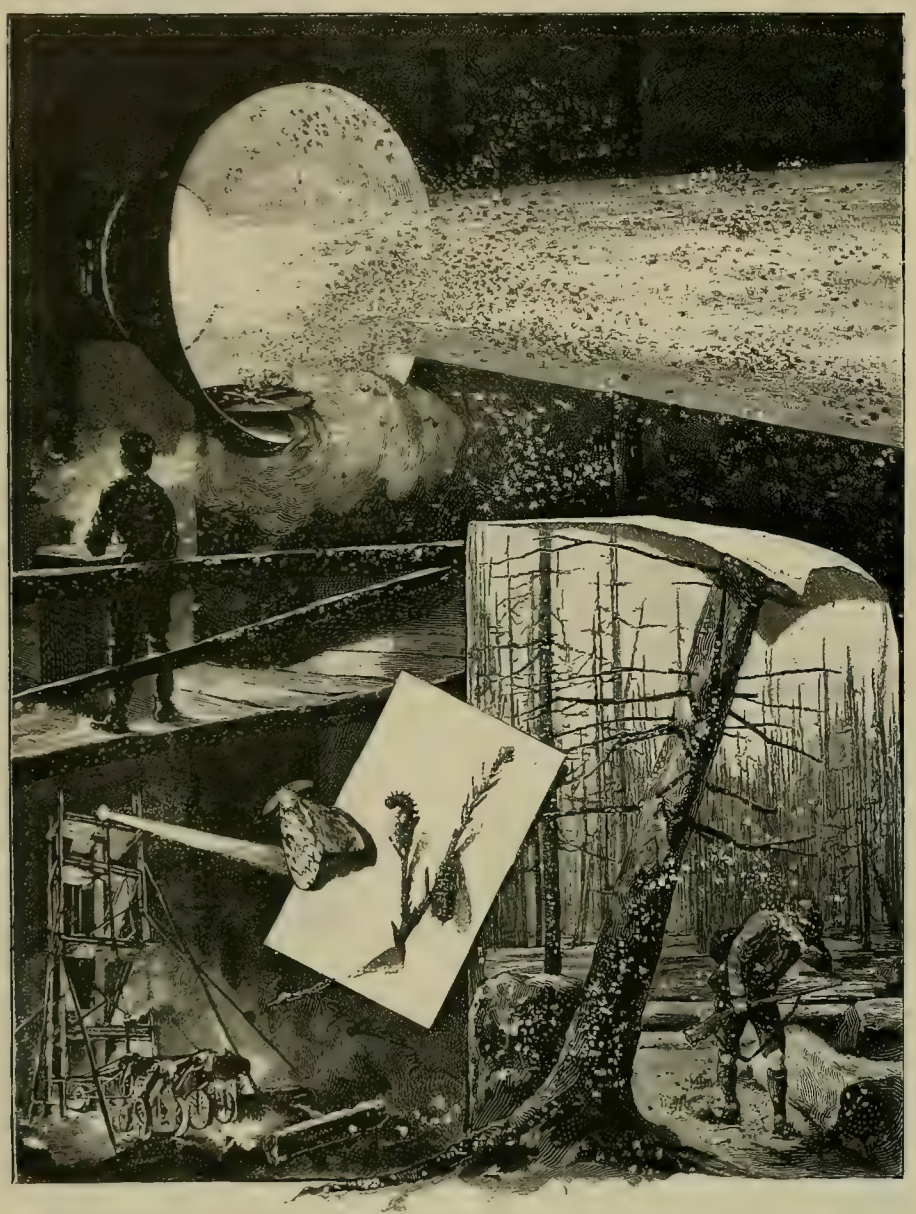
The inventor of this lamp is W. B. Henderson, Pittsburg, Pa.

The Wisconsin Telephone company will extend its underground work from Jefferson and Wisconsin streets, Milwaukee, east to the lake, about 1,500 feet, thus removing all the poles and overhead wires from Wisconsin street This line consists of 200 wires on 45 and 50-foot poles and its removal will greatly improve the street. This change was necessary on account of the noise from the Becker electric street railway which parallels the line.

War on Forest Bugs

It is not the large or ferocious animals, but the smallest and most insignificant of the animal kingdom that challenge the skill of the scientist and the patience of the agriculturist.

The cut which is reproduced from *Ueber Land und Meer*, shows the deplorable remains of a once beautiful park near Munich, Bavaria and the electric contrivance for destroying the countless myriads of insects, whose war of destruction has not left a leaf on the branches of the magnificent trees. This little insect is known in Europe as the nun on account of the peculiar shading of white and black imbrications on its wings. Like all insects of the genus *papilio* to which it belongs, it is very destructive during its caterpillar state. The insects appear in such swarms that all attempts to destroy them have proved unavailing. Fires were lighted, but, flames and smoke produced no result. Large sheets of cotton cloth soaked in adhesive glue, resembling huge sheets of sticky fly-paper were stretched from tree to tree, but no relief was found. Regiments of school children proclaimed holy war on the bugs, and were paid a few pennies for each bucketful of caterpillars, but hostilities soon ceased for the reason, doubtless, that a continuance would have bankrupted the city treasury.



WAR ON FOREST BUGS.

Electric light was finally utilized. The metamorphoses of the caterpillar had taken place, the little winged nun was flying from branch to branch looking for a place to deposit eggs. A rough framework was built with a large electric projector at the top. At the same point was a powerful exhaust fan operated by a motor leading to a kind of grinding mill. The insects, attracted by the light, would be drawn by the draft into a passage leading them down to death and mutilation in the grinder.

In some parts of Northern Europe afflicted by similar plagues, ingenuity has gone still further in utilizing the crushed insects. The mass is mixed with flour and water, and is baked and used for feeding poultry. "*Inest sua valeo parvis.*"

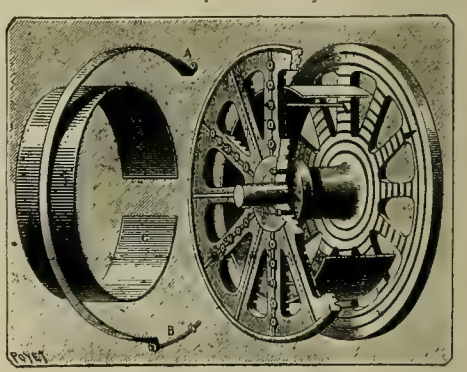
Chicago Electric Club Parties.

The Chicago Electric club proposes to give during the winter a series of four parties, the first of which will take place December 26th. Kinsley's ball room, adjoining the club rooms has been secured, and Pound's full orchestra will furnish music. The price of tickets for the four parties will be $5, and each member has the privilege of extending an invitation to a friend. The committee in charge consists of Alex. Kempt, F. E. Degenhardt, and W. J. Buckley.

Pulley with Variable Diameter.

It is frequently desirable in testing machines to vary the sizes of pulleys. This is ordinarily accomplished by means of cone pulleys or extra pulleys. The use of the cone presents certain disadvantages, especially in the case of wide belts. In the cut is represented a pulley so constructed that the diameter may be varied at will within certain limits. The design is that of M. Albaret of the Paris machine testing station. The pulley was constructed for use in that station.

The device consists of two circular plates, one of which is attached permanently to the shaft.



PULLEY WITH VARIABLE DIAMETER.

The other is removable, but held in place by bolts. On the inner sides of the plates are cut concentric grooves, as the cut shows. To form a pulley of the desired diameter the removable plate is taken off, stout bands of steel are slipped into the grooves and are held in place temporarily by the strap *AB*, with an adjusting screw. The plate is then bolted in position, and the pulley is ready for use. The cut is reproduced from *La Nature*.

Electric Light Plant in the Masonic Temple, Chicago.

Among the numerous projects under way in Chicago at the present time there are few which command greater attention than the Masonic Temple, the corner stone of which was laid recently. It is proposed to push this building to an early completion and as it will be one of the greatest structures in the country, it is needless to say the undertaking will be one of vast proportions.

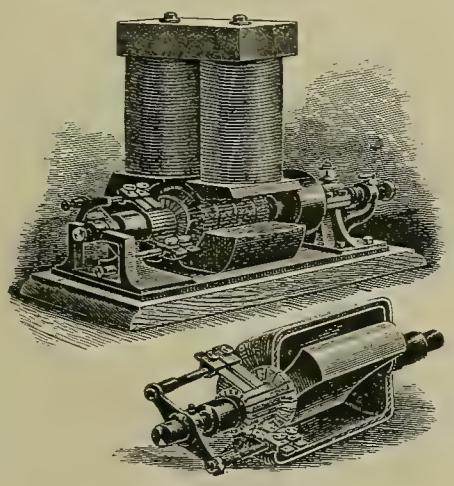
It is proposed to light the building throughout by electricity and an isolated plant will be installed. Last week bids were received for this installation. It is proposed to introduce 7,000 incandescent lights. Six dynamos will be installed and three 225-horse power engines will drive them. It is also proposed to use electric motors to a considerable extent for operating elevators, ventilating fans, and for many other purposes.

Frank Lott, an electrical engineer in charge of a London electric light station in a recent communication to the electrical papers of London, calls attention to a statement made by Mr. Mordey, in which the latter expressed the opinion that incandescent lamps on a series system would be shorter lived than those in a multiple arc system. Mr. Lott speaks of a lamp that has been used on a series system for more than three years and has been having over 10,000 hours, and is still in good condition.

Regulator for Dynamos and Motors.

The illustration represents a regulator in which the armature core is designed to shift automatically in accordance with the lead of the armature, always taking up its position with its poles in the strongest part of the field. It is designed that the brushes shall be held to the point of the least sparking, and the adjustment of the brushes effected automatically by every change of load upon the dynamo or motor. The device has been invented be Fremont J. Cleaver, electrician of the Second Avenue Electric Power Railroad company, Pittsburg, Pa., and George Fassold of the same city. The armature has circular end pieces mounted on tubular shafts, and to these end pieces is secured a hollow cylinder of non-magnetic material, wound with the conductor in the usual way, as shown in the broken-away portion of the main view in the illustration, the terminals of the coil being connected with the commutator cylinder.

Upon the central shaft, and loosely fitting the hollow cylinder, is an armature core consisting of the segment of a cylinder of iron having concave sides, as shown in the small view. The



REGULATOR FOR DYNAMOS AND MOTORS

central shaft is prolonged beyond the tubular armature shafts, the ends of the central shaft being supported on pointed screws in yokes attached to the supports of the journal boxes of the tubular shafts. To the central shaft at its commutator end is secured a cross arm of insulating material in which are held rods carrying the commutator brushes. The cross arm also carries metallic contact plates which are electrically connected with the rods, which touch curved bars that receive the current from the brushes. The curved bars have binding posts for receiving the conducting wires leading from the dynamo. On the end of the central shaft opposite that carrying the cross arm is attached one end of a spiral spring attached by its other end to the yoke, to oppose the pull of the armature on the segmental core, and to return the core and the brushes to their original position when the machine is idle, so that the brushes will always occupy the same position relative to the segmental core. The cut is reproduced from the *Scientific American.*

Miner's Lamp.

A French writer contributes the following to the *Colliery Guardian:* "Further experiments recently made at St. Etienne have clearly demonstrated that fire damp in its most sensitive state—that is, mixed with air in the proportion which gives the highest degree of inflammability—cannot be ignited by a spark from the pick. The sparks in this instance were struck from hard iron ore—carbonate of iron. The recent explosions at St. Etienne have again directed attention to electricity as the only safe means of lighting the fiery workings. The 'Stella' electric safety lamp, tried some time ago at the Anzin colleries; and since improved in construction, is much talked about. It is to be hoped that this problem of a practicable electric safety-lamp will soon be solved. The matter is worthy the attention of inventors, but for those who are not practically anquainted with the conditions of mining it is sheer waste of time to meddle with it."

The railway department of the Chicago office of the Thomson-Houston Electric company reports the following statement in regard to the business done from January 1 to November 30, 1890: Number of contracts, 64; number of generators, 74; number of motors, 647; horse power of motors, 9,940; horse power of generators, 6,130.

Installing Interior Conduits.

In installing the interior conduit system the greatest labor is expended upon the joints and couplings. The methods heretofore employed by the Interior Conduit Insllation company of New York for making joints have been found satisfactory, but in order to insure perfect work great care had to be exercised on the part of the workman. In order to obviate the necessity for this extreme caution a new form of coupling, Fig. 1, has been introduced.

The new joint will make unnecessary the use of the threading tool, threaded coupling and cementing compound. The sleeve is made of soft galvanized iron and being of a slightly larger diameter than the tube itself, fits snugly

FIG. 1. INTERIOR CONDUITS.

upon it. The tool, Fig. 2, made in the form of a pair of pliers, serves to press the two slight corrugations upon the outside of the halves of the sleeve and into the body of the tube, but in so doing does not in the least injure the latter or alter its internal diameter at that point. Joints so made, it is stated, are impervious to moisture and have great strength.

By the new method joints may be made upon the floor or bench, and the lengths of the tubing lifted with safety to the wall or ceiling without fear of straining or opening the joints.

Electric Light and Photography.

Francis A. Cameron of New York, while in Chicago a few days ago, spoke of the use of electric light in photography, as follows: "Electricity is being brought more and more into intimate connection with photography. It is now used in lighting studios and for securing artistic effects of light and shade. In order to avoid black, hard shadows the light is projected onto a sheet of alabaster and thence on the subject. The result is soft and exquisite in tone. The electric light is also used for printing, for enlargement, for balloon and kite photography. In aerial photography the camera is attached to a kite. When the desired height has been reached the exposure is made by electricity, and pictures are thus secured which it would be impossible to obtain by any other means."

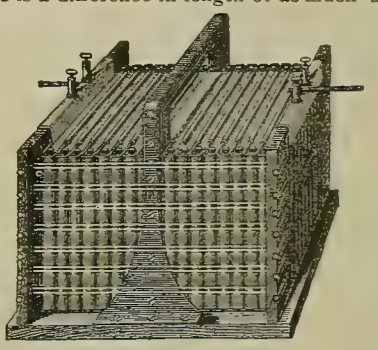
Electric Railways for Chicago.

Two ordinances were introduced in the Chicago city council last week granting the Calumet Electric Street Railway company the right to construct two new lines. The route indicated by the first ordinance is from the intersection of Cottage Grove avenue and Ninety-third street, west on Ninety-third street extended, to South Park avenue extended, south on South Park Avenue extended, to Ninety-fifth street and thence west on Ninety-fifth street to Stewart avenue. One of the two tracks must be completed on all the streets within one year from the date of the passage of the ordinance. The company already has a franchise on Ninety-third street from Harbor avenue, in South Chicago, to Cottage Grove avenue. The cars are running as far west as Stony Island avenue and the work on the extension to Cottage Grove avenue is progressing.

The route in the second ordinance is from the intersection of Seventy-ninth street and Cottage Grove avenue, south on Cottage Grove avenue to Eighty-seventh street; beginning also at the intersection of Ninety-third street and Cottage Grove avenue and south on Cottage Grove avenue to Ninety-fifth street. Ordinances are now pending for electric car lines on Ninety-fifth, Ninety-ninth, One Hundred and Eleventh and One Hundred and Fifteenth streets, from State street east to the east line of Cottage Grove avenue, and thence into Pullman territory.

The Reynier Elastic Accumulator.

In the original storage battery designed by Emile Reynier of Paris, each cell was contained in a varnished sheet iron vessel lined with India rubber. A cell was composed of two positives and one negative, separated by sheets of porous silica. The two end sheets were fluted to increase the space available for the electrolyte. The quantity of the liquid was, however, small. In the latest type of cell M. Reynier uses containing vessels of pure lead, the necessary flexibility being obtained by surrounding the lead cell with an expansible corrugated case. A number of cells are connected in series, and are placed between two rigid end pieces drawn tightly together by strong springs. This arrangement gives the active material considerable artificial elasticity, and through its use, it is claimed, a high rate of discharge is obtained. The expansions and contractions of the plates take place freely, it is stated, without disintegration, owing to the action of the springs. There is a difference in length of as much as 6



REYNIER ELASTIC ACCUMULATOR.

per cent. between a completely discharged and a fully charged battery. The active material being constantly under pressure, there is no need for heavy grid-like supports. As the plates and the cells are held together in this elastic manner, they are able to withstand severe shocks, and are on this account peculiarly suited to the exigencies of traction work.

The cut represents a storage battery of the latest type. It consists of 16 cells mounted between end-pieces of hard wood, strengthened by iron bands. The following are some figures relating to this particular type of storage battery:

E. M. F. (full)	32 volts
E. M. F. (at terminals)	28 volts
Discharging current	3 to 6 amperes.
Average available energy	150 watts.
Capacity	30 ampere-hours.
Work (available)	740 watt-hours.
External dimensions: Length	16″
External dimensions: Breadth	12″
External dimensions: Height	12″
Total space occupied (less than)	1.5 cubic feet.
Total weight	110lbs.
Weight per watt-hour	.15lb.
Watt-hours per lb. of cell complete.	6.73
Volume per watt-hour	3 cubic inches.

It may be added that the figures for the total weight and total volume include everything. The battery is very solidly constructed with the view of its employment in electric tramway and similar work.

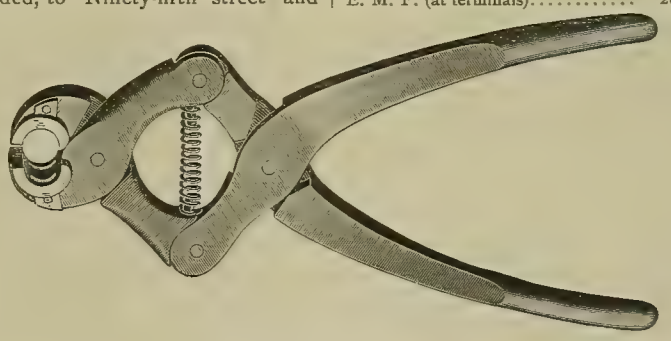


FIG. 2. INTERIOR CONDUITS.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building. - - CHICAGO

Telephone 1746.

W. A. FREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Electric Light Plant in the Midland Hotel, Kansas City, Mo. Illustrated	327
National Electric Light Association	327
Chicago Board of Trade Quotations	327
Wisconsin Electric Club	327
Reducing Aluminum	327
Trolley Wheel. Illustrated	328
Chicago Electric Club Social	328
Splicing Carbons	328
Electric Railway at Rochester, N. Y. Illustrated	328
Process of Making Metal Tubes by Electro-Deposition. Illustrated	328, 329
Wood Meter. Illustrated	329
Volta's Poverty	329
Multi-Carbon Arc Lamp. Illustrated	329, 330
War on Forest Bugs. Illustrated	330
Chicago Electric Club Parties	330
Pulley with Variable Diameter. Illustrated	330
Electric Light Plant in the Masonic Temple, Chicago	330
Regulator for Dynamos and Motors. Illustrated	331
Miner's Lamp	331
Installing Interior Conduits. Illustrated	331
Electric Light and Photography	331
Electric Railways for Chicago	331
The Reynier Elastic Accumulator. Illustrated	331
Editorial	332
Water Rheostat. Illustrated	333
Luscomb's Trolley Wire Hanger. Illustrated	333
English Postmaster General and Electrical Engineering	333
Electrical Department of the World's Fair, by Exposition	333, 334
Fishing by Electric Light	334
Proposed London Subway	334
Electrical Department of the World's Fair	334
Science and the Art of Inventing—Abstract of a Lecture by Edward P. Thompson before the New York Electrical Society	334, 335
DEPARTMENTS.	
Correspondence	335, 336 337
The Electric Light	337
The Electric Motor	337
The Telegraph	337
Electrical Patents	338

AT the last meeting of the New York Electrical society Edward P. Thompson discussed the subject, "How to Make Great Inventions, or the Science and the Art of Inventing." An abstract is presented elsewhere. The topic was handled in a most entertaining manner, and the article is well worthy a careful perusal.

SAVING in the matter of details should be the motto of the central station man. There was a time when he could "waste" and still "want not," but that day is passed and competition now makes necessary the strictest economy at every point. For an illustration of what may be done in this direction the reader is referred to another column. Under the heading "Splicing Carbons" there is a suggestion well worth the attention of any arc light station manager. The careful observer interested in central station affairs has, doubtless, often noticed the bits of arc light carbons thrown away by trimmers. In the article to which we have made reference a plan is presented by which these apparently useless pieces may be united and made fit for service as negative carbons. Perhaps the method has been employed before, but it is not practiced to any extent. We do not see why it should not be the means of a considerable saving.

IT will be noticed by the letter from Minneapolis this week that the electric cars between that city and St. Paul are now in operation. They come into direct competition with the steam car lines and, as the fare is much lower, the electric route is causing a great decrease in patronage on the former lines. Our correspondent predicts that the tendency of the introduction of cheap means of communication will be to restore harmonious relations between the belligerent twin cities.

THE committee on exhibits of the National Electric Light association has issued a circular calling attention to the electrical exhibition at the Providence convention, February 17, 18 and 19. The substance of the committee's announcement is given in another column. It is proposed to make the exhibition one of more than ordinary interest, and for that reason manufacturers are requested to send apparatus used in the early days of electric lighting, as well as their most modern machinery.

THE question of municipal control of electric light plants which has been agitated in Chicago during the last few years will soon be brought to an issue. Mayor Cregier and his associates will ask the legislature at Springfield to pass an act giving the city the power to go into the electric light business in competition with Chicago capital. Until the bill is prepared and ready for presentation it is probable little will be said about it by the promoters of the scheme. A discussion of the proposed measure would only disclose the injustice of the proposition. But the legislature which will meet at Springfield this winter will contain men whose reputation for fair dealing and honesty is not above suspicion. If an effort is not made, therefore, to arouse the people to a realization of the injustice threatened, these men may endeavor to destroy the enterprises which the proposed bill attacks. The defense of the electric lighting interests rightfully belongs to the State association organized over a year ago. The members of this body throughout the state should use their influence with the representatives from their districts to defeat the proposed measure.

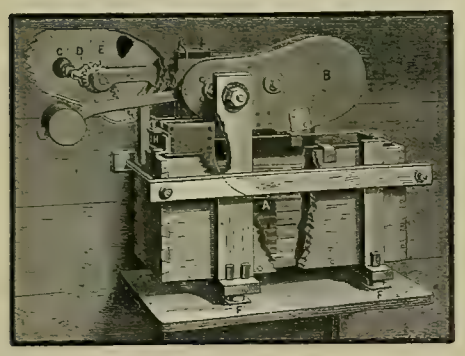
MASTER WORKMAN POWDERLY is quoted by one of last week's daily papers as saying that the introduction of electrical appliances and other labor-saving machinery was defrauding laboring men of the right to work. With reference to electrical machinery, Powderly is reported as declaring that "capitalists in their greed had even cornered God's wrath and compelled it to do their bidding." Such talk relative to labor-saving machinery in general, is of course twaddle, but when this agitator begins to particularize and attempts to demonstrate that the introduction of electricity is something akin to a curse, he becomes ridiculous. Powderly's words, if he was correctly quoted, do not merit comment. A few questions might be put to him, though. If every electric light, both incandescent and arc, were to be extinguished tonight and remain so, would the price paid for any class of labor increase, and would a single workman be benefited? We need not point out to Mr. Powderly that as a result, a number of large factories employing thousands of men might be shut down. Then again, would the health of the closely housed workman improve on his return to the bench under the gas-jet and smoky torch? Mr. Powderly claims, we believe, to have worked in the shops, but we fear his memory may be treacherous, so let him ask the man working overtime or the habitual night worker, whether the artisan has suffered in this direction from the cornering of "God's wrath" by the greedy capitalists. It is to be presumed that Mr. Powderly would malign the electric motor. As he is the champion of the oppressed, doubtless the mule and the horse will come beneath his sheltering wing. Think of the vast numbers of these patient animals now out of employment! Think too that this number is constantly on the increase, as is the number of men employed in developing the usurper. We might fill a column pointing out where electrical devices have not only been the direct means of increasing the general health, comfort and safety of the working man, but also where their introduction has given work to many an idle hand. Mr. Powderly should think a little before assailing an agent whose use is now universally acknowledged to be a boon to mankind.

CHICAGOANS who spent the summers of 1889 and 1890 in the city might with reason feel that there was a time when the electric arc lamp could be called a nuisance. Night after night the brilliant white light from the lamps on the streets of Chicago was the means of attracting vast swarms of bugs which filled the lamp globes and covered the pavements. Where these little insects came from it was difficult to say, but one thing was certain: They were a nuisance, and the electric light brought them together in greater numbers. With this in mind Chicagoans will find interesting reading in the present issue. In the article entitled "War on Forest Bugs," an account is given as to the novel manner in which the electric arc lamp is employed in Bavaria to attract forest bugs to destruction. A beautiful park near Munich, Bavaria, has suffered from the depredations of a little insect called the "nun." The pests swarmed over the trees, stripped them of their foliage and all efforts to check the work of destruction seemed unavailing. At last a scheme in which the electric light was employed, was hit upon. A large arc lamp and reflector were set up in the forest. The lamp was located at or near the mouth of an opening leading from a powerful exhaust fan. This fan discharged into a grinding mill. This tells the story. The Bavarian bugs are as partial to the arc light as are the Chicago sand flies, but the fate of the former is a sad one. Attracted by the light the insects approach, are caught in the air current to the fan and in a few moments, as the story goes, they enter "a passage leading them down to death and mutilation in the grinder."

AN article which appears in this issue on the "Electrical Department of the World's Fair," is a strong plea against dilatory tactics. From the start it has been evident to a careful reader of the daily reports that those at the head of the great enterprise, have, apparently, but a vague idea as to what will constitute the electrical exhibit. There will be an electrical exhibit, we are told, and one commissioner has made the startling suggestion that electricity be utilized for power transmission. As far as one can see though, this is the extent of the efforts made up to the present time. Before an efficient move can be made there must necessarily be an organization of this particular department and when this organization shall take place seems now to be the question. Why the work should be allowed to rest for another year we fail to see. There is everything against a delay. As the writer in the article referred to states most forcibly, foreign manufacturers are not going to "tumble over each other" in their anxiety to make electrical exhibits at an American exposition. With their inborn conservatism and a thorough appreciation of our treatment of them as exemplified in the passage of the McKinley bill, it is to be feared that some persuasion will have to be exercised. It lies with the directory to start the ball rolling. It is safe to say that there will be but little interest displayed on this side of the water either, until the fraternity sees that an organization has been made, and an executive head appointed. Those who have had experience in exposition work know only too well what procrastinators exhibitors are, and on this account they, as well as the foreign manufacturers, should be subject as early as possible to the "prodding" process. Organization and persuasion take time, and the best thing we can do is to start immediately with the work.

Water Rheostat.

The water rheostat shown in the cut is used by the Societe Pour la Transmission de la Force par l'Electricite of Paris in recent installations. The containing vessel is wood which is lined with thick gutta percha. The box rests on insulators *F*, *F*. The electrodes *A*, and *B*, are



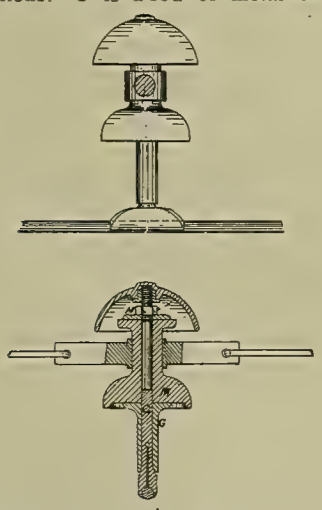
WATER RHEOSTAT.

made of sheet iron; the former is made of three plates and the latter of two. To the movable electrode *B*, is attached a counterweight as shown in the cut. This is heavier than the electrode and tends thus to raise it out of the water. The rheostat is operated by means of the gearing shown at the left. When the two electrodes are brought together a spring operates to force them into firm contact.

Luscomb's Trolley Wire Hanger.

Overhead electric railway conductors are now commonly secured by solder to the insulators. The operation of soldering and also the action of the solder itself, tend to diminish the strength of the conductor and is otherwise undesirable. When the conductor is soldered to the insulator, it is difficult to detach it, and this is also inconvenient and expensive. The conductors are sometimes secured in place by clamping devices; but where these devices encircle the conductor or project below it, and so offer an obstruction to the passage of the trolley, they are objectionable.

The hanger illustrated in the cuts was designed with the view of overcoming these objections. The device might be called a clamping insulator. Its construction will be understood by reference to the lettered parts in the illustrations: *C* is a rod of metal shaped as



FIGS 1 AND 2. LUSCOMB'S TROLLEY WIRE HANGER.

shown, and with its enlarged end split so that the two halves will form a clamp for the trolley wire. The ends of the clamp are shaped to embrace the conductor without entirely encircling and thus forming an obstruction to the passage of the trolley wheel. That portion of the rod *C* which adjoins the clamping-jaws is conical, so that as the beveled collar *G* is crowded down on the enlarged portion of the rod, the clamps are forced together and made to hold securely the conductor. The insulating material *M* is placed on the rod and above it is placed a nut *N*. By screwing down the nut the collar *G* may be crowded down and the clamps set on the conductor. A metal washer is placed between the nut and the insulating material. The unscrewing of the nut enables the collar to be moved back from the conical portion of the rod *C* and the clamps released. As will be clear, instead of the nut and collar for closing the clamp, a simple nut may be employed, the conical portion of the rod *C* being threaded and the nut being of a shape to correspond as shown in Fig. 3. The jaws of the rod *C* are so curved and thinned down, as shown in Figs. 1 and 2, that they partially encircle and clamp the conductor, but at the same time offering no obstruction to the passage of the trolley.

H. H. Luscomb, Boston, Mass., is the inventor of this hanger.

English Postmaster-General on Electrical Engineering.

Among the speakers at the recent banquet of the London Institution of Electrical Engineers was H. C. Raikes, the English postmaster-general. In responding to the toast "Her Majesty's Ministers," he said:

"It is no doubt a fact that the department which I am called on to preside over has closer relations with electrical engineering than perhaps any other of the great departments of the state. It is not necessary that I should refer in detail to the enormous amount of telegraphic business which has grown up in the 19 years during which the department of the postoffice has been charged with its administration in this country. But it is probably interesting to know that in that time the number of telegrams has grown from 10,000,000 in 1871 to 62,500 000 in 1889, that is to say, it has sextupled in the course of those 18 years. You will easily understand how important it is for our department to be *au courant* with all the latest developments of electrical science and the wonders of electrical skill.

"But it is not the postoffice alone of government departments which has relations with electrical engineering.

FIG 3. LUSCOMB'S TROLLEY WIRE HANGER.

Second to the postoffice, if indeed second, is the Board of Trade in relation to your science. The Board of Trade has special charge of lighthouses, and the Board of Trade has had the opportunity of testing and of specially utilizing more than one of the considerable discoveries of your president in that branch of electric science. We can only regret that in the neighboring country of Spain, on whose shores that terrible catastrophe happened the other day, there is not, so far as I am aware, either a Board of Trade or an Institution of Electrical Engineers. If they had the advantages which we possess, we might hope and believe that the lights at Cape Villano might have been in such a state as to prevent the loss of that good ship and of those brave lives that went down into the deep. The Board of Trade is not only interested in lighthouses, but also in the great question of electric lighting. I know that a great many gentlemen, and perhaps a majority of those present, are of opinion that electric lighting has been unduly arrested by the jealousy of Parliament, or of departments of the government. I understand that feeling, but I do not share it When you have a young science, it is desirable to give that science time to feel its feet, and in some way appreciate what it can do before you rush headlong into employing it. I cannot but think that Parliament has been wise in holding its hand for some years before taking any decisive steps for licensing and extending the use of the electric light because it has no doubt given time for experiments to greatly improve the science and to secure for the public, now that they are beginnin to make use of it, a very much better article in the way of electric light than they would have done had they rushed blindly into it eight or ten years ago The Board of Trade has another connection with electrical engineering—with respect to electricity as a motive force. The recent opening of the new subterranean railway in South London has given us all an opportunity of testing, by actual experience, how this most interesting experiment will work, and it will be the special duty of the Board of Trade to keep its eyes open, to study the working of the new system, and report upon it in an independent way, which will enable the public generally to judge for themselves how far that experiment may be imitated elsewhere. Then the Admiralty has its relations with electrical engineering, because day by day it is becoming more and more necessary to have recourse to electricity in handling those great monsters of the deep, which are the fighting ships of our day, and are so ponderous and unwieldy, that ordinary skill might be powerless to handle them. The War Office, too, as you know, is also dependent on electrical engineering, for no man nowadays could take the field for a campaign unless he had obtained the best means for the supply of information, both from the front to headquarters and from headquarters to the front. Therefore you will see all those departments of the state are separately very much beholden to the electrical engineers. It is almost impossible, in dealing with the operations of a body like this, to over-estimate the enormous changes which through your instrumentality are affecting our daily life. I am not going to say, as I believe some enthusiasts say, that you have actually annihilated time and space, but you have so far modified time and space that it is impossible for those who live in this day to attach to those words anything like the sense in which they were used in the preceding generation."

Electrical Department of the World's Fair.

By Exposition.

The committee on electricity of the World's Columbian Exposition is now considering the question, it is reported, whether it is advisable to organize the electrical department at once, or to defer the organization for at least a year. The matter assuredly is one which concerns every electrical worker in the country. Unless the writer is greatly mistaken, the fraternity at large is greatly interested in the electrical section of the World's Fair, and hopes to see it truly representative of the great advancement achieved within the last few years. To be representative it must comprehend not only exhibits showing what has been accomplished in America, but displays illustrating the work of foreign nations. The foreign exhibit should not be made on a small scale; it should include comprehensive displays from a large number of countries.

An extraordinary amount of preliminary work is a condition precedent to a successful exhibit partaking of an international character. This preparatory labor will require a deal of patience and a deal of time. Foreign manufacturers are not going to tumble over each other in their anxiety to make electrical exhibits. They naturally are conservative, and if they once possessed any enthusiasm on the subject, their ardor was somewhat dampened by European discussion of the McKinley bill.

As we said, they are conservative, and in addition they are indifferent. An incident will perhaps emphasize the fact. An officer in one of the largest of European electrical concerns—no confidence is betrayed when it is stated that the company was the Allgemeine Electricitæts Gesellschaft of Berlin—was asked by the writer if his company proposed to be represented at the fair. He said he did not know, but his manner suggested the most profound and startling indifference to the World's Fair and the electrical department. He said his company would make an extensive exhibit at the electrical exposition at Frankfort-on-the-Main, but as for Chicago, he knew nothing about its fair, and he cared less. This was an expression of opinion from a foreigner who had visited this country several times, could speak its language and, what is still more important, he had quite a large sum of money invested in electrical industries in the United States.

If he was indifferent to such an extent his brethren are probably not over-enthusiastic. The English and French manufacturers and inventors are more favorably disposed toward the fair, but their interest is not extraordinarily intense.

To overcome this indifference among foreign manufacturers will require time. To induce them to make comprehensive exhibits will take all the time that the officers of the electrical department can find. It is assumed that it will require no effort to excite the proper degree of interest among electrical workers at home, but the task of prodding them should not be delayed too long.

If there were no other reasons than those which we have thus briefly alluded to, they would be sufficient, it is thought, to indicate that the electrical department should be organized as soon as practicable. But there are additional reasons. The writer has held to the belief from the outset that the electrical department is to be one of the greatest attractions at the fair. The magnitude of the department, it is thought, has not been sufficiently emphasized. If it is what it should be, it will require more space than any one has yet conceived to be necessary. The directors in a general sort of a way have counted upon a large display, but the writer, at least, thinks they have not begun to appreciate the countless number of special exhibits for which room will be demanded. As time passes propositions for novel electrical features will begin to pour in. They will have to be passed upon; some will be worthy of adoption; others will be valueless or worse.

Ideas of this kind, it seem, point to the correctness of the view that the department should

be organized in the near future. By organization, it is not meant that a new salary list should be recommended to the authorities of the fair. If that were the proposition it would not be worth pressing it; the officials would reject it off-hand. We do think that the appointment of an electrician-in-chief or whatever officer is to be at the head of the section should be made at once. His salary could commence whenever his services were actually required, a year hence perhaps. Headquarters could be located and put in charge of a clerk. The preliminary work could then be commenced. We doubt not that the electrician-in-chief would be willing to give to the department a general oversight, taking his pay at first in honor. A beginning would thus be effected. It would grow from this modest commencement until it assumed such proportions that the office force would be increased until finally the head of the department would be required to devote his entire attention to it. The main point is to make a beginning; to arrange for a headquarters from which printed matter may be issued, and to which inquiries may be directed.

The suggestion may be exceedingly indefinite; but if we have made clear the idea that immediate action should be taken our purpose is served. We shall not quarrel about any details for making a start. The suggestion of a mode of making a beginning which we have outlined, may be entirely impracticable as i is made off hand, but if so a substitute could be found, we think, which would accomplish the same result. By all means make a start at once.

Fishing by Electric Light.

A San Francisco *Chronicle* reporter recently saw some twenty men, women and boys sitting about a square mass of piling bordering an open surface of water, which was brilliantly lighted by a neighboring electric light, fishing. They rapidly pulled up their nets – for hooks were not used—each filled with from six to a dozen fish. Fish could be seen leaping frequently from the water.

During the daytime, according to the newspaper, the place is deserted by fish. At night, the brightness of the electric light attracts the finny wanderers. They gather in such numbers that to catch them with baited hooks would be tiresome. For this reason the crowds that gather there nightly, fashion nets out of hoops and draw the strings close together. No bait is used, and the fish entangle themselves in the net by the dozen.

Proposed London Subway.

Considerable interest is taken in London in a bill introduced in Parliament authorizing the construction in London of a subway in which all underground pipes and electric cables should be laid. In view of New York's experience with subway construction the English electrical press is discussing the proposition at length. The London *Electrical Review* in a leader, says:

Fortunately, with the exception of the Strand, along which probably more traffic is carried daily than on any other thoroughfare in the world London streets are tolerably free from confusion of underground pipes. Nevertheless, considerable difficulties have arisen in many other streets, owing to the lack of sufficient space to lay electric light conduits either at a sufficient depth, or in the most convenient spot desired by the companies. The proposed bill would, if it passed through both Houses, provide for the construction of a subway which would contain all the systems of pipes and conduits—an ideal of perfection, according to the promoters. There are, however, many difficulties in the way of bringing such a scheme to a successful issue. In the first place, the cost of making the subway would entail an enormous expense—probably several millions sterling—and who would pay the piper? The money could hardly be raised on loan by the London County Council, for, if so, the companies interested would, on the completion of the work, be called upon to pay a rental for utilizing the subway, and this would amount to a not inconsiderable item in the cost of production, which, correctly defined, is that sum which remains after *all expenses* have been deducted. Provided that the County Council did not raise the money, an attempt might be made to get a clause inserted in the bill to compel the gas, water and electric light companies themselves to construct the subway, since it would be built for their convenience—oh, no —for their use. That such a clause could be passed seems incredible. The companies are already strongly represented in Parliament indirectly, and with the assistance of other members, it is fair to assume that such an objectionable clause would be rejected.

The proposed subway would during the course of construction not only cause considerable interruption in the supply of water, gas and electric light, thus entailing great loss to the companies, but it would also necessitate the reorganization of the three systems of distribution, another item of great expense. Again, if a subway is to be made the question arises as to the kind of subway to be constructed but this need not be referred to in detail. Suffice it to say, that if a subway is to be built, the gas, water and electric light mains must not be placed in after the haphazard style adopted in Paris or in New York. The ideal subway appears to be one arranged in divisions, each being distinct from one another, and each being water and air tight.

Electrical Department of the World's Fair.

The National Commission of the World's Columbian Exposition has approved the report of the committee on classification. This committee has decided to assign everything pertaining to the electrical display to "Department J." The devices exhibited will be classified and arranged in sixteen groups. The report designates the heads under which these exhibits are to be classed and the subdivisions into which they shall be arranged. Here is the extract from the report giving the classification of electrical exhibits:

DEPARTMENT J.—ELECTRICITY.

GROUP 116, APPARATUS TO ILLUSTRATE THE PHENOMENA AND LAWS OF ELECTRICITY AND MAGNETISM.

Class 703.—Statical electricity.
Class 704.—Dynamical electricity.
Class 705.—Thermal electricity.
Class 706.—Magnetic electricity.
Class 707.—Magnets, temporary and permanent.
Class 708.—Direct and induction coils.
Class 709.—Galvanometers.

GROUP 117, THERMO ELECTRIC BATTERIES.

GROUP 118, ELECTRIC BATTERIES; SECONDARY OR STORAGE BATTERIES.

GROUP 119, MACHINES AND APPLIANCES FOR PRODUCING ELECTRICAL CURRENTS BY MECHANICAL POWER—DYNAMOS.

Class 710.—Dynamos of direct current.
Class 711.—Dynamos of alternating current.
Class 712.—High and low voltage.
Class 713.—Commutators.

GROUP 120, TRANSMISSION AND REGULATION OF THE ELECTRICAL CURRENT.

Class 714.—Cables, wires and insulators; rheostats, switches, ammeters, resistance boxes, indicators and meters, voltmeters, hydrometers and converters.
Class 715.—Safety and protective appliances, arresters, etc.
Class 716.—Lightning rods and ornaments, insulators, rods, cables and "grounds."

GROUP 121, ELECTRIC MOTORS AND THEIR APPLICATIONS.

Class 717.—Movement of machinery in various industrial operations.
Class 718.—Pumping and hoisting from mines.
Class 719.—Propulsion of railway cars, street railway cars, mining cars, propellers, etc.

GROUP 122, LIGHTING BY ELECTRICITY.

Class 720.—The arc system and its fixtures, appliances, etc.
Class 721.—The incandescent system, its fixtures, lamps and appliances.

GROUP 123, HEATING BY ELECTRICITY.

Class 722.—For warming and heating apartments.
Class 723.—For heating flat-irons and other objects in industrial operations.
Class 724.—Maintenance of constant high temperature in small ovens, etc.

GROUP 124 ELECTRO-METALLURGY AND ELECTRO-CHEMISTRY.

Class 725 —Electrotyping.
Class 726.—Electro plating, gilding and nickeling.
Class 727.—Electric deposition of iron and other metals.
Class 728.—Electric deposition of metals as a means of extracting them from their ores or alloys.
Class 729 —Electric furnaces.

GROUP 125, ELECTRIC FORGING, WELDING, SHAPING, TEMPERING, BRAZING, ETC.

Class 730.—Apparatus and methods or forging, bending, twisting, making angles or straightening metals and metal work.
Class 731.—Apparatus and methods of welding and joining iron, steel and other metals.
Class 732.—Brazing, soldering, tempering, etc.

GROUP 126, ELECTRIC TELEGRAPH AND ELECTRIC SIGNALS.

Class 733 —Various systems of transmitting and recording.
Class 734 —Electric chronographs.
Class 735.—Annunciators.
Class 736.—Burglar alarms.

GROUP 127, THE TELEPHONE AND ITS APPLIANCES.

Class 737.—Cables; construction; underground work.
Class 738.—Protection of strong current apparatus.
Class 739 —Switch-boards.
Class 740.—Transmitting apparatus.
Class 741.—Receiving apparatus.
Class 742.—Signaling apparatus.
Class 743.—Subscriber's apparatus; numbers, code, registers, etc.

GROUP 128, THE PHONOGRAPH.

Class 744.—Receiving and recording apparatus.
Class 745.—Apparatus for the reproduction of recorded sounds and articulate speech.

GROUP 129, ELECTRICITY IN SURGERY AND THERAPEUTICS.

Class 746.—Electric cauteries and apparatus.
Class 747.—Apparatus for application of the electric current as a remedial agent.
Class 748.—Apparatus for the destruction of life.

GROUP 130, APPLICATIONS OF ELECTRICITY IN VARIOUS WAYS NOT BEFORE SPECIFIED.

Class 749.—Ignition of explosives; gas lighting, etc.
Class 750.—Control of heating apparatus by electricity, as applied to steam and hot-air pipes and registers.
Class 751.—Electric pens.
Class 752.—Application in photography.

GROUP 131, HISTORY AND STATISTICS OF ELECTRICAL INVENTION.

Class 753.—Objects illustrating the development of the knowledge of electricity and of the application of electricity in the arts.
Class 754 —Collections of books and publications upon electricity and its application.

A glance at this list of uses to which electricity may be applied to advantage cannot fail to impress one with the magnitude and importance of the wonderful agent now so generally employed. This report, however, contains the briefest possible summary of the electrical exhibits, and it is highly probable that the plans now maturing will, when presented to the public, give a more complete idea of the extent of this display. There is no question that with good management the electrical department can be made permanently the greatest attraction at the exposition, as it rightfully should be. It must be admitted, however, that thus far neither the national commission nor the local directors seem to have thoroughly grasped the situation; at any rate they have failed to give any sign of a realization of the true importance of this department of the Fair.

Science and Art of Inventing.

The New York Electrical society held its 134th meeting on the 10th inst., when Edward P. Thompson lectured on, "How to Make Great Inventions: or the Science and Art of Inventing."

Premising that to succeed in anything a man must have a love for it, the lecturer opened his remarks by a description of the principles by which the would-be inventor must be guided, and said that any given individual takes a step toward becoming or improving himself as an inventor who studies the need of the public; learns the difficulties connected with that department of art or industry in which the need exists; excites his mind with the belief that he can provide means to remove the difficulties; and proceeds with diligence toward the solution of the problem. Glancing briefly at some of the electrical problems which yet remain unsolved, Mr. Thompson referred to alternating current motors, and stated that as there is no motor known which can be operated commercially on a large scale by the alternating current, a system of electric power cannot be combined with a system of alternating current lighting. The difficulty with the motors for alternating currents that had been brought out had been their low efficiency, so they were principally applicable to the driving of small ventilating fans, and such minor applications. The work done, however, during the past few years by such men as Prof. Elihu Thomson, Nikola Tesla, Ludwig Gulmann, Lieut. F. Jarvis Patten, Chas. J. Van Depoele, and Prof. W. A. Anthony, with his two colleagues, Messrs. Jackson and Ryan, has resulted in the discovery of valuable principles, which are pregnant with promise of further developments.

The storage of electrical energy was referred to as another field full of fascination to the inventor, and rich in the rewards it holds out for the solution of its difficulties. One more improvement equal in magnitude to that of Faure over Plante would make the storage system a grand success. Mr. Thompson then showed the possibilities in the economic conversion of electricity into heat for domestic purposes, the artificial light of the future, as set forth recently by Prof. Nichols, color photography, storage of the forces of nature, transmission of signatures, conversion of heat into electricity, electric transmission of mails, the generation of electricity, the prevention of sparking, and the measurement of electric currents, and he made suggestions as to the lines which afforded the greatest promise of success in grappling with some of these problems.

The lecturer then treated of the two classes of invention, the generic and the specific, giving as an illustration of the former the arc lamp. Before its invention the principle that momentary light is produced by interrupting an electric current was known. The invention effected an artificial permanent light by applying this principle. By experiment he found that the light or spark gradually consumed the electrodes, and by providing means for forcing the electrodes together according to the rate of their con-

sumption, he produced one of the most useful inventions of the day.

A generic invention may be made by applying one or combining two or more principles of physical, electrical or chemical science to a new and useful purpose. The corollary to this is: Any given problem of generic invention may be solved by becoming acquainted with the principles of physics, electricity and chemistry, and then searching for principles which by their combination will produce the result sought. Both these principles prove the advantage and almost the necessity of thorough scientific education for the inventor, and lead to the inevitable inference that it would be for the good of the industrial arts and the public if in our various scientific colleges were established a class for the development of the power of inventing. At present students study science and store it away in their brains as though the storage was to be permanent. By the time they undertake to use the knowledge, they have forgotten most of it.

It is easy to realize what enormous benefit would accrue to the student if he were encouraged and assisted in a systematic application of the principles he is daily imbibing. If the invention emanating from such a system proves to be old, the exercise is none the less valuable. It will be original, even if not novel, and will thus serve to train the inventive faculty and assist in forever fixing the principle in the mind. Suppose, for instance, the exercise embraced the practical utilization of the electrical principle that selenium is a conductor of electricity when exposed to light, and a non-conductor of electricity when in the dark. One student might propose to solve the problem of rising with the sun He would have an electric bell in circuit with an electric battery, and a piece of selenium, which would hang in the window. No current would pass in the night because the selenium is in the dark, but it would pass and ring the bell when exposed to the light of the rising sun. Another student might suggest the wonderful invention of Elisha Gray, who employed this principle for transmitting sound. Still another student might propose to make a meter for measuring the amount of energy consumed by an incandescent lamp during each month by placing the selenium near the lamp. While the lamp was burning away a local and small current would flow and operate clockwork, when the lamp was out, the clockwork would stop; or the current while flowing could operate any suitable meter. Such a discipline as this would be manifestly of the highest value.

Among the rules based on the principles reviewed by the lecturer are the following: "As soon as anyone, either by investigation, alone, or with the assistance of a chemist or physicist, or as soon as a scientist or any individual announces a scientific fact or principle not known before; embrace the opportunity of being the first to to apply the fact or principle to a useful purpose. In reading periodicals or scientific papers; have this rule of invention in view. Look out for the results of scientific investigation, not as a student who simply reads for the acquisition of knowledge, nor as a critic, nor as a pastime, but for the single and concentrated purpose of being the pioneer in the application." The man who would be a successful inventor, too, cannot afford to despise such things as membership in an electrical society, a subscription to a scientific paper, and a careful periodical study of the "Patent Gazette." Mr. Thompson gave additional clearness and force to many of his points by abundant illustrations, selected with singular felicity from the lives of famous inventors. The lecture was exhaustive and well digested. and it more than fulfiled the promise of its title; the ability to invent was shown to depend not so much on the so called genius as a careful acquisition of guiding principles and materials, and their systematic application under the direction of patient thought and active intelligence.

A lively discussion followed, in which Dr. Crocker, W. J. Hammer, Francis Forbes, Dr. Otto A. Moses and others took part.

CORRESPONDENCE.

New York Notes.

NEW YORK, December 13.—The indifference of the Board of Electrical Control toward the settlement of the subway dispute on which hinges the electric lighting of the streets, is becoming more and more evident. Complications are arising and the greatest dissatisfaction is expressed at the latest developments in the subway matter. The action of the Gas Commission in rejecting all the bids of the electric lighting companies was followed the next day by a meeting of the Board of Electrical Control which was attended by high officials of the electric lighting companies. The discussion of the question of turning over the control of low tension subways to the new company, known as the Empire City Subway company, was of unusual interest. It is said that an agreement had been made previous to the meeting of the board by which a resolution was to be introduced authorizing the Consolidated Telegraph & Electrical Subway company to sub let part of its work to the Empire City company. At the mention of this resolution, the representatives of the electric light companies made objections on the ground that such an arrangement would favor the Edison company at the expense of all the other companies.

The representatives of the electric light companies had already had a conference following the action of the Gas Commission, and were prepared to meet the mayor at the time he might call the meeting of the board. The objections of the Gas Commission, viz., that the bids were much higher than last year's were agreed to be met fairly. The high rental of the subways had caused the advance of 2 to 3 cents a lamp to be asked by the electric companies and on this account it was agreed to reduce the bids in proportion, if the city would agree to reduce the rental of the subways. The electric companies figure that the subway ducts cost $3,350 per mile while the rental charged is $1,000 per mile, or one cent an hour for every light, while the cost of running wires underground is 20 per cent. more than it cost to maintain them overhead.

With this agreement in mind, the representatives of the electric companies attended the meeting. The result was that a resolution was offered by Commissioner Hess providing that the rentals to be paid to the subway companies by the electric light companies be fixed at $700, $800 and $900, for each mile of duct for 2, 2½, and 3 inch tube respectively. The resolution was adopted. President Lauterbach, of the Consolidated company, said that his company would contest the decision of the board in fixing the rentals, as he claimed they were entirely too low.

During the discussion in regard to sub letting to the Empire City company, an injunction was served on the mayor, restraining the board from modifying the existing contracts with the Consolidated Subway company and from conveying or transferring any of the subways to the Empire company. It is supposed that the Manhattan Electric Light company obtained the injunction. The meeting was brought to a close by the remark of the mayor, "Now the whole thing can be taken into court together."

At a meeting of the Commissioners of the Niagara Falls Reservation, it was voted to ask the Legislature for an appropriation of $25,000, to continue the maintenance of the reservation, to build new roads and to light the park. The question of electric lighting came up and was generally approved, although no decision was reached. At the next meeting of the commissioners something definite is expected to be done.

The resentencing of Jugiro to be executed by electricity during the week commencing January 19 in consequence of the decision of the Supreme Court of the United States, is now followed by an application to the Court of Oyer and Terminer asking that a commission be appointed to determine the mental condition of Jugiro. The suggestion of possible insanity of the prisoner came from a letter from Warden Brush to the Japanese Consul General in which he says: "For the last three weeks Jugiro has been sullen, refusing to eat and in fact taking very little nourishment at all. As we have no one who can talk to him, I should be much pleased if you yourself or some one representing your office would visit him."

The regular monthly meeting of the Electric club will be held Thursday evening, December 18. Prof. Francis B. Crocker, of Columbia College, will lecture on "Electrical Units of the Present and Future."

The fifty-second meeting of the American Institute of Electrical Engineers will be held next Tuesday evening at which A. E. Kennelly will read a note on "Inductance and its Proposed Unit, the Henry." Emile Berliner will exhibit for the first time in New York, the perfected gramophone of which he is the inventor. The experiment of "etching sound" will be made.

The Western Union directors, acting on the recommendation of the executive committee, have declared the regular quarterly dividend of 1¼ per cent. A year ago the directors declared an extra dividend of ¾ per cent. which is omitted this year. After paying the regular dividend there will be a surplus from the earnings of the current quarter of $680,000. One of the directors says it is conceded that the company made a mistake in not declaring dividends of 1½ per cent. quarterly instead of declaring an extra dividend last year, and that later on they will rectify this mistake, and make the quarterly dividends 1½ per cent.

W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Dec. 13.—Henry Villard has been in the Twin cities since Wednesday. His visit is of interest to electricians, because of his connection with the Minneapolis Edison Light & Power company and of his partial ownership of the electrical equipment of the Minneapolis & St. Paul street railway systems. When Mr. Villard was here earlier in the year there was some negotiation in regard to the project of damming the Mississippi river at Meeker Island, between the two cities, where a fine undeveloped water power exists, with the purpose of establishing a plant for generating electricity. At that time the Edison Light & Power company acquired property and franchises there, and it looked much as if the enterprise would be initiated. Later it was said to have been abandoned. In regard to their intentions in this direction Mr Villard said yesterday: "The Meeker Island project has been abandoned, and my operations in the electrical field here depend upon the result of a conference I shall have with the Edison company of this city, which has privileges of exploiting electricity in that territory." Some interesting results are expected to accrue from this meeting of the Edison company, and they are not unlikely to be in the direction of the development of local water power for electrical purposes.

Through service was instituted Monday on the inter-urban electric railway between Minneapolis and St. Paul, the fare being 10 cents with transfer privileges to all lines in each city. A promiscuous assortment of motors drawn from lines in both cities were utilized, and will be used until the regular motors are received. The first day's business on the line was marvelous. Thousands of people packed the motors all day long, and the temporary service was found to be entirely inadequate to the demand. The full extent of the revolution in interurban travel to be accomplished by this innovation can scarcely be computed. Until Monday the Great Northern and Chicago, Milwaukee & St. Paul railways held the monopoly of this travel. They have given the public a good but expensive service. They have held the fare at 30 cents for single trips and 50 cents for round trips, alternating their trains every half hour during the day and evening. There has already been a marked decrease in their passenger business, which will be much greater when the electrical line is equipped as it is intended. The electrical trains now consume an hour in the trip, but will reduce this to forty-five minutes under the regular schedule. The railways cannot hope to compete in the cheapness of fares, and will unquestionably have to look to local or suburban patronage for their profits. Already there are many rumors of change in their arrangements, one being that only hourly trains will be run and another that round trip fares will be reduced to 25 cents. No matter what they do it seems to be foreordained that they will drop into secondary importance as a means of communication between the two cities.

The public at large expects much benefit in the way of development to inter-urban interests and in re-establishing harmonious business relations between the belligerent twins, from the new electrical railway. Mr. Lowry is especially sanguine on this subject. Cheap and rapid transportation can scarcely fail to concentrate many new enterprises and build many prosperous suburbs between the cities, and local prejudices will hardly be able to cope with these advantages. The street railway company also has in view one or two more inter-urban lines which will probably be built as soon as the first one is successfully established. These will also contribute much in the same direction.

The 1,200-horse power Corliss engine recently received for the main power house at St. Paul is now set up and will be doing service within a few days. Two more engines of the same capacity are being built at Milwaukee and will be in position by February 1. In St. Paul the large copper conduit wires are now laid under Third street to Wabasha. The remaining conduits contemplated will run under Wabasha to University avenue, and thence to the Minnesota transfer; under Fifth street to Broadway and under Broadway to Thirteenth street; under Tenth to Broadway and Lafayette, and thence under all the streets of the Lafayette line; and under West Seventh street to Lee avenue.

The injunction suit of John Gluck against the Minneapolis Street Railway company, was continued by stipulation until January 10. The residents on Hennepin boulevard are preparing to contest the construction of any street car line on that thoroughfare to the bitter end.

The Robinson & Moan Car company is the defendant in a number of attachment suits brought by local lumbermen. This company is not now engaged in business having been succeeded by the Northern Car company several months ago. At the date of the succession, the old company had on hand several contracts for electrical cars which were turned over to the Northern company. Robinson & Moan failed to furnish the material as stipulated and the Northern company refused longer to displace its own work on account of the delay. This precipitated the attachments. Robinson & Moan are believed to be solvent, and the Northern Car company is unquestionably so.

There are now sixteen independent electric lines in operation in Minneapolis. None of the remaining lines will be completed this year.

C. D. Brown has procured from the patent office a caveat securing to him a patent on an appliance for cutting off the electric current on wires as soon as a break occurs. The usefulness of such an invention, if successful, can readily be seen. The street railway company will test the attachment and use it if it is successful.

Louis Schultz, a local electrician, died at the Family hotel of pneumonia Tuesday.

The superintendent of the government building in this

city has announced that that structure is to be lighted by electricity. The plant will be put in by the government.

The Minneapolis Union depot will shortly be equipped with an arc and incandescent lighting plant, which it has long needed.

The Minneapolis Gas Light company announces that it will make a 20 per cent. reduction in the price of gas, beginning Jan. 1, 1891.

The city council of Stevens Point, Wis., proposes to go ahead with its municipal lighting scheme, notwithstanding the protests of citizens. Several companies have entered the competition for the contract, which provides for the establishment of a plant for 40 arc lights of 2,000 standard candle power.

The plans of the Eau Claire Light & Power company have been somewhat changed by the disastrous fire of December 1, by which they lost their complete plant valued at $20,000. It was their intention to build this winter and in the spring an electric extension to their street car system to Chippewa Falls, which is about ten miles distant. They had already procured the co operation of Chippewa Falls citizens. The reconstruction of their plant will probably delay this project, but it will undoubtedly be consummated within the year. Eight new cars have been ordered of a New York company. N. O. F.

Milwaukee, Wis.

MILWAUKEE, Dec. 13.—The legal fight between the Milwaukee & Whitefish Bay Railway company, of which Charles F. Pfister of Milwaukee is president, and the Villard street railway interests, resulted in a victory for the home concern. The dispute, it will be remembered, involved the right of way on certain streets, running parallel to the Villard syndicate's East Side line. The Pfister company, not many months ago, secured a franchise which gave it the right to build a street railway on the streets referred to, and proceeded to take steps to construct an electric line. The Villard company produced an old franchise which everybody had either forgotten or had supposed forfeited. It covered a portion of the streets claimed by the rival company, and it was sought to prevent the building of the proposed line.

Injunctions followed on both roads and considerable delay resulted. Judge Johnson of the Circuit Court, finally rendered a decision in what had been agreed upon as a test case. He held that the common council had no right under the state constitution to grant exclusive street railway franchises, but he decided that the franchise under which the Villard company claimed the disputed right of way had been forfeited. The court even went so far as to question the validity of the assignment of the franchise to the present Cream City Railway company.

It appears that when the old Cream City Railroad company sold out, the franchise was not included in the deed given to O. E. Britt, the representative of the Pittsburg people, who bought the road at that time. He nevertheless attempted to transfer the franchise to the Cream City Railway company, the name of which was not changed when Villard bought out the Pittsburg people. The Villard people have appealed from Judge Johnson's decision to the Supreme Court.

Mr. Pfister and his associates, believing that the appeal will result favorably to them, will probably award contracts for electric street railway lines on the East and South Sides during the present winter.

Within the next thirty days all the Villard interests in Milwaukee will be consolidated. These interests include the Cream City Railway and Milwaukee City railroad, the two largest street car systems in the city; the Badger Illuminating company, and the Edison Electric Light company. The common council has already consented to the consolidation of the two electric light companies, and the statement that the two street railways will be put into the same company is authoritative. As soon as the new company is organized, there will be steps taken to issue consolidated bonds to the extent of perhaps $5,000,000, the proceeds from the sale of the bonds will be used to transform the street car lines into electric systems and for other purposes. It is said that something like $2,000,000 will be required to put in electric systems on the Villard lines.

Henry Villard himself was in Milwaukee a few days ago. In company with David S. Wegg of Chicago, he consulted with Henry C. Payne and Edward G. Wall, his representatives here, and examined his properties. He pronounced the Edison electric light plant, which he is building on River street, the largest plant of its kind on the American continent. It is stated by Villard's representatives in Milwaukee that the recent shake-up in the financial world will not interfere with the Villard enterprises here.

The time originally fixed by the common council for equipping the Villard street railways with electricity has nearly expired and the work has not even commenced yet. Henry C. Payne states that the failure of the overhead system to give satisfaction is the cause of the delay. His people, he states, are waiting for Edison to perfect his storage battery car. Mr. Payne says that Edison is hard at work and that his new invention is liable to accomplish wonders. There is little hope of the Villard lines becoming electric systems much before the end of 1891.

John S. Schantz of Milwaukee, has begun suit against John A. Hinsey and S. S. Badger to recover something like $15,000, which he claims to be due him for selling the Badger Illuminating company's plant and business to Villard. He avers that the plan was his, that he secured an option from the defendants and conducted the negotiations with Villard, going to New York for the purpose, but at the last moment the defendants themselves stepped in and froze him out.

Milwaukee's electric cars acquitted themselves quite creditably during the first heavy storm of the season. There was some delay in climbing hills, but otherwise the snow caused little trouble.

The Badger Illuminating company has entered upon a contract to supply the city with electric lights for the period of three years at the rate of $112.50 per lamp per year. The Badger Illuminating company's bid was 30 cents per lamp lower than that of the Milwaukee Light & Power company, which proposed to supply only a part of the city, but a strong effort was made to have new bids called for, and for a time it looked as though the movement would be successful. But the old contract expired on December 1, and the city had the alternative of trying to secure lower bids and being in darkness for a while or accepting the Badger Illuminating company's bid, which is $37.50 per lamp lower than the old contract price.

Among people who are interested in such matters, a great deal of speculation has been caused by the announcement of the approaching consolidation of the Villard electric interests in Milwaukee. The situation is certainly a peculiar one. Henry C. Payne who looks after the street railway department, is chairman of the Republican State Central Committee, Edward C. Wall, who looks after the Villard arc light business, is chairman of the Democratic State Central Committee. Were the Villard street railways to be put into one company, and the electric light business into another, there would probably be no change relative or otherwise, in the positions of these gentlemen. But the statement having been authoritatively made that one company is to include both the railway and electric light plants, there is more than a likelihood that the relative positions of Messrs. Wall and Payne will be altered. Payne, it is thought, will be made president of the company. The Villard people, however, will be anxious to retain the valuable services of Mr. Wall, and will undoubtedly offer him the management of the electric light business. But his acquaintances consider that Chairman Wall of the Democratic State Central Committee, will have some scruples about becoming the subordinate of Chairman Payne, of the Republican State Central Committee. Mr. Wall, himself, says that Villard may not want him at all, and if he is wanted, he may not care to stay.

Five large dynamos have just been added to the Badger plant. Although the Villard interests are to be consolidated, the Badger or arc light plant will remain in its present location. The new Edison plant on River street will furnish incandescent light to the public and provide power for the Villard street car lines when they are equipped with electricity. C.

Wichita, Kan.

WICHITA, Dec. 5.—The Electric Railway company has suffered heavily from the operations of thieves, who have taken everything they could find. Railway ties and trolley wires were carted away in large quantities. The company has received the steam pipe which has caused so much delay. It is now being put into position and steam power will be ready to use soon. The new dynamos for the power station have arrived and the electric machinery is about ready. The two new dynamos will furnish the power for the plant until the Riverside dynamo and the one stationed at the plow works are removed to the central station, where the four will be ready for service on any emergency. The company will be ready to utilize the Douglas avenue bridge across Chisholm creek as soon as it is completed. It is supposed the construction of the bridge will interfere with the College Hill service to some extent, provided there is any service that far east before work is commenced on the bridges.

J O. Davidson, president of the Citizens' bank, during his trip East disposed of $250,000 of the electric railway bonds, which makes the total bonded indebtedness of the company $300,000. This is not as much by $50,000 as was originally intended to issue, but owing to the fact that the construction of the line cost a little less than at first estimated, it was not necessary to increase the indebtedness to that amount. The company is going ahead with the work as rapidly as possible, and the entire system will be completed.

Davenport, Ia.

DAVENPORT, Dec. 13.—The question of city lighting was thoroughly discussed and it is hoped finally disposed of by the city council at its special meeting yesterday afternoon. Several companies had sought the contract and competition was exceedingly sharp. The proceedings of the meeting were watched with interest by the business men of the city. The report of the committee on light, providing that the contract be awarded to the Electric Illuminating company of Chicago, was adopted after considerable discussion. The Electric Illuminating company agrees to furnish 175 2,000 candle power arc lamps for $75 a year and 200 incandescent lamps at $20 per year. It is provided that the company shall place a bond of $10,000 with the city to insure the faithful performance of the contract. A feature of the proceedings is the agreement by the company not to transfer its contract to any other company. In order to insure the execution of this provision of the contract it is agreed that the company shall forfeit $5,000 if it violates this provision.

The Electric Illuminating company has agreed to install the Hawkeye Electric company's apparatus for its incandescent lighting. O.

Kansas City, Mo.

KANSAS CITY, Mo, Dec. 13.—Plans for a combined waterworks and electric light plant to cost $45,000, have just been drawn by the Western Engineering company for Columbia, Boone county, Mo. The bonds for the improvement were recently voted by Columbia, and the work of construction will soon be begun.

It is highly probable that Kansas City, Kan., will be without a fire alarm system as long as the present mayor continues in office. Mayor Coy declares that a fire alarm system is a luxury that the city cannot afford to pay for at the present time, and he avers that he will veto any ordinance providing for the establishment of such a system.

Just before midnight Tuesday night an accident occurred at the Consolidated Electric Light & Power company's plant on Fifth avenue near Riverview in Kansas, City, Kan. The large pulley that operates the Westinghouse alternating dynamo while making 1,650 revolutions per minute, became demoralized. The rim and six arms of the wheel flew into a thousand pieces, besides tearing things up in general. A large piece tore a hole in the roof. By half-past one o'clock the machinery was adjusted and all the lights in the city which had been extinguished were in operation again.

The fact that Kansas City, Mo., is without an electric fire alarm system is given by the insurance companies as one of the reasons why certain classes of fire insurance risks are higher in this city than in any other large city in the country. It is well known to the officials of the leading insurance companies of the country that the fire department is dependent for information in regard to fire after nine or ten o'clock at night upon less than fifty widely scattered telephones, a majority of which are in private residences and in drugstores and saloons and livery stables and are not always accessible.

In speaking of the fire department, Mr. Cannon, president of the board of public works said:

"I think it is quite necessary that the fire department should have an electrical signal system, especially since the money with which to purchase it is now in the city treasury. A fire alarm signal system in this city will deprive the insurance companies, through the board of underwriters, of one of their excuses for making fire insurance rates higher in this city than in any other cities. I favor establishing it for that reason." P.

Concord, N. H.

CONCORD, Dec. 13.—The Concord Electric & Gas Lighting company has nearly completed its new central station. It is a commodious, one story brick building, with the tallest chimney in the city. It will be furnished with a modern steam plant of about 300-horse power, and the electrical equipment will be largely Thomson-Houston make. The Consolidated Electric company of Boston will build at the station a large slate switch-board for the seven or eight generators.

A Thomson-Houston arc lamp was recently taken down in this station which had not been removed from the hangers for nearly five years, although in constant use for the entire time.

The Concord Electric Street Railway company is operating its road which was equipped by the Thomson Houston

Electric company. It has seven miles of track, and at present five motor cars, which number will be largely increased another season. The Thomson-Houston company has been operating the road for twenty days, and it starts with flattering prospects. Already a large increase in patronage is reported, the cars are unusually large and of the vestibule style. They are warmed and are elegantly finished and furnished.

It is to be expected that the heavy New Hampshire snow storms will bother the company as they did the steam dummies which were in use one winter ago.

There are four or five isolated incandescent plants in this city, and the Republican Press association has just completed an installation of one of the Standard Electric company's Little Giant 110 dynamos of 300 lamps' capacity.

A. B. C.

Pittsburg, Pa.

PITTSBURG, Dec. 13.—The Hon. John S. Wise of the Edison Electric company, was a visitor in Pittsburg a few days ago. The purpose of his visit was the settlement of financial business with the Pleasant Valley Electric Street Railway company of Allegheny City.

Owing to the inclement weather during the last week or so the active operation of the Duquesne Traction company's lines will be again postponed. The company received twenty-two additional cars yesterday, which were immediately taken to the car shed for equipment with electric motors. The management hopes to have the first car running by the beginning of the new year.

The Wheeling, W. Va., Electric company, which sometime since sold the property on which its plant is located to a syndicate of adjoining and contiguous property owners, who were annoyed by the vibration caused by the operation of the plant, and which could be felt for two squares, has its new plant almost ready for occupancy. The company furnishes arc and incandescent currents, and the power current for a fifteen mile street railway. The engineers who were intrusted with the construction of the plant have made every effort to overcome the vibration which caused so much annoyance at the old plant, and which compelled its removal. The floor of the dynamo room is to be practically one immense foundation. First will be laid a concrete bed, thirty inches thick, and on top of that a brick foundation of hard burned brick laid in Portland cement, with the most perfect bands and every joint flushed with cement. Each machine will have, in one sense, a brick foundation, but all of them will be joined together in one immense block.

The Pittsburg authorities are again considering some advisable method of getting the overhead electric wires out of sight. This last agitation against the "dangerous" wires was caused by a fire on Penn avenue, this city, where two people were burned to death. At the coroner's inquest it was stated that the electric wires in the front of the building had greatly obstructed the efforts of the fire department in overcoming the flames, and hence the coroners' jury recommended the enactment of such laws and the enforcement thereof, which would lead to the abolition of the overhead wires altogether.

Some idea may be formed of the development of electric lighting in this city from the fact, that one of the local companies alone furnishes 120,000 incandescent electric lamps in one year, which shows how far electric light has superseded artificial gas illumination in this city.

A special meeting of the stockholders of the Westinghouse Electric & Mannfacturing company was held last Wednesday for the purpose of voting upon a proposition of the board of directors to issue $3,000,000 of preferred stock. It will be remembered that last summer the company increased its capital stock from five to ten million dollars. Of the latter sum only six millions and eight hundred thousand dollars have so far been issued and for that reason the company thought it advisable to make the remainder of the stock preferred. When Mr. Westinghouse put the proposition before the meeting it was unanimously adopted.

E. H. H.

The presence of George B. Pennock, "President of the Pennock Battery, Electric Light and Improvement company," in the city of Peoria, Ill, was duly announced in the local papers last week. The object of Mr. Pennock's visit to Peoria is explained in the course of an article on his "system." Mr. Pennock says he will operate a street car on the Ft. Clark road within a week or ten days. Concerning the possibilities of this system it is declared, presumably on the authority of the Pennock company, that "by the Pennock system a car can run from 2,500 to 3,000 miles, and then all that is necessary is to recharge the cells with chemicals and go on as before." Comparing the storage battery system with that which he is exploiting, Mr. Pennock says: "There is no comparison between the two systems with regard to saving labor and in economy of management or wear and tear." That is true, but not in the sense in which it was evidently intended.

THE ELECTRIC LIGHT.

The N., C. & St. L. railroad will install an electric light plant in its machine works at Nashville, Tenn.

The Fort Worth, Tex., Electric Light & Power company will increase the capacity of its plant, it is said.

The Titusville, Fla., Electric Light company has been incorporated and will build a plant immediately.

The Victoria, Tex., Electric Light, Power & Ice company will increase the capacity of its electric plant.

The city of Northport, Ala., will, it is stated, petition the legislature for authority to issue bonds to secure the erection of an electric light plant.

The C. B. Lewis company of Watertown, Wis., has ordered of the Thomson-Houston Electric company of Chicago, a 100-light incandescent plant.

The electric light plant at Wilmerding, Pa., the new town near Pittsburg, where the Westinghouse Air Brake works are located, is now being increased from a capacity of 1,500 to 2,000 lights,

The Chicago Incandescent Light & Wiring company has been incorporated with headquarters in Chicago; capital stock, $10,000; incorporators, Lewis B. Scott, Charles P. Emmons and George N. Lyman.

W. R. Caulkins, agent of the Central Thomson-Houston company, at Cleveland, O., has secured a five years' lighting contract at Elyria, Ohio. One hundred arcs and 650 alternating lights will be installed.

The Auburn Park Electric Light, Power, Heat & Railroad company has been formed at Auburn Park, Ill., capital stock, $30,000; incorporators, B. Franklin Cronkrite, William E. W. Johnson and George E. Farley.

Labor troubles have greatly annoyed electric construction companies in Chicago during the year. The latest trouble was with the steam fitters. The Chicago Edison company has been greatly delayed in the completion of its south side station through these troubles.

Among the sales made by the Thomson-Houston Electric company, Western isolated lighting department, during the last week, are the following: Bimetallic Mining company, St. Louis, Mo., 200-light incandescent plant; the Albert Dickinson company, seed warehouse, 115 Kinzie street, Chicago, 100 light incandescent plant.

Since the first of December the Westinghouse Electric & Manufacturing company has received contracts for alternating current electric lighting apparatus for a capacity of 5,650 incandescent and 120 arc lights. Olean, N. Y., has contracted for an increase of its plant, and when the new apparatus has been installed, the plant will have 1,400 incandescent lamps' capacity.

The London County Council's bill will contain a clause giving the council power to require any electric lighting company to supply electrical energy to the council's electric testing stations, even if the station for which the supply is required be beyond the limit of the company's area of supply, and authorizing such company, subject to the usual notices, to break up streets for the purpose of laying the mains necessary to afford such supply to the testing stations.

The incandescent lamp is receiving a goodly share of attention of late and according to recent statistics it is safe to assume that in the year 1891, 10,000,000 sixteen-candle power lamps will be sold. It is said that in the manufacture of this enormous number of lamps 125,000 ounces of platinum will be necessary, and at the present price will amount to $2,125,000. It is figured that the probable income from these lamps will be $6,000,000, while the cost of a single item of their composition is over one-third of the total income. The demand for platinum is steadily increasing and the natural consequence is a gradual rising value. The entire world's production is small and unless some substitute for platinum is soon discovered, the manufacture of incandescent lamps will be more and more costly.

The alternating current electric lighting plant of the Missouri Electric Light & Power company, in St. Louis, Mo., has grown so rapidly that it has now become one of the largest central station plants of alternating current electric lighting in the United States. The company was organized in the early part of 1887, with apparatus of a generating capacity of 12,000 lights. This was the first contract for Westinghouse alternating current apparatus which had come from St. Louis. The other systems of incandescent lighting of the larger companies in America were already in operation in that city, but nevertheless the Missouri company found a very ready demand for its lights and the success of the plant was assured from the very start. This fact very soon manifested itself when the management found that the supply at the central station was not sufficient to satisfy the demand longer and an increase had to be made in the generating capacity. A 3,000-light Westinghouse dynamo was added and for a time the immediate wants of the company's patrons for lighting were complied with. But it was only temporary and then the company added two more 3,000 light Westinghouse alternating current dynamos to the capacity of the station. The company now had a generating power by which it was enabled to furnish 2 ,000 sixteen candle power incandescent lamps, which made it the largest electric lighting plant in St. Louis, but the new system of lighting had by this time gained such a popularity among the people of the city that the supply was again taxed to its utmost capacity until a few days ago, the Westinghouse company received another contract for the installation of one of its 3,000-light machines. This will give the Missouri Electric Light & Power company alternating current apparatus with a generating capacity of 24,000 incandescent lamps, which makes it the largest alternating current central station plant in America, west of the Allegheny mountains.

THE ELECTRIC MOTOR.

The power plant of the San Antonio, Tex., Street Railway company will be enlarged.

It is stated that the electric railway between Ann Arbor and Ypsilanti will be built by the last of December. Julius E. Beal is the president of the new company.

The city council of Providence, R. I., last week decided to deny the application of the Union Railway company for permission to operate an overhead electric system.

The Paris Societe pour le Travail Electrique des Metaux has put an electric accumulator car on the line between the Palais de l'Industrie and the Place de la Concorde. Laurent-Cely accumulators are used.

The Love Electric Traction company was formed last week at Chicago, to build electric railroads and electrical appliances; capital stock $10,000,000; incorporators, John C. Love, Homer N. Hibbard and Albert G. Wheeler.

The total number of cars equipped with Thomson-Houston motors in St. Louis is 139, the number of motors is 278, and their total horse power is 4,170. There are four separate lines in the city equipped with the Thomson-Houston railway system, in addition to which there is one line across the suspension bridge, and a smaller line immediately across the river from St. Louis connecting with the bridge line on which Thomson-Houston apparatus is used.

A Springfield, Ill., correspondent writes December 15 as follows: "The representatives of the several electric railway systems were here to-day competing for the contract for the electrical equipment of the People's Electric Street railway of this city. The prize was captured by Paul Bossart, representing the Rae system of the Detroit Electrical Works. This is a very desirable contract. The equipment will consist of fourteen motor cars and two generators."

The Buffalo, N. Y., Railway company has been formed for operating a street railroad with branches, in all about 116 miles in length, in the city of Buffalo, and it is to continue for 999 years. The company is capitalized at $6,000,000, and has as directors for the first year: H. Sellers McKee, Pittsburg; Edward E. Denniston and Richard M. Clay, Philadelphia; C. C Cuyler, New York; Henry M. Watson, Murray A. Verner and Samuel S. Spaulding, Buffalo; Thomas D. Cuyler, John P. Illsley, C. F. Stevens, Stephen E. Haas, Charles A. Pearson and G. R. Nichols, Philadelphia. It is understood that this company will assume control of the principal lines now in operation in the City of Breezes. Electricity will be introduced throughout the system, it is claimed.

According to an Eastern contemporary: "The West End Street Railway company of Boston, the great consolidated company that is introducing electricity for motive power, had gross earnings of $5,780,082 for the last year, an increase of $580,180 over the previous year The operating expenses were $4 234.041, or 73¾ per cent. of the earnings. The cost of the road and equipment is put in the report at $15,690 707, representing $9 891,150 of stock, $4,034,442 of bonds, and $3,246,659 of floating debt. The company has $2,008,850 in stock yet to issue to reach the authorized limit. The report shows that on the lines where electricity has supplanted horse power the increase of travel has been 44 per cent., one of these lines showing the enormous increase of 73 per cent., while there has been very little if any growth of business on the lines still operated with horses."

THE TELEPHONE.

The gas meter in the telephone exchange, Milwaukee, was affected by the cold snap last week and darkness was the result. From 10 P. M. until 1 A. M. the operators were compelled to grope about in the dark. As a consequence the service all over the city had to suffer, and many were the calls that remained unanswered. Annunciators dropped down every moment, but as their numbers could not be seen connections could not be made. Chief Operator McManman was finally found and hastened to the office, where he and the watchman after an hour's hard work succeeded in thawing out the meter. When the gas had been turned on again the telephones whose annunciators had dropped were called up, and where it was possible, an explanation was given.

Personal Mention.

S. S. Davis, manager of the People's Light & Fuel company, of Moline, Ill , was in Chicago last week.

Among the guests at the Chicago Electric club Monday evening was G. L. Patterson of Stanley & Hall, New York city.

H. Ward Leonard, of the Edison General Electric company, New York, was in Chicago Monday evening and attended the meeting of the Electric club in the evening.

Henry Villard was in Chicago last Saturday. He visited the Chicago Edison company's station on Adams street and made a general inspection of Edison interests in the city.

A theater party composed of Henry Villard, Gov. Gray of Indiana, Ferd W. Peck, and Prof. Badt, of the Thomson-Houston company, Chicago, occupied a box at the Auditorium anniversary last week.

Miscellaneous Notes.

A Thomson welding plant is to be installed in the carriage manufactory of Craver, Steel & Austin at Harvey near Chicago.

W. W. Donaldson, Roderick Macrae, A. H. Robertson

and others, have incorporated the Donaldson-Macrae Electric company to manufacture electrical machinery at Baltimore. The capital stock is $20,000.

The commemorative address by Augustus Lowell at the twenty-fifth anniversary of the Massachusetts Institute of Technology has been issued in pamphlet form and will be read with interest by all who have had occasion to note the admirable work of this institution.

Allen R Foote, secretary of the National Electric Light association, is making a strong effort to increase the membership of the organization. He has just sent circulars to members showing the importance of increasing the membership to 1,000, and asking those now enrolled to co-operate to secure this number on the list.

Business Mention.

The National Electric Manufacturing company of Eau Claire, Wis., has issued an illustrated catalogue describing its direct current incandescent system.

R. Thomas & Sons of East Liverpool, O., have just issued a profusely illustrated catalogue descriptive of their hard vitreous porcelain electrical supplies.

Borden, Sellick & Co., Chicago, have issued a pamphlet describing and illustrating the uses to which the Harrison Conveyor is put. This conveyor is extensively used in coal mines.

The Electric Construction & Supply company of Butte, Mont., has been organized to do general contract work throughout the Northwest. The company will carry a complete line of electrical supplies. E. P. Kinney is general manager.

D. C. Spruance, treasurer of the Star Electrix company of Philadelphia is making a flying trip through the West and reports sales right and left. Mr. Spruance has a wide acquaintance with the electrical fraternity, and he says no effort is required to sell Electrix goods.

James H. Bates, formerly connected with the Sprague Electric Railway company, the local Edison company of Philadelphia and the Fort Wayne Electric company, is about establishing a house in New York to deal in electrical supplies, motors, etc., with Moore Brothers, 106 and 108 Liberty street.

M. M. Wood has severed his connection with the Edison General Electric company of Portland, Ore., as district electrical engineer, and is now one of the engineering staff of the Electrical Supply company of Chicago, where his extended electric lighting and railroading experience will unquestionably render his services valuable.

Charles G. Armstrong who has been connected with the Great Western Electric company, has accepted a position with George Cutter, 333 Rookery Building, Chicago. Mr. Armstrong will have charge of the shop which Mr. Cutter will locate on the west side. Here will be manufactured a number of devices which Mr. Cutter has invented as well as several specialties designed by Mr. Armstrong.

The Sawyer-Man Electric company reports the incandescent lighting business to be greatly on the increase, the receipts of orders for one day recently breaking previous records and amounting to about 30 000 lamps. It is stated that the sales for the month of October and November were the largest in the history of the company. Orders from Egypt, China, Australia and Germany as well as the two Americas were among the receipts of a single day.

Few business publications are perused with the interest which will be accorded to a little pamphlet just issued by William J. Hammer. Mr. Hammer has recently opened an office as consulting and constructing electrical engineer in New York city. The little volume contains evidence of Mr. Hammer's ability for his work. Letters from Thomas A. Edison and Elihu Thomson testifying to Mr. Hammer's ability, are presented. A list of a number of noted electrical installations which were in charge of Mr. Hammer are beautifully illustrated.

Charles G. Armstrong, late assistant manager of the Great Western Electrical Supply company, has left this company and is now engaged in contract work. He has devised a number of very ingenious electrical appliances, some of which have been noticed in these columns, and will be prepared to install these as well as other carefully planned contrivances. He is well known among architects as well as among the electrical fraternity in the West, and already has some large contracts under way. His present address is 333 "The Rookery," Chicago.

The Electrical Supply company, 171 Randolph street, Chicago, reports an unusual run on Habirshaw wire. It is making special arrangements which will assure a sufficient supply in stock at all times to meet the increasing demand for this wire. The company's arrangement for selling Edison lamps at Edison prices, and its supply of Sunbeam lamps put it in particularly good shape to supply all classes and conditions of the lamp trade. The Bradner adjustable hanger which is sold by the company, is perfectly simple and effective, not to speak of its ornamental aspect. By its use unsightly loops, knots and adjusting balls are dispensed with.

Among the materials which enter largely in the manufacture of all sorts of electric appliances, both hard and soft rubber have played an important part. Special tools and machinery have been designed, and the processes perfected so that rubber pieces giving a high and lasting insulation can be made in quantity at very reasonable prices. These pieces often need to be of sizes and shapes to adapt them to the apparatus of which they form a part, and their design belongs properly to the department of the practical electrician. This fact seems largely to have been overlooked, and the rubber manufacturers have been left to furnish insulating pieces which might, or might not be well adapted to combine the strength, rigidity or elasticity, and the insulation needed under the circumstances The Revere Rubber company has established an electrical department and has placed its general Western agency in the hands of the well-known electrician, George Cutter. His long and varied electrical experience would seem to fit him for designing special shapes of insulating pieces to meet any practical case, and with him at the helm such a new departure should tend to raise the insulation standard of various electric appliances. George Cutter's office is at 333 "The Rookery," Chicago.

The committee of the Franklin Institute to which was referred the specimens of products of the Eureka Tempered Copper company has made its report. It appears that the committee not only subjected the specimens to a critical examination, but also sent circulars "to over 100 establishments in the United States and Canada, using tempered copper asking for results of their use of the same with any expression of opinion that they may see fit to give." The committee reports that the chemical examination to which the specimens were subjected, show that they were "commercially pure copper." Out of fifty-three letters the committee says, "Thirty-four expressed opinions, based upon their experiences, which were highly favorable to the tempered copper. Thus, it was stated that for bearings on coal-mining machinery it lasts much longer than any other metal before used; that it outlasts from three to four times the old style of commutator copper bars or brushes; very satisfactory for brasses on engine rods; bearings on dynamos run very cool and require but little lubrication; gives entire satisfaction on bearings of three threshing engines; in wrist-pin boxes and in cross-head; as step in gauge lathe, between end of spindle and set-screw is superior to hardened steel, brass, rawhide or wood, all of which were previously tried; very uniform in hardness and remarkably free from blow-holes; gave good results as a driving pinion in gear work; stood up well as armature bearing in street car motors (a trying test), in small bearings, where the brass bearings would not last over sixty days the tempered copper has been in nearly a year, and is apparently in as good a condition as when first put in. Many other extracts could be given, particularly from parties indorsing the copper for commutator brushes and segments, to which it seems particularly well adapted. A number of specimens of castings are presented with this report, showing high excellence in quality and uniformity. Mechanical examination bears out the statements of the applicants as to the purity of the metal. We believe that the claims of the applicants are substantiated by the experience of the majority of the parties using their copper, and also by our own investigations. We are of the opinion that the Eureka Tempered Copper company has made a decided step in advance in the preparation of copper for many industrial uses, and we recommend the award to Almer Thomas and Luzerne Merket, of the John Scott Legacy Medal and Premium."

Electrical Patents.

Issued December 9, 1890.

442,104. Electric Signal for Engines. Michael Conley, Chicago, Ill.

442,114. Electric Gate. Harleigh Gillette, Highland Park, Ill.

442,126. Electrical Vote Recorder. Sylvanus D. Locke, Hoosick Falls, N. Y.

"Claim one: In an assembly chamber, a series of desks for the members, each of which is provided with two electric push buttons or keys underneath the cover, one for the aye and the other for the nay vote, and with suitable identifying and localizing devices for said keys above the cover."

442,127. Hanging Device for Electric Arc Lamps. James Lounsbury, Chicago, Ill.

"Claim one: The combination of an adjustably-suspended lamp having lamp-contacts of annular form carried thereby, and circuit-contacts comprising arms having bifurcated ends adapted to embrace the lamp-suspending medium, and to engage the lamp contacts carried thereby."

442,139. Multiple Telegraph or Telephone. Abner M. Roseburgh, Toronto, Canada.

442,140. Circuit for Electric Railways. Frank W. Sabold, Albany, N. Y.

442,143. Multiple Switch-Board System. Charles E. Scribner, Chicago, Ill.

The invention relates more especially to the operators' apparatus, and by its use the circuits are simplified. The metallic circuits are balanced so as to avoid the effects of induced currents from other circuits. The test for all lines, whether metallic or grounded, is made uniform, while the single or grounded circuit lines may be extended to form metallic circuits without disturbing the connection upon the switch-board nor the spring-jack switches. A feature of this invention consists in the discovery that the introduction of a retardation-coil into a ground branch extended from one side of a metallic circuit entirely overcomes the harmful effect of such ground branch, by preventing the flow of the induced currents, which would otherwise create a noise in the telephone.

442,144. Telephone Exchange Apparatus. Charles E. Scribner, Chicago, Ill.

442,145. Multiple Switch-Board System. Charles E. Scribner, Chicago, Ill.

442,146. Telephone Exchange Apparatus. Charles E. Scribner, Chicago, Ill.

The invention relates to telephone exchanges in which metallic circuits are employed; and its object is to provide apparatus which shall permit of looping the different lines together without including any unnecessary resistance in the talking circuit.

442,155. Insulating Covering for Pincher Handle. G. F. Virtue, Boston, Mass.

442,162. Underground Electric Conduit. Homer H Young Kansas City, Mo.

442,173. Electric Motor or Dynamo Electric Machine. Charles E. Dressler, New York, N Y.

442,187. Method of and Apparatus for Manufacturing Secondary Battery Electrodes. James G Johnson, Denver, Colo.

442,203. Separating Diaphragm for Electrolytic Cells. Isaiah L Roberts, Brooklyn.

442,204. Diaphragm for Electrolytic Cells. Isaiah L. Roberts, Brooklyn.

442,208. Speed Regulator for Electric Motors. William W. Schiffmann, St. Paul, Minn.

442,232. Attachment for Span Wires for Suspended Electric Conductors. Frank Mansfield, New York, N. Y.

442,267. Telegraphy. Edward B. Ives, New York, N. Y.

442,270. Device for Attaching Incandescent Electric Lamps to Gas Fixtures. Norman Marshall, Boston, Mass.

442,287. Incandescent Lamp Socket. George W. Hunt and Albert E. Rich, Brooklyn, N. Y.

442,332. Electrolytic Apparatus. Isaiah L. Roberts, Brooklyn.

442,333. Apparatus for use in Electrolysis. Isaiah L. Roberts, Brooklyn.

442,334. Electrolytic Apparatus. Isaiah L. Roberts, Brooklyn.

442,335. Process of Treating Asbestos. Isaiah L. Roberts, Brooklyn.

442,336. Carbon Electrode and Method of Making the Same. Isaiah L. Roberts, Brooklyn.

An electrode consists of a compressed or firmly-compacted block of finely-divided carbon and paraffine or its described equivalent.

442 338. Relay. Jens G. Schreuder, Edgewood, Pa.

442,339. Charging Apparatus for Switch and Signal Mechanisms. Jens G. Schreuder, Edgewood, Pa.

442,342. Telephone Toll Station. John W. Vaughn, Jersey City, N. J.

442,347. Railway Car Telegraph. Craig R. Arnold, Sharon Hill, Pa.

442,365. Electric Traction-Increasing System. Mark W. Dewey, Syracuse, N. Y.

442,370. Electric Connector. William H. Garland, Weymouth, Mass.

442,383. Non-Interference Fire Alarm Signal Box. Preston V. Merrifield, Grand Rapids, Mich.

442,385 Electric Leak or Flow Detector. Gustave S. Neu, New York.

442,390. Secondary Battery. James E. Pumpelly, Chicago.

"Claim three: The combination, with an electrical secondary battery, of the plates of the negative electrode and the plates of the positive electrode, all having their broad surfaces on the same or parallel planes, so constructed and relatively arranged that the electrolytic action takes place between the edges of the plates of the opposing electrodes in contradistinction to their broad surfaces."

442 391. Secondary Battery. James K. Pumpelly, Chicago.

"Claim one: The combination, with an electrical battery, of cellulose and wood-pulp fiber."

442,396. Electrolytic Apparatus. Isaiah L. Roberts, Brooklyn.

442,407. Electric Railway. Merle J. Wightman, Hartford, Conn.

442,415. Pulley Attachment for Electric Lamps. Thomas H. Brady, New Haven, Conn.

442,423 Method of and Apparatus for Measuring Electric Currents. Stanley C. C. Currie, Philadelphia, Pa.

442,446. Trolley Wire Hanger. Henry H. Luscomb, Boston, Mass.

442,451. Ceiling Block. H. T. Paiste, West Chester, Pa.

442,452. Ceiling Block. H. T. Paiste, West Chester, Pa,

442,459. Electric Motor and Frame. Albert Schmid. Allegheny.

442,472. Holder for Electric Lamps and Hoods. George L. Batchelder, Bloomington, Ill.

442,473. Electric Bell. Charles B. Beers and William B. Tuttle, Bridgeport, Conn.

442,497. Printing Telegraph. William W. Taylor, Mansfield, Mass.

442,501. Electric Meter. James J. Wood, Brooklyn, N. Y.

442,516. Galvanic Battery. Clarence E. Dutton, Jr., Washington, D. C.

"Claim twelve: A battery cell having a hollow carbon electrode, a metallic rod passing there through, and serving as a positive pole, and a nut on said rod engaging said electrode."

442,575. Conductor for House Lighting. William H. Eckert, New York, and William H. Gregory, Brooklyn, N. Y.

442,580. Electric Arc Lamp. William B. Henderson, Crafton, Pa.

442,588. Electric Switch. Norman Marshall, Boston, Mass.

442,594. Electrolytic Apparatus. Isaiah L. Roberts, Brooklyn.

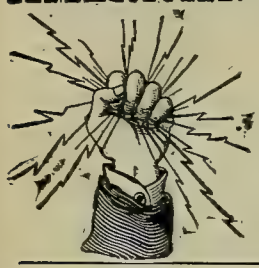
EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,



Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

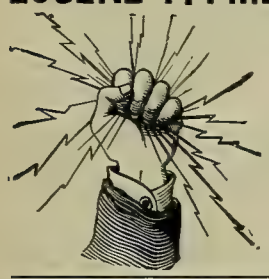
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

— MANUFACTURERS OF —

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS

4 LASALLE AVE CHICAGO.

MAKE ANYTHING IN BRASS.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 19, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:
- W. H. SALISBURY & CO., Chicago, Ill.
- A. H. GARDINER CO., Milwaukee, Wis.
- TODD & STANLEY CO., St. Louis, Mo.
- ENGLISH, MORSE & CO., Kansas City, Mo.
- E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE FIBRONE MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

ELECTRIC LIGHT POLES FOR SALE.

Proposals for all or any part of the following cedar poles will be received at office of the

CINCINNATI ELECTRIC LIGHT CO.,
Cor. 4th and Plum Streets, Cincinnati, Ohio:

5	cedar	poles	30	feet	long.
44	"	"	34	"	"
389	"	"	35	"	"
682	"	"	40	"	"
46	"	"	45	"	"
12	"	"	50	"	"
63	"	"	assorted sizes.		

EXPERIMENTAL, MODEL AND ELECTRICAL

Work, Intricate and Special Machinery, and anything that and be done in a first class experimental machine shop is solicited.

E. D. STIFF, 67 & 69 So. Canal St., Chicago,

Light Manufacturing under Contract.

FOR SALE --- CHEAP.

Two new **Thomson-Houston Electric Motors**, one 10 and one 15-horse power. Will sell cheap. Address

J. W. CALKINS & SON,
Chicago Office Rockford Electric Mfg. Co.
356 Rookery Bldg.

FOR SALE.

VERY CHEAP.

Several 10, 15, 25 and 50-H. P. Van Depoele Electric Motors, made for Street Cars; also Gear and Attachments for same; also one 150-H. P. Van Depoele Electric Generator; also two Street Car Trucks, with 4½-inch Axles and Bemis Gear; also a lot of Pulleys and Hangers

For particulars address

W. A. STILES,

Room 1028, 112 CLARK ST., CHICAGO.

To Directors of Electric Light or Power Central Stations.

POSITION WANTED

By a manager, at present in charge of a large electric light central station, who wishes to change for satisfactory reasons. Can demonstrate by results his ability as a mechanical and electrical engineer, and as business manager. Prospects of future growth of company will be considered with salary, but only those whose business will warrant the payment of at least $3,000 salary to the right man, need answer.

Address "K,"
Care of WESTERN ELECTRICIAN.

IF YOU HAVE A BATTERY,

Gravity or Leclanche, use the Delany Battery Strip. It prevents salts from creeping, keeps batteries and shelves clean, prevents local action, and prolongs life of battery. **WARRANTED.** Per doz., Gravity, 60c; Leclanche, 50c.

PATRICK B. DELANY,
South Orange, N. J.

EDISON LAMPS REDUCED TO 44 CTS.

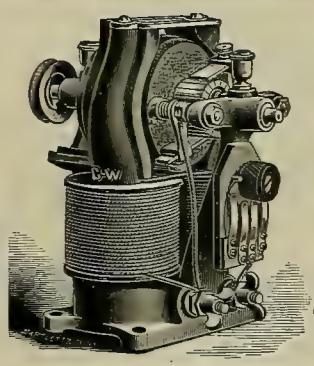
16 CANDLE POWER LAMPS.

Lots of 25 to 150 ..... 44 cents each.
Lots of 150 to 500 ..... 42 cents each.
Lots of 500 ..... 40 cents each.

Other sizes in proportion. All sizes in stock, with bases to fit any make of lamps or sockets.

Full Line OKONITE WIRES in Stock. Safest and best wire made.
Full Line of Edison Sockets and Appliances,

STANDARD ELECTRICAL WORKS, CINCINNATI, OHIO.



THE CROCKER-WHEELER

PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation
Forged Fields, Let into Base-Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Prest.

LONG LIFE, High Efficiency, **A CONSTANT** And Beautiful LIGHT.

The SUNBEAM is a SUCCESS.

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

OKONITE TRADE MARK

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL OKONITE COMPANY, Limited, - - 13 Park Row, NEW YORK.

BRANCHES Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, St. Louis, Kansas City, San Francisco, London and South America.

NOTICE TO CONTRACTORS.

OFFICE OF CITY CIVIL ENGINEER, INDIANAPOLIS, IND., Dec. 4, 1890.

Notice is hereby given that sealed proposals will be received by the Common Council of the city of Indianapolis, on Monday evening, Jan. 5, 1891, for lighting the city of Indianapolis, Ind.

FOR ELECTRIC LIGHTS.

Proposition to be for 400 lights; for 500 lights; for 600 lights; for 700 lights; and for 800 lights, all to be 2,000 standard candle power arc lights, suspended on mast arms.

All bids to be made to comply with provisions of general ordinance No. 14, 1888, of this city, providing for the placing of all electric-light wires within North, South, East and West streets to be laid under ground, outside of which boundaries wires may be strung on poles.

The contractor to furnish all necessary material, and do all the work of whatever kind necessary to construct, equip and maintain in good and substantial electric installation, complete and ready for operation, for lighting the city, and when the same is completed, shall operate the same in its entirety, for a trial period of Sixty (60) days.

The lights furnished shall be as good as the best standard 2,000-candle-power lights used in any city of the United States.

At the end of the trial period, if the lights are as good as above specified, and should the performance of the entire plant prove satisfactory, the city will accept the same, and the rental shall date from the beginning of the trial period. But should the performance of the entire plant not be satisfactory to said city, the plant will not be accepted, and no rent will be paid until said plant is made, in its entirety, perfectly satisfactory to said city.

The equipment must in all respects be of the best manufacture, and of the latest and most improved design.

Bidders to make their propositions upon the basis of an all-night lighting schedule, beginning one-half hour after sunset and ending one-half hour before sunrise; also on a basis of a five years' and also on a ten years' contract. Lights to be located under the direction of the committee on public light of the Common Council and Board of Aldermen and city civil engineer.

The plant will consist of an equipment capable of operating and sustaining circuits upon which to operate arc lights of 2,000 standard candle power each.

Not more than 50 lamps to be lighted by any one circuit.

The mean photometric candle-power of the lights, measured at an angle of 45 degrees from a horizontal, shall be as great as that shown by the best standard 2,000-candle-power arc light now in use in the United States.

All intermediate poles shall be straight, five white cedar, shaved and not less than six inches in diameter at the top, and shall not be less than thirty (30) feet in length, to be set five (5) feet in the ground.

All poles, including all cross-arms, pins and brackets, to be painted two coats of good paint of such color as the city engineer may designate.

All poles to be set plumb, true to line, and guyed whenever direction changes, or otherwise necessary.

Poles to be set not more than 140 feet apart in any case, and estimated at the rate of 40 poles per mile.

All wires must be thoroughly insulated with some good material, not easily absorbed and impervious to moisture, and the insulation to be guaranteed water and weather-proof for three years. All joints to be soldered, and covered with at least five layers of Kerite tape, or some other non-conducting material equally as good.

When the direction changes an insulated loop-guard shall be attached to the pole to hold the wire, in case of breaking of pin or bracket. Wires must, in all cases, clear the ground at least twenty five feet, and must be kept clear of contact with any adjacent lines or wires. Insulation from grounding from outside contacts must be perfect.

All wiring and other work shall, in addition to the above, be done according to the rules and regulations of the National Board of Fire Underwriters.

The contractor will be required to enter into a written contract, agreeing to perform the whole work according to the true intent of the above specifications, and shall state the time within which he will do the whole of said work, and have the plant in operation; said time shall not exceed six months after the date of signing the contract.

The contractor shall be required to furnish a bond, with satisfactory sureties, protecting the city from liability on account of infringements of patents or otherwise, and also from all damages and costs of suits that may arise on account of construction, maintenance, rental, use or ownership by the city, and guaranteeing the full and faithful compliance with the terms of this contract with the city.

All work to be done under the direction and supervision of the city civil engineer, and any points omitted in the above specifications shall be subject to directions given by him from time to time during the progress of the work.

The contractor will be required to accompany his bid with a certified check for five thousand dollars ($5,000) payable to the Mayor of said city of Indianapolis, Indiana, for said city, and the amount thereof shall be retained by said city of Indianapolis as liquidated damages in the event of his failing to enter into a contract and file proper bond within ten (10) days from date of award of contract, and to be returned to said contractor upon his filing a good and sufficient bond within such time for the faithful performance of the contract. The contractor to erect the plant as above, furnishing all the necessary appliances, and doing all the work of constructing, and operating and maintaining the same, and to furnish lights as above specified, for a given sum per light per annum.

The rental to be paid monthly.

The city shall be granted the option of purchasing, at the expiration of the contract period, the entire plant of any contracting company, at a price that shall be fixed by a board consisting of five members, two to be selected by each of the contracting parties, and the fifth to be selected by said four members so selected by said contracting parties. The city shall give to said contracting company six months' notice immediately prior to the expiration of any such contract, of the city's intention to purchase such plant.

The Common Council and Board of Aldermen reserve the right to reject any and all bids.

FOR GAS LIGHTS.

For bids to furnish gas lights as follows: 500 lights, 1,000 lights, 2,000 lights, 3,000 lights and 4,000 lights.

FOR VAPOR LIGHTS.

For vapor lights as follows: 300 lights, 400 lights and 500 lights.

Bidders for furnishing gas or vapor lights, or both, to bid on a basis of one, two and three years' contracts, and shall each submit with their bids certified checks for $2,000, guaranteeing faithful compliance of their contracts. All bidders for electric, gas or vapor lights shall bid on a basis of an all-night lighting schedule, and for the lighting, cleaning and repairing of their respective lights. All additional lights to be provided at the contract price. The city reserves the right to reject any and all bids.

A. P. SHAWVER, City Civil Engineer.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

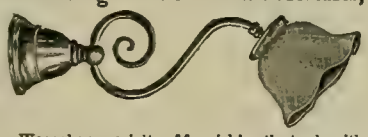
Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,



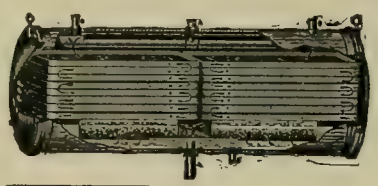
We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES, SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

ELECTRIC RAILWAY LIGHT AND POWER.

JAS. McLAUGHLIN.

14 Years' Experience.

A Pioneer in the Business.

Repairs and Parts for all Systems.

48, 50 and 52 NORTH CLINTON ST.,

CHICAGO, ILL.

AYRTON & PERRY,

AMMETERS and VOLTMETERS.

CHIEF CHARACTERISTICS:

Portability. No Permanent Magnets. Direct Reading Scale. Uniform Divisions. Unaffected by Dynamos and Motors.

It makes no difference which way the current enters. The ammeters may be left in circuit continuously.

Each Voltmeter has a special contact key.

Send for Catalogue 1-66 of Electrical Test Instruments.

QUEEN & CO., PHILADELPHIA.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

C. B. HOLMES, Prest. & Genl. Mgr. WM. C. NICHOLS, Secretary & Treasurer.

G. W. GRIFFIN, Superintendent of Construction.

INCANDESCENT LAMPS.

50 TO 110 VOLTS.

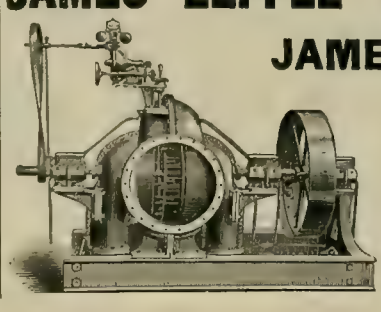
TO FIT STANDARD SOCKETS.

THE BUCKEYE ELECTRIC CO.,

P. O. Box 123, CLEVELAND, OHIO.

WRITE FOR CIRCULAR.

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL, FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

THE

Hazelton Tripod Boiler.

Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

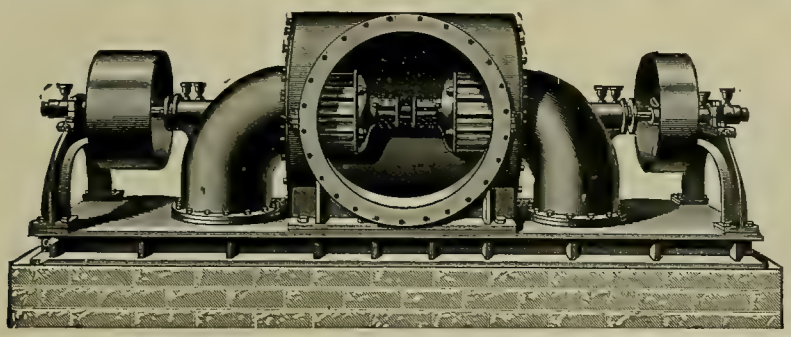
ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,

CHICAGO, ILL.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft, with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed. Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

HARRISON CONVEYOR

FOR HANDLING

Grain, Coal, Tan Bark, Seeds, Etc.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illus. Catalog. **BORDEN & SELLECK CO., 48 and 50 Lake St., Chicago, Ill.**

You make a mistake if you don't buy **E**lectrical **S**upplies from **F. & F.**, Cleveland, **O**hio. **S**end for the latest "**L**ist of **B**argains for **B**ell **H**angers" and "rock bottom" on **M**edical **B**atteries. **W**e undersell all. **A**ddress **F**letcher & **F**letcher **E**lectric **C**o., **C**leveland, **O**. **M**ention this paper if you want bottom prices.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA

Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA.
Eastern Sales Office, 35 Broadway, NEW YORK.
Western Sales Office, 225 Dearborn St., CHICAGO.
North Western Sales Agent, G. W. Williams, DETROIT, MICH.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

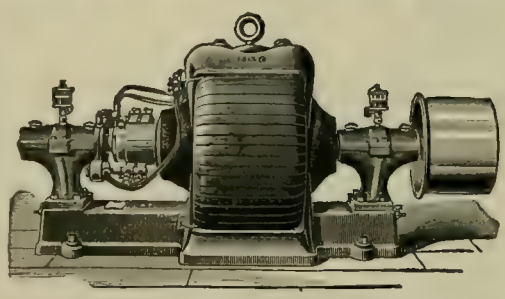
THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

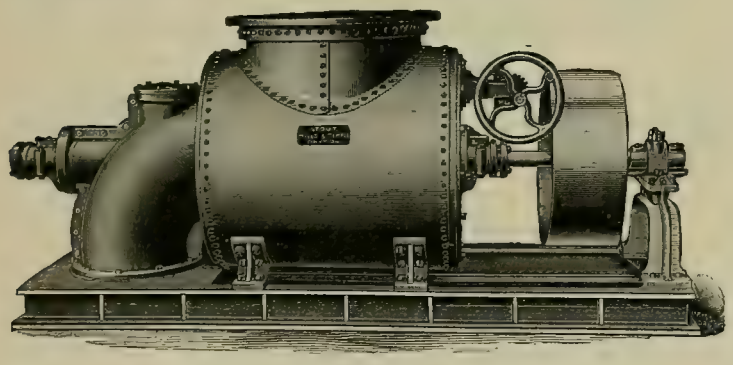
NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

Electrical Testing Apparatus manufactured to order, repaired or calibrated.

WESTERN ELECTRIC COMPANY, - - NEW YORK.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

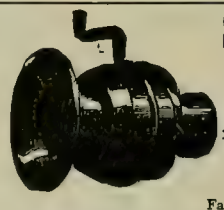
OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.



SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE, out August 1st.

INSULATED AND BARE

WIRE

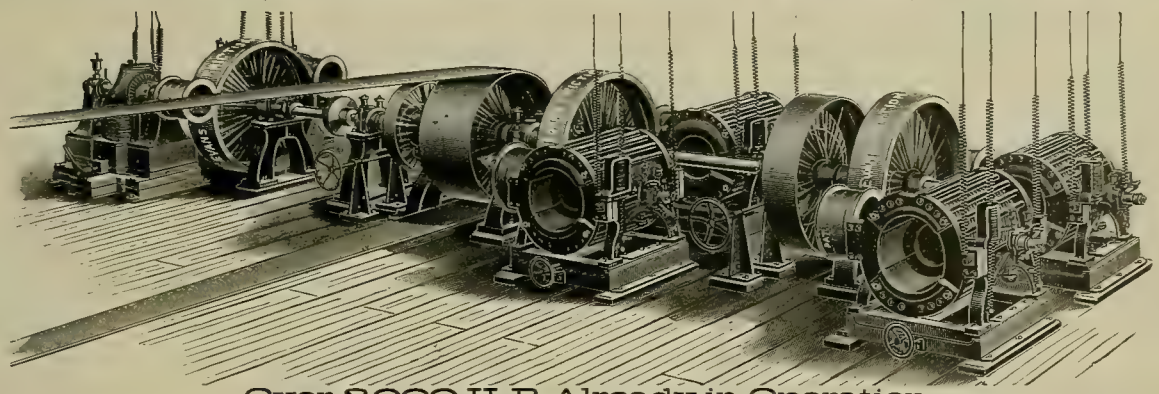
The Empire City Electric Co.,

15 & 17 DEY ST., NEW YORK.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

(STATION OF THE NORTH ATTLEBORO STEAM AND ELECTRIC CO.)

This Station has been in Successful Operation Since March, 1890.



Write for Full Particulars and List of Parties who are Using.

Over 3,000 H. P. Already in Operation.

Send for Catalogue "D" to THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

Manufactured by

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.
FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

THE REYNOLDS

IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.

Write for our Catalogues

SOLE BUILDERS

EDW. P. ALLIS & CO.,

RELIANCE WORKS. MILWAUKEE, WIS.

Manufacturers of and Dealers in

Pulleys, Gears, Shafting, Hangers, Leather, Rubber and Cotton Belting, Lubricants, and Mill and Engine Supplies of Every Description.

CHICAGO BRANCH, 41 and 43 SOUTH JEFFERSON ST.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

Electrical Supplies.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS, WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a Specialty of Supplies for Hotel and House Work. **114 S. Second St., Philadelphia, Pa.**

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR NEW AND COMPLETE CATALOGUE,

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators. Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

CINCINNATI HEADQUARTERS

ELECTRIC LIGHT AND TELEGRAPH SUPPLIES.

WEATHER PROOF · SIMPLEX · OKONITE · GRIMSHAW WIRES · SINGLE AND DOUBLE COTTON FIELD AND ARMATURE WIRE · FLEXIBLE CORD · ROSETTES · CLEATS · TAPE OF ALL KINDS · SWITCHES · CUT-OUTS · PINS · BRACKETS AND INSULATORS · THE LARGEST AND BEST ASSORTED STOCK TO BE FOUND ANYWHERE. ASK FOR PRICES BEFORE PURCHASING.

The JONES · BROS · ELECTRIC · CO. 28 30 & 32 WEST COURT ST.

OKONITE
TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

DR. GASSNER'S DRY BATTERY

FOR OPEN CIRCUIT WORK.

The Batteries are now made in the following sizes:

No.		Height.	Width.
18.	Rectangular (Double Cell),	7½ in.	3⅝ in. x 3⅛ in.
17.	"	7½ "	3⅝ " x 1⅞ "
16.	Cylindrical (Enameled),	7 "	3 in. diam.
15.	"	7 "	3 "
10.	"	5½ "	3 "
19.	Oval,	6½ "	3⅜ in. x 1⅞ in.
02.	Rectangular,	4½ "	2¼ " x 1½ "

A. SCHOVERLING, Sole Agent and Manufacturer,
111 Chambers St., New York.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.

BARNES' NEW SENSITIVE DRILL

Speed, from 0 to 1600 revolutions without stopping the machine or shifting belts.

This new sensitive drill embodies principles not found in other tools of its class, is simpler in construction and more effective in operation than any sensitive drill in the market.

The speed of the drill spindle can be *increased or diminished instantly*, or the *motion reversed* without stopping the machine or *shifting belts*.

More or less driving power can be applied to the drill spindle, as the size of the drill or the nature of the work may demand.

We claim for this drill superiority both in simplicity of construction, which renders it less liable to derangement, and in effectiveness of operation, on account of the variation of speed and power being so completely under the control of the operator, whereby all the adjustments are made with the least possible loss of time. It is smooth and almost noiseless in operation, and entirely free from the vibratory motion commonly found in drills of this class, where the spindle is driven by belt.

Sold subject to trial, with single or multiple spindle. Send for Catalogue.

W. F. & Jno. Barnes Co.
ROCKFORD, ILL.
Address, No. 761 Ruby Street.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON.

MANUFACTURING ELECTRICIAN.

Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

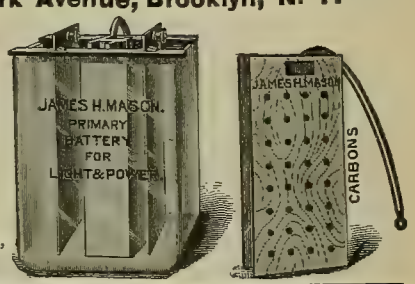
COMPLETE PLANTS FOR SMALL STORES.

Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



PRINCIPAL DEPOT:
Chestnut St., cor. Twelfth, Philadelphia.

BRANCH HOUSES.
Nos. 767 & 769 Broadway, New York.
" 1260 & 1262 Broadway, New York.
" 160 Tremont Street, Boston.
" 151 & 153 Wabash Avenue, Chicago.
" 444 Fulton Street, Brooklyn.

Cable Address: White, Philadelphia.

The S. S. White Dental Manufacturing Co.

Founded by Samuel S White in 1844.

JAMES W WHITE, President. J. CLARENCE WHITE, Secretary
HENRY M. LEWIS, General Manager. SAMUEL T. JONES, Treasurer.

Philadelphia November 4th, 1890.

Edison Mfg. Co.,

Orange, N. J.,

Gentlemen:

Yours of October 16th duly received, and sickness has caused the delay in answering it. As to the Edison Laland Battery, we have been using primary batteries to operate dental electric pluggers and motors since 1875, and am compelled to say that the Edison Laland Battery far excells all other batteries we have ever used.

Yours truly,

The S. S. White Dental Mfg. Co.

E. T. Starr

NOW READY! NOW READY!!

Third Edition Dynamo Tenders' Hand-Book, with moonlight schedule for 1890. Second Edition Incandescent Wiring Hand-Book with additional chapters. An astonishing record: The rapid and continued demand for Lieut. Badt's practical hand-books has compelled us to print Fifteen Thousand copies within Eighteen months, as follows:

Dynamo Tenders' Hand-Book,	1st Edition	2,500	Copies.
" " " "	2d "	2 000	"
" " " "	3d "	2,000	"
Incandescent Wiring "	1st "	2,500	"
Incandescent Wiring Hand-Book,	2d Edition	2,500	Copies
Bell Hangers' "	1st "	2,500	"
" " "	2d "	1,000	"
Total within Eighteen months		15,000	"

Bell Hanger's Hand Book.

BY F. B. BADT.

PRICE $1.00. 106 pages, 97 illustrations, flexible cloth binding, type page 5½x3 inches. First edition exhausted, second edition now ready, making a total of 3,250 copies printed to date. Just the book for people engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat apparatus, etc. etc.

TABLE OF CONTENTS.

VOLTAIC ELECTRICITY.

Contact Series.
The Voltaic or Galvanic Cell.
Generation of Current.
Local Action.
Polarization.

DESCRIPTION OF BATTERIES.

The Smee Battery. The Grenet Battery.
The Daniell Battery.
The Grove Battery.
The Bunsen Battery.
The Carbon Battery.
Nickel-Plating Battery.
Fuller's Mercury Bichromate Battery.
The Leclanche Battery.
The Diamond Carbon Battery.
The Law Battery.
Gravity Batteries.
Dry Batteries.
Classification of Batteries.

ELEMENTARY DATA.

The Electric Current.
Ohm's Law.
Conductors and Insulators.
Direction of the Current.
Connecting Batteries.
Cells Connected in Series.
Cells Connected in Multiple Arc.
Recapitulation.
Work.
External Resistance.
Rules for Connecting Batteries.
Data Regarding Batteries.
Divided Circuits.
Electro-magnets. Induction Coils.
Electric Bells.
Single Stroke Bells.
Long Distance Call Bell System.
Push Buttons.
Buzzer.
Indicating Box Bell.
Annunciators. Electric Alarms.
Hotel Fire Alarm and Room Call.
The Hess System.
The Western Electric Company's System.
The Double Wire System,
Partrick & Carter System.
The Electro-mercurial Alarm.
The Metallic Thermostat.
Burglar Alarms. Desk and Safe Alarms.
Electric Gas Lighting Apparatus.
Portable Gas Lighters.
Apparatus for Public Buildings.
Apparatus for Residences.
A Novel Automatic Burner.
Connections of Gas Lighting Systems.
Electric Heat Regulators.

RUNNING ELECTRIC WIRES.

Proper Installation.
How to Fish Wires.
Wiring Fixtures for Gas Lighting.
Wiring Elevator Annunciators.
Best Time for Wiring.
Extra Insulation.

TESTING INSTRUMENTS.

Detector Galvanometer and the Magneto Bell.
Tests for Faults.
Bell Hangers' Tools.
Wire Tables.
Specifications for Wiring a Hotel.

Dynamo-Tenders' Hand-Book.

BY F. B. BADT.

PRICE $1 00. First and second editions exhausted; third edition now ready, making 6,500 books printed to date, containing additional pages and moonlight schedule for 1890. 93 pages, 70 illustrations, flexible cloth binding, size of type page 5½x 3 inches. Designed for dynamo tenders and linemen, stationary and marine engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

TABLE OF CONTENTS.

ELEMENTARY DATA.

The Electric Current. Ohm's Law.
Work.
Conductors and Insulators.
Direction of the Current.
Detector Galvanometer and Magneto Bell.

ARRANGEMENT OF POWER.

The Dynamo Room.
Motive Power.
Shafting and Pulleys.
Foundations for Dynamos. Belts.

DYNAMO ELECTRIC MACHINES.

Description of the Dynamo.
The Continuous Current Dynamo.
The Series Dynamo.
The Shunt or Derived Circuit Dynamo.
The Compound Dynamo.
The Alternating Current Dynamo.
Preparation of a New Dynamo for Operation.
Starting a New Dynamo.
Keeping a Dynamo in Good Order.
Brushes. The Commutator.
Repairs to the Armature.
Repairs to the Field Magnets.
Testing the Wire Coils of a Dynamo for Contact against Iron.

DISEASES OF DYNAMOS.

Non-Generation of Current by the Dynamo.
Excessive Sparking of Commutator and Brushes.

LAMPS.

Arc Lamps.
Suspension of Arc Lamps.
Trimming and Cleaning Arc Lamps.
Incandescent or Glow Lamps.
Multiple Arc System.
Multiple Series System.
Series Multiple System.
Arc and Incandescent Lamps on the Same Circuit.
The Alternating System.

INSTRUMENTS.

Current Indicator or Ampere Meter.
Pressure or Potential Indicator, or Voltmeter.
Current Regulator.
Switches.
Safety Devices.
Lightning Arresters.
Ground Detector.
Switch-Board.

CIRCUITS OR LEADS.

Outdoor Leads for Arc Lighting.
Outdoor Leads for Incandescent Lighting.
Arc Circuits inside of Houses.
Incandescent Circuits inside of Houses.
Size of Wires for Incandescent Lamp Installations.
Testing.

ACCUMULATORS.—DESCRIPTION AND OPERATION OF ACCUMULATORS.

SAFETY REGULATIONS.

Rules of the Boston Underwriters' Union.
English Regulations.
Abstract of the Chicago Electric Light Laws.
Rules and Regulations of the New York Board of Electrical Control.

Table of Electric Light Conductors.
Lamp Lighting Schedule—Moonlight System.
Construction Tools.

Incandescent Wiring Hand-Book.

BY F. B. BADT.

PRICE $1.00. Type page 5½x3 inches, flexible cloth binding, 72 pages, 41 cuts, and 5 tables, three of which are 12x18 inches. These tables give **at once** and without any calculations, the size of wire required in each case for any percentage of loss. First edition exhausted, second edition containing additional matter now ready, making 5,000 copies printed to date. A timely book, containing full illustrations for incandescent wiring and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, general electrical data, calculating sizes of wire, wiring of fixtures, elevators, buildings, isolated and central station plants The only book of the kind published.

TABLE OF CONTENTS.

INTRODUCTORY.

The Multiple Arc System.
The Three- wire System.

METHODS OF RUNNING WIRES.

Cleat Work.
Moulding Work.
Concealed Work—
a. When the building is Being Constructed.
b. In a Completed Building.

LOCATION OF SAFETY DEVICES AND SWITCHES.

The Tree System.
The Closet System.
Safety Devices.
Switches.
Splices.
Safety Rules.
Insulation and Testing for Faults.

FIXTURES AND ELEVATORS.

Wiring of Fixtures.
Wiring of Elevators.
Wire Gauges.

GENERAL ELECTRICAL DATA.

Coulomb.
Ampere.
Volt.
Ohm.
Conductors and Insulators.
Ohm's Law.
Conductivity.
Divided Circuits.
Work, Energy.

CALCULATING SIZES OF WIRES.

Plans and Symbols.
Drop of Potential and Loss of Energy.
Practical Rules for Determining Sizes of Wires.
Safe Carrying Capacity.
The Three-wire System.
Explanation of Tables.
Appendix I. Plan for Wiring a Tall Office Building.
Appendix II. The Interior Conduit System.
Table No. 1, Gauges in Circular Mils.
Table No. 2, Electric Light Conductors.
Table No. 3, 50 Volt Lamps.
Table No. 4, 75 Volt Lamps.
Table No. 5, 110 Volt Lamps.

Elements of Electric Lighting.

BY PHILIP ATKINSON, A. M., PH. D.,

260 pages, 12 mo. 104 Illustrations. Price $1.50

This book is a revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. A complete and comprehensive treatise on electric lighting giving the latest practical facts with the least amount of technicality and mathematical formulæ; with full treatment of the dynamo, the storage battery and the principles of direct and alternate current lighting.

TABLE OF CONTENTS.

ELECTRICITY A MODE OF MOLECULAR MOTION. PRINCIPLES OF THE DYNAMO.

The Armature. The Commutator. Closed Circuit and Open Circuit. The Brushes. The Field Magnets, The Dynamo's Mode of Action. Difference of Potential. Reversed Currents. Commutation. The Armature's Mode of Action. Shunt and Series Dynamos Compared.

ALTERNATE CURRENT DYNAMOS.

Principles of the Alternate Current Dynamo. The Siemens-Halske Dynamo. The Lontin Dynamo. The Gordon Dynamo. The Westinghouse Dynamo. The Converter.

DIRECT CURRENT DYNAMOS.

The Edison Dynamo. The Weston Dynamo. The Sperry Dynamo. The Brush Dynamo. The Thomson-Houston Dynamo. The Western Electric Dynamo. The Ball Dynamo. The Mather Dynamo. The Van Depoele Dynamo. The Hochhausen Dynamo. The Wood Dynamo.

ELECTRIC TERMS AND UNITS.

Electric Potential. Electromotive Force. Resistance. Current. Electric Induction. Magnetic Induction. Conductivity and Insulation. Quantity and Intensity. Electric Units. The Volt. The Ohm. The Ampere. The Ampere Hour. The Coulomb. The Farad. The Microfarad. The Watt. The Electric Horse-Power. The Joule.

ELECTRIC MEASUREMENT.

The Potential Indicator. The Deprez-Carpentier Ammeter. Ayrton and Perry's Ammeter, Ayrton and Perry's Voltmeter. Ayrton and Perry's Spring Voltmeters and Ammeters. The United States Electric Lighting Co.'s Ammeter. The Western Electric Co.'s Ammeter. The Curdew Voltmeter. Ayrton and Perry's Meter. The Forbes Coulomb Meter. The Edison Current Meter. The Standard Light Unit. The Bunson Photometer.

THE ARC LAMP.

Principles of the Arc Lamp. Arc Light Carbons. The Jablochkoff Electric Candle. The Jamin Electric Candle. The Sun Lamp. Automatic Adjustment of Arc Light Carbons. The Foucault-Duboscq Lamp. The Serrin Lontin Lamp. The Brush Arc Light Lamp.

THE INCANDESCENT LAMP.

Reynier's Lamp. Early Experiments. Incandescent Light Carbons. The Edison Carbons. The Lane-Fox Carbons. The Cruto Carbons. Swan Carbons. The Weston Carbons. The Bernstein Carbons. General Details of Filament Construction. Construction of the Incandescent Lamp. Position of Lamps. Renewal of Lamps.

THE STORAGE BATTERY.

Electric Storage. Plante's Secondary Cell. Chemical Reaction in the Plante Cell. The Plante Battery. Faure's Secondary Cell. Chemical Reaction in the Faure Cell. Faults of the Faure Cell. The Improved Faure Secondary Cell. The Fluid. Electric Formation of the Plates. Electromotive Force. Resistance and Current of Cell. Weight of Cell and Thickness of Plates. Cause of Buckling. Variable Resistance of Electrolyte. Inspection. Formation of the Faure Battery. The Julien Accumulator.

ELECTRIC DISTRIBUTION.

Arc Light Distribution. Series Installation. Hefner von Alteneck's Regulator. Incandescent Light Distribution. The Direct Current System. Parallel Installation. Multiple Series Installation. Series Multiple Installation. Combined Arc and Incandescent Installation. The Edison Three-wire System. The Storage Battery System. The Induced Alternating Current System. The Primary Alternating Current System. Meters. Fuses. Switch Boards. Lighting Mines. Installation Rules.

SENT POST PAID ON RECEIPT OF PRICE. ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

W. N. Hobart, Pres't. L. O. Maddux, Vice-Pres't and Treas. J. H. Eickershoff, Sup't.
J. C. Hobart, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.
15 TO 300 HORSE-POWER. COMPOUND AND VALVELESS.
Most perfect regulation ever obtained.
NO SMALL PARTS REQUIRING REPAIRS. NO ECCENTRICS NO STUFFING BOXES.
NO PISTON RODS. INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.

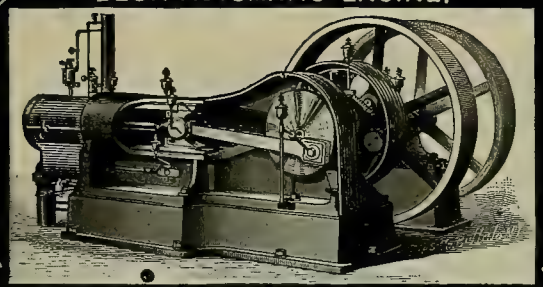
The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.
FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

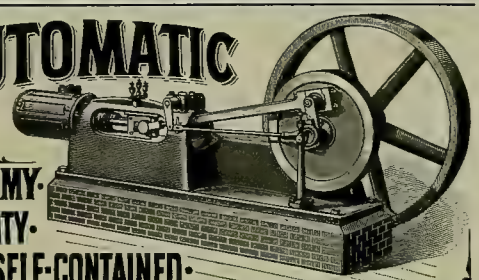
MATERIAL AND WORKMANSHIP OF THE BEST.
BECK AUTOMATIC ENGINE.
ECONOMY UNEXCELLED
REGULATIONS PERFECT
HOT BEARINGS UNKNOWN
PRICES MODERATE



TAYLOR MFG CO. CHAMBERSBURG, PA.
COMPLETE STEAM PLANTS A SPECIALTY

THE RICE AUTOMATIC

GUARANTEED ECONOMY.
REGULATION · DURABILITY ·
SIMPLICITY · SELF-CONTAINED ·
8 TO 300 H.P.
PAIR & TANDEM · COMPOUNDS ·
THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.



FAIRBANKS, MORSE & CO.,

St. Louis, Chicago, Kansas City, Denver, Omaha, St. Paul.

SELLING AGENTS.

You Will Oblige

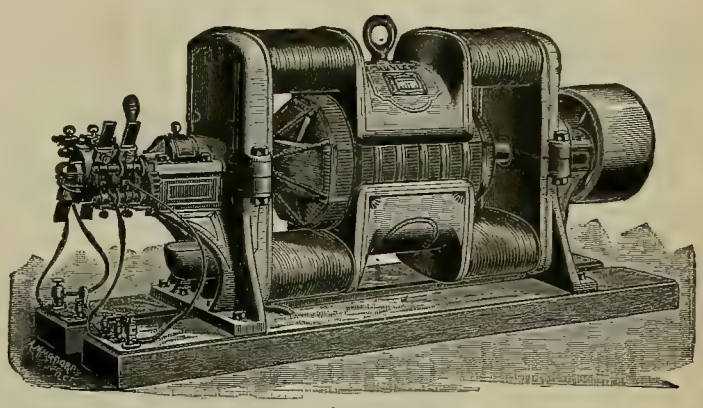
Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

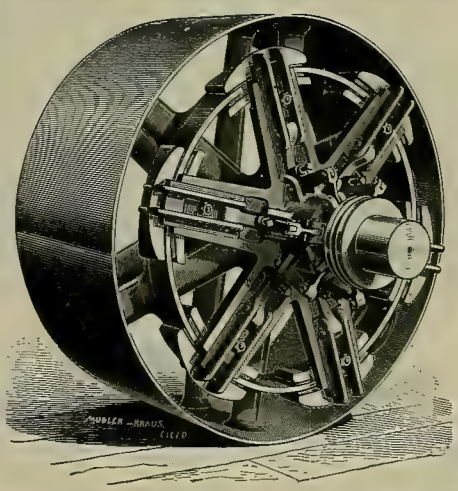
CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.



HILL

Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

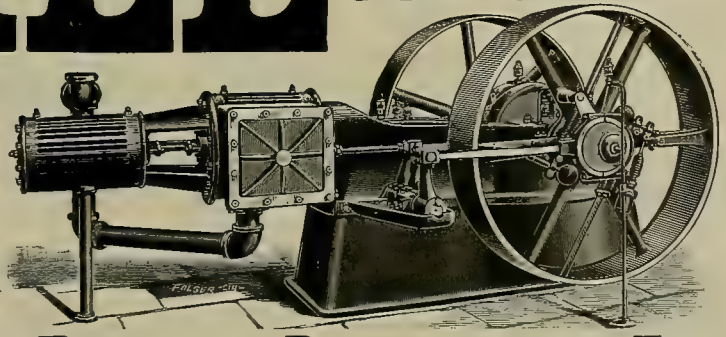
KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

BALL AUTOMATIC CUT OFF ENGINE

Standard.
Cross Compound.
Triple Expansion.
Tandem Compound



SELLING AGENTS:

C. R. VINCENT & CO.,
15 Cortlandt Street, NEW YORK.

J. W. PARKER
38 So. Fourth Street, PHILADELPHIA, PA.

COOLEY & VATER,
224 Washington Avenue, MINNEAPOLIS, MINN.

W. B. PEARSON,
Room 403 Home Insurance Building, CHICAGO, ILL.

WILLIAM T. BONNER,
618 New York Life Insurance Building, OMAHA, NEB.

ENGINES for ELECTRIC RAILWAYS and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

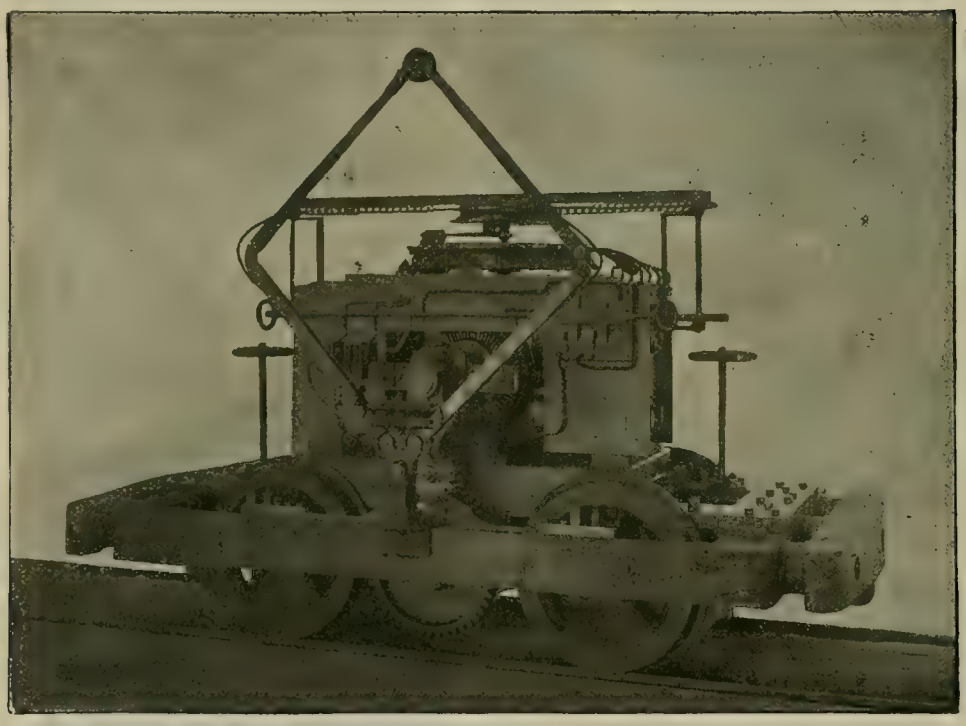
BALL ENGINE COMPANY, ERIE, PA.

THE

THOMSON-HOUSTON ELECTRIC CO.

TO THE OWNERS OF WATER OR STEAM POWER:

LONG DISTANCE TRANSMISSION OF POWER
by Electricity is now successful and economical.
A greater efficiency, both as to first cost and operating expenses, is guaranteed than by any other method of power transmission.
Electric power transmitted for any purpose and to drive any class of machinery.
ELECTRICITY IN MINES may be used for Hoisting, Pumping, Tram Cars, Ventilation, Drilling, and Lighting.



THOMSON-HOUSTON ELECTRIC MINING LOCOMOTIVE.

THOMSON-HOUSTON GENERATORS AND MOTORS

Cannot be Excelled for Durability and Efficiency.

We will be pleased to furnish on demand full information on our electric appliances and make estimates for transmission of power plants, and for the equipment of mines with Electric Power and Lighting Apparatus.

COMPLETE INSTALLATIONS, OR ELECTRIC MACHINERY ONLY, FOR ALL KINDS OF ELECTROLYTIC WORK, ESPECIALLY FOR THE

Electrolytic Refining of Copper.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.
CHICAGO, 148 Michigan Ave.
ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,

GENERAL WESTERN AGENTS

PERKINS ELECTRIC LAMP CO.

To Fit Any Socket, Any Candle Power,
Highest Efficiency.

GRIMSHAW WHITE CORE

Wires, Cables

and Tapes.

ANNUNCIATORS,

BURGLAR ALARM BELLS, BUTTONS, ETC.

PORCELAIN CUT-OUTS,

Main and Branch Cut-Outs, Rosettes and Switches, Underwriters' Weather Proof Wires and Line Supplies.

Write for Prices on these Specialties Our New Catalogue for 1891 Just Out.

54 & 56 FRANKLIN STREET, CHICAGO.

THE
ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
CHICAGO.

The Tough Lineman.

The crowd appalled, in mute suspense,
Gazed at the lineman, who, suspended,
Hung o'er the multitude so dense—
All fancied that his race was ended—
But when they took him down
These words the victim softly said:
"I s'pose it's dark all over town,
But I can't help it!" "Aren't you dead?"
They cried amazed—"Praised be the gods!
"O, no," he said, "I'm pretty tough;
They don't make volts and ohms enough
To kill me—I've sold lightning rods!"

—*New York Herald.*

The history of overhead wires in New York is "a story of the rear guard."

Where "Shield Brand" is used it is not necessary to employ ex-lightning-rod agents as linemen.

MORAL—Use "Shield Brand" Moistureproof Line Wire and avoid trouble.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

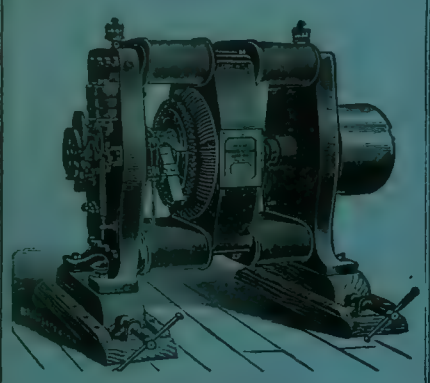
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



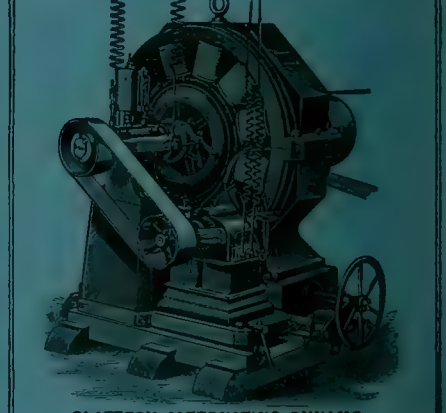
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK, - - - 115 Broadway.
CHICAGO, - - - 185 Dearborn St.
PHILADELPHIA, - - 907 Filbert St.
PITTSBURGH, - - - 533 Wood St.
DETROIT, MICH., - - 57 Gratiot Ave.
SAN FRANCISCO, 35 New Montgomery St.
TORONTO, CAN., - 138 King St. W.
DALLAS, TEX., - - McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

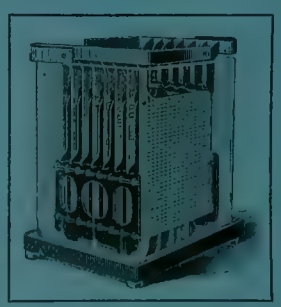
BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR CO.,

44 Broadway, NEW YORK.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 Carter Street, Philadelphia, Pa.
CHICAGO AGENCY:—239 La Salle St. SAN FRANCISCO:—220 Sutter St.
BOSTON:—HOLTZER-CABOT ELECTRIC CO., 111 Arch Street.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. VII. CHICAGO, DECEMBER 27, 1890. No. 26

Ireson's Self-Adjusting Leather-Link Belting.

Patd. Nov. 16, '86.

Especially adapted for all Electric purposes and other high-speed machinery.

Send for Ireson's Illustrated Treatise on Self-Adjusting Leather Link Belting, furnished gratuitously.

Manf'd by CHARLES L. IRESON, 97 High St., Boston, Mass.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE,

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

Are You Workin'

ELECTRIC RAILWAYS?

If so, 'tis well to know

THE STANDARD UNDERGROUND CABLE CO., Manufactures a SUPERIOR LINE OF

Insulated Wires and Cables.

CHICAGO. PITTSBURGH. NEW YORK.

MAGNOLIA METAL.

INDORSED BY THE UNITED STATES AND GERMAN GOVERNMENTS.

NEW YORK AND BROOKLYN BRIDGE, BROOKLYN, Nov. 7, 1890.

THE MAGNOLIA ANTI-FRICTION METAL CO., 74 Cortland Street, New York City.

GENTLEMEN:—This certifies that we have had your metal in use about six months on the crank pin of a four hundred and fifty horse power Wright engine, and also as packing rings on the piston rod of a locomotive. In both places it has given entire satisfaction, not causing the least trouble.

Yours very truly, C. C. MARTIN, Chief Engineer and Supt.

(2121)

ELECTRIC LIGHT,

HIGH OR LOW VOLTAGE.

The India-Rubber and Gutta-Percha Insulating Co.

VULCANIZED INDIA-RUBBER Cables, to any specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES,

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES AND CABLES, very pliable. Every variety of INCANDESCENT CORES.

UNDER WATER AND UNDERGROUND.

MANUFACTURERS OF

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High insulation and Long Life, all millage.

WM. M. HABIRSHAW, F. C. S., Gen'l Mgr., Offices: 159 Front St., NEW YORK, U. S. A.

Western Agents: THE ELECTRICAL SUPPLY CO., 171 Randolph St., CHICAGO, ILL.

MARINE ELECTRIC LIGHT Installations

STANDARD MARINE CORES to any Millage or Specification up to 9,000 Megohms per knot.

TWO-CIRCUIT CONCENTRIC CABLES, both circuits, 9,000 Megohms per knot.

NAVY PORTABLES, SILK, COTTON and HEMP.

BELL WIRE, rubber covered, for Marine Work.

PLIABLE CABLES, for Search Lights.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use. Subterranean Use, Submarine Use. Concealed Wiring in all Locations

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

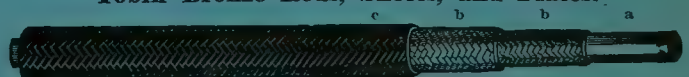
ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

Tobin Bronze Rods, Sheets, and Plates.



CUT SHOWING STYLE OF INSULATION.

a.—Copper Wire. b. b.—Two Braids, saturated with Fire-Proof Insulation. c.—Braided Cotton, saturated with a black, Weather-Proof Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff Street, New York, / 133 and 135 Wabash Ave., Chicago, Ill.

FACTORIES: ANSONIA, CONN.

THE MILLIKEN PATENT ELECTRIC RAILWAY POLE.

MANUFACTURED BY

MILLIKEN BROS.,

No. 55 LIBERTY STREET, NEW YORK. | No. 59 DEARBORN STREET, CHICAGO.

Standard Side, Center and "Pull-Off" Poles. Special Attention Given to Insulation. Special Poles of any Required Length, or to Stand any Strain Made to Order.

Adopted by all the Leading Roads and Recommended by the Best Engineers.

In use in the following cities: NEWARK, BUFFALO, JERSEY CITY PATERSON, TROY, PITTSBURGH, HAMILTON, O., ETC.

Over 6,000 Ordered in the Last 3 Months.

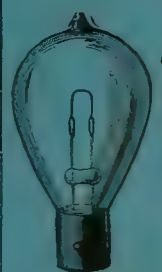
ORDERS FOR STANDARD POLES FILLED FROM STOCK.

WRITE FOR PARTICULARS.

E-D-I S-O-N

Miniature Incandescent

ELECTRIC LAMPS.



1-2 to 36 Candle Power.

For use with Batteries or Dynamos.

3 to 40 Volts.

We will Send Free, Catalogue E,

Which shows prices of, and experiments with Edison Lamps, and gives directions

How to Make a Cheap Battery,

And how to operate them. Any intelligent boy can operate these batteries and lamps.

EDISON LAMP COMPANY, Harrison, N. J.

CENTRAL STATION STATISTICS

Of the Central Stations in operation July 1st, 1890, in

ALABAMA. **CONNECTICUT.** **DISTRICT OF COLUMBIA.**

50% **73%** **100%**

Were using Thomson-Houston apparatus as evidenced by the following figures.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all Systems.
Alabama, - - - -	20	10	50 per cent.
Connecticut, - - -	26	19	73 per cent.
District of Columbia, -	1	1	100 per cent.

Do not be startled by these figures but remember them and bear in mind the fact that more will be presented for your consideration next week, and that there are **22 STATES** in this country, in each of which our system is used in upwards of **50 PER CENT** of the Central Stations.

A WORTHY TRIBUTE

To our automatically regulated dynamos, noiseless and steady arc lamps, long lived incandescent lamps, and the perfected details and economical operation of our system.

THOMSON-HOUSTON ELECTRIC CO.,

620 Atlantic Avenue, Boston, Mass.
Wall and Lloyd Streets, Atlanta, Ga.
115 Broadway, New York City.
15 First Street, San Francisco, Cal.
266 First Street, Portland, Ore.
831 New York Life Building, Kansas City, Mo.
148 Michigan Avenue, Chicago, Ill.
405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co. ——
Abendroth & Root Mfg. Co. xiii
Alexander, Barney & Chapin. xix
American Electrical Works. xiii
Ansonia Brass & Copper Co. i
Automatic Switch Co. vi
Baggot, E. xiv
Bain, Foree. xiv
Ball Engine Co. xiv
Barnes, W. F. & Jno. xxi
Barton, Geo. P. ——
Baxter Electric Motor Co. xxvi
Bernstein Electric Co. xxi
Bleckert & Nelson. xvi
Borden & Selleck Co. xv
Brush Electric Co. xxv
Bubier Publishing Co. ——
Buckeye Electric Co. xiv
Bunnell & Co., J. H. xii
Butler Hard Rubber Co. xx
C. B. & Q. R. R. ——
C. & C. Electric Motor Co. xvi
C. & N. W. R. R. Co. ——
Calkins & Son, J. W. xiii
Central Electric Co. ix
Chicago Electric Club. ——
Cincinnati Electric Light Co. xiii
Cleverly Electrical Works. iv
C. M. & St. P. R. R. Co. ——
Colburn & Co., I. W. xv
Columbia Incandescent Lamp Co xv
Connecticut Motor Co. vi
Consolidated Electric Storage Co. ——
Continental Dynamo Co. ——
Cowles Electric Smelting and Aluminum Co. xv
Crocker-Wheeler Motor Co. xiii
Crosby Electric Co. iv
Curtis Regulator Co. xiv
Day's Kerite Insulation. i
Dayton Globe Iron Works Co. xvi
Delany, P. B. ——
Eastern Electric Cable Co. xiii
Edison Mfg. Co. xxi
Edison General Electric Co.,— Lighting and Power Dept. viii
Edison General Electric Co.,— Lamp Dept. i
Electric Construction & Sup. Co iv
Electrician Publishing Comp'y ——
Electrical Supply Co. xxiv
Elektron Mfg. Co. vii
Empire City Electric Co. xvi
Empire China Works. xiv
Eureka Tempered Copper Co. xv
Evans Friction Cone Co. xvii
Fibrone Mfg. Co. xiii
Fletcher & Fletcher Electric Co xv
Forest City Electric Works. ——
Fort Wayne Electric Co. xxvi
Gibson Co., W. D. iv
Globe Carbon Co. xv
Great Western Electric Sup. Co. v
Greeley & Co., E. S. ——
Harmount, G. A. vi
Hawkeye Electric Mfg. Co. iv
Hazelton Tripod Boiler Co. xiv
Heisler Electric Light Co. ——
Hill Clutch Works. ——
Holmes, Booth & Haydens. xv
Holtzer-Cabot Electric Co. i
Humphrey, H. H. ——
Hutton, Henry. xiv
Illinois Electric Material Co. xii
India Rubber & Gutta Percha Insulating Co. i
Interior Conduit & Insulation Co. xii
Ireson, Chas. L. i
Jewell Belting Co. xiii
Jones Bros. Electric Co. xvii
Knapp Electrical Works. xxiii
Laminar Fibre Goods Co. xv
Law Telephone Co. xiii
Leclanche Battery Co. vii–xix
Leffel & Co., Jas. xiv
McLaughlin, James. xiv
Magnolia Anti-Friction Metal Co i
Mason, James H. xxi
Milliken & Co. i
Monitor Electric Co. vi
Munsell & Co., Eug. xiii
Munson Belting Co., Chas. xii
National Carbon Co. iv
National Electric Mfg. Co. x
Northwest Thom'n-Houston Co. xviii
Noye Mfg. Co., Jno. T. ——
N. Y. Belting & Packing Co. xii
Okonite Co. xiii
Ostrander & Co., W. R. xvi
Paiste, H. T. xii
Peckham Street-Car Wheel & Axle Co. vi
Partrick & Carter xx
Pennsylvania Co. ——
Phillips Electrical Works, E. F. xiii
Phoenix Glass Co. xxvi
Pittsburgh Sheet Metal Tool Co. xiv
Pond Engineering Co. xxi
Powell Co., Wm. xiv
Queen & Co. xiv
Roeblings' Sons Co., Jno. A. xvii
Sawyer-Man Electric Co. xi
Schieren & Co, Chas. A. xii
Schoverling, A. ——
Schuyler Electric Co. xx
Shultz Belting Co. ——
Southern Electrical Supply Co. xxi
Sperry Electric Co. xvi
Standard Electrical Works xiv
Standard Paint Co. xii
Standard Underground Cable Co. i
Standard Carbon Co. xx
Stanley & Hall. xii
Star Electrix Co. vii
Stephenson & Co., Jno. xix
Stiff, E. D. & Co. xiv
Stiles, W. A. xiii
Stillwell & Bierce Mfg. Co. xiv, xv
St. Louis Electrical Supply Co. xvii
Sunbeam Incand. Lamp Co. xiii
Taussig, S. xv
Taylor Mfg. Co. xx
Thomson-Houston Electric Co. Lighting department. ii
Thomson-Houston Electric Co., Railway department. xxii
Triumph Compound Engine Co xx
Turner Brass Works. xiii
Union Hardware Co. xii
United Electric Traction Co. vii
United States Electric Lighting Co. ——
Van Nuis C. S. ——
Wanted. xv, xvi
Western Electric Co. xvi
Westinghouse Electric and Mfg. Co. xi
Weston Electrical Instrument Co. xiv
Wollensak, J. F. iv
Woodbridge & Turner. xv

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.
Consolidated Electric Storage Co.

Aluminum.
Cowles Electric Smelting & Refining Co.

Annunciators.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co. E. S.
Holtzer-Cabot Electric Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.,
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Anti Friction Metal.
The Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Arc Lamps.
Brush Electric Co.
Electric Construction & Supply Co
Foree Bain.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Northwest Thomson-Houston Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Bubier Mfg. Co.
Bunnell & Co., J. H.
Central Electric Co.
Crosby Electric Co.
Edison Mfg. Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Jones Bros. Electric Co.
Law Telephone Co.'
Leclanche Battery Co.
Mason, J. H.
Monitor Electric Co.
Partrick & Carter.
Queen & Co.
Schoverling, A.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Holtzer-Cabot Electric Co.
Partrick & Carter.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.,
Knapp Electrical Works.
Monitor Electric Co.
W. R. Ostrander & Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stanley & Hall.
Wollensak, J. F.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., E. S.
Holtzer Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Stanley & Hall.
Star Electrix Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
Jewell Belting Co.
Chas. Munson Belting Co.
Mason, James H.
N. Y. Belting & Packing Co
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.

Books Electrical.
Electrician Publishing Co.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Jones Bros Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Standard Electrical Works.

Cables.
(See wire insulated.)

Cable Electric (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Standard Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Stephenson Co., John

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain, Foree.
Electric Construction & Supply Co.
Knapp Electrical Works.
McLaughlin, Jas.
N. W. Thomson-Houston Co.
Stiff, E. D. & Co.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
H. H. Humphrey.
Henry Hutton.
McLaughlin, Jas.
National Conduit Mfg. Co.
Northwest Thomson-Houston Co.
Pond Engineering Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric Co.
Western Electric Co.
Western Power Construction Co.
Woodbridge & Turner.

Copper Wires and Tapes.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Phillips, Eug. F. Electrical Works.
Roebling's, Jno. A. Sons Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Illinois Electric Material Co.
Partrick & Carter.
Paiste, H. T.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Star Electrix Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain, Foree.
Colburn & Co., I. W.
Continental Dynamo Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Partrick & Carter.
Queen & Co.
Star Electrix Co.
Stiff, E. D. & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electric Railways
Edison General Electric Co.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner.

Electroliers and Combination Fixtures.
Baggot, E.
Bleckert & Nelson.
Great Western Electric Supply Co.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Noye Mfg. Co., Jno. T.
Taylor Manufacturing Co.
Triumph Compound Engine Co.

Fire Alarms.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Stiff, E. D. & Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting Electric.
Cleverly Electrical Works.
Electrical Supply Co.
Knapp Electrical Works.
Partrick & Carter.
Western Electric Co.
Wollensak, J. F.

General Electrical Supp'lies.
Alexander, Barney & Chapin.
American Electrical Works.
Ansonia Brass & Copper Co.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Cleverly Electrical Works.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co.
Empire City Electric Co.
Fletcher & Fletcher Electric Co.
Forest City Electrical Works.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Holtzer-Cabot Electric Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Okonite Co.
Ostrander & Co., W. R.
Partrick & Carter.
Southern Electrical Supply Co.
Stanley & Hall.
Star Electrix Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Stiff & Co., E. D
Turner Brass Works..
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.
Wollensak, J. F.

Globes and Electrical Glassware.
Great Western Electric Supply Co.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Fibrone Mfg. Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
Knapp Electrical Works.
Laminar Fibre Goods Co.
Monitor Electric Co.
Munsell & Co., Eugene.
Okonite Co.
Partrick & Carter.
Standard Paint Co.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Insulated Wires and Cables Magnet Wire.
American Electrical Works.
Central Electric Co.
Day, A. G.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Interior Conduit & Insulating Co.
Interior Conduit & Insulation Co.
India Rubber & Gutta Percha Insulating Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Okonite Co.
Partrick & Carter.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Standard Electrical Works.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Eureka Tempered Copper Co.
Magnolia Anti-Friction Metal Co.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Lamp Co.
Edison General Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley E. S. & Co.
Heisler Electric Light Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwest Thomson-Houston Co.
Sawyer-Man Electric Co.

Lamps, Incandescent—Con'd
Southern Electrical Supply Co.
St. Louis Electrical Supply Co
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lathes and Machine Tools.
W. F. & John Barnes Co.

Magnet Wire.
(See insulated wire.)

Medical Batteries.
Fletcher & Fletcher Electric Co.
Partrick & Carter.

Mica.
Eug. Munsell & Co.

Mining Apparatus, Electric.
Bain, Foree.
Sperry Electric Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Foree.
Brush Electric Co.
Baxter Electric Motor Co.
Connecticut Motor Co.
Crocker-Wheeler Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Sperry Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Patent Solicitors.
Barton, Geo. P.

Pins and Brackets.
Central Electric Co.
Electric Supply Co.
Great Western Electric Supply Co
Illinois Electric Material Co.
Standard Electrical Works.
Southern Electrical Supply Co.
St. Louis Electrical Supply Co.
Western Electric Co.

Poles.
Central Electric Co.
Electrical Supply Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Milliken & Co.

Publishers Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co.
Fletcher & Fletcher Electric Co.
Great Western Electric Supply Co.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Standard Electrical Works.
Union Hardware Co.
Western Electric Co.

Railways Electric.
(See electric railways.)

Speaking Tubes.
Central Electric Co.
Electrical Supply Co.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Western Electric Co.
Wollensak J. F.

Speed Indicators.
Queen & Co.

Springs.
Gibson Co., W. D.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Co., Wire Dept.
Electrical Supply Co.
Great Western Electric Supply Co.
India Rubber & Gutta Percha Insulating Co.
Illinois Electric Material Co.
Okonite Co.
Western Electric Co.

Telegraph Apparatus.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co.
Empire City Electric Co.
Great Western Electric Supply Co.
Greeley & Co., E. S.
Jones Bros. Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter.
Standard Electrical Works.
Western Electric Co.
Writing Telegraph Co.

Telephones, Electric.
Standard Electrical Works.
Western Electric Co.

Test Instruments.
Bain, Foree.
Central Electric Co.
Electrical Supply Co.
Greeley & Co., E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Trucks, Electric Car.
Edison General Electric Co.
Peckham Street-Car Wheel & Axle Co.
Stephenson Co, Jno.
Thomson-Houston Electric Co.
United Electric Traction Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works.
Leffel & Co., James.
Stillwell & Bierce Mfg. Co.

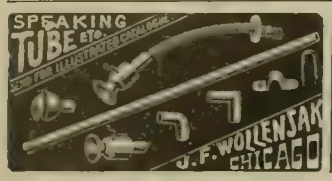
Wire, Bare.
American Electrical Works.
Ansonia Brass & Copper Co.
Central Electric Co.
Electrical Supply Co.
Holmes, Booth & Haydens.
Illinois Electric Material Co.
Knapp Electrical Works.
Partrick & Carter.
Roebling's Sons, Jno. A. Co.
Western Electric Co.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.



Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.

—WE MAKE—

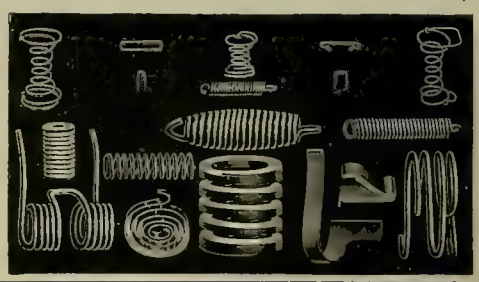
Electric Supplies Under Contract.

THE WM. D. GIBSON CO.,

65 N. Jefferson St.,
CHICAGO, ILL.

SPRINGS

FOR ELECTRICAL MACHINERY A SPECIALTY.



GIVES A CLEAR AND STEADY LIGHT.

THE ONLY COMMERCIAL ARC LAMP FOR INCANDESCENT CIRCUITS.

Burning 2 in Series on Circuits of 100 to 120 Volts.
Will Use 6½, 8 or 10 Amperes of Current.

Please state System and Voltage Used. Address

THE ELECTRIC CONSTRUCTION & SUPPLY CO.

18 Cortlandt St., NEW YORK CITY.

We Guarantee Them Electrically and Mechanically.

CROSBY DRY BATTERIES

FOR OPEN CIRCUIT WORK.

ELECTROMOTIVE FORCE, 1.55 VOLTS.
CURRENT 1 TO 15 AMPERES.

THE ONLY BATTERY SOLD SEMI-CHARGED.

DOES NOT WORK UNTIL WANTED.

ONLY A SMALL QUANTITY OF PURE WATER NECESSARY TO CHARGE IT.

NEAT, CLEAN, EFFECTIVE, SIMPLE, COMPACT, PORTABLE.

RECUPERATES QUICKER AND OFTENER THAN ANY OTHER.

MADE IN ALL SHAPES AND SIZES.

TELEPHONE FOR LONG OR SHORT DISTANCE.

FOR GAS LIGHTING, ANNUNCIATORS, BELLS, BURGLAR ALARM AND MEDICAL USES

IT HAS NO EQUAL.

For Circulars and Price Lists apply to Principal Office

CROSBY ELECTRIC CO.,

87 and 89 South Fifth Avenue, - - NEW YORK.

THE HAWKEYE

ELECTRIC MFG. CO.,

DAVENPORT, - - IOWA.

BUILDERS OF

Complete Central Station AND ISOLATED PLANTS,

ARC AND INCANDESCENT APPARATUS.

OUR DYNAMOS are unsurpassed by any made for efficiency, automatic regulation, and general workmanship.

Licensee of the ***Renowned Perkins Incandescent Lamps,*** Famous for long life without discoloration.

ELECTRIC MOTORS for Railway Circuits and Central Stations; any voltage, highest efficiency, all sizes.

Prices Reasonable. - Write us for Catalogue and Price List.

SPECIAL!

THIS WEEK OUR "SPECIAL" IS

ELECTRIC FIXTURES.

We have in stock about $40,000 worth of almost every style and variety.
We will sell these at manufacturers' prices.

We have a stock of over a quarter of a million dollars worth of

Electric Supplies

OF EVERY KIND AND DESCRIPTION.

OUR MOTTO: { Large Sales, Small Profits.

We agree to give our customers
The Best Goods
For the Least Money,
and Guarantee Prompt Delivery.

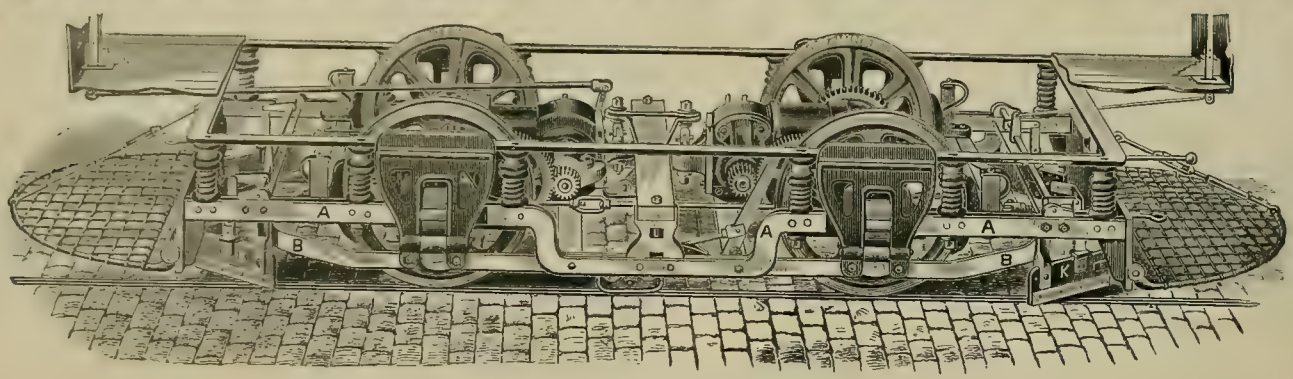
MAIL ORDERS RECEIVE THE SAME CAREFUL ATTENTION AS THOSE GIVEN IN PERSON.

THE GREAT WESTERN

ELECTRIC SUPPLY CO.,

190 & 192 FIFTH AVENUE, CHICAGO, ILL.

PECKHAM'S IMPROVED
CANTILEVER MOTOR TRUCK.



EQUIPPED WITH

"Peckham's Patent" Interchangeable Wheels, Safety Life Guards, Track Brakes Ice and Snow Scraper, Pendulum Motor, Hangers and Rubber Capped Springs,

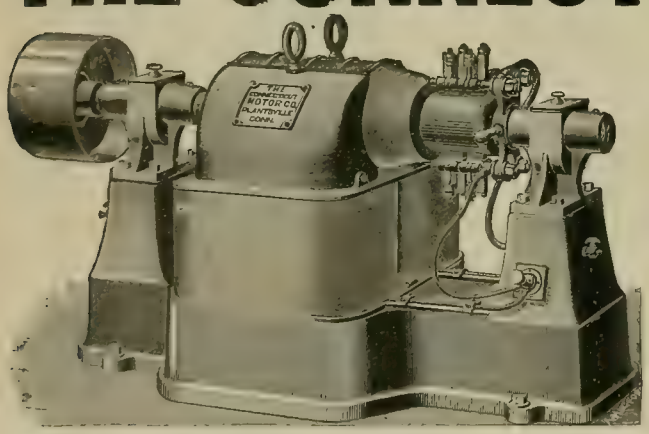
WARRANTED TO PREVENT OSCILLATION OF CARS.

The Strongest, Safest and Most Efficient Motor Truck in Use.

For Descriptive Circulars, Price Lists and Testimonials, Apply to

THE PECKHAM STREET CAR WHEEL & AXLE CO., 45 Broadway, NEW YORK.

THE CONNECTICUT MOTOR CO.,



OFFICE AND WORKS:

PLANTSVILLE, - - CONN.

CONSTANT POTENTIAL

Electric Motors and Generators

1-2 TO 50 HORSE POWER.

FIRST-CLASS WORKMANSHIP AND HIGH EFFICIENCY.

NEW YORK, 127 Fifth Ave. BOSTON, 32 Oliver St. PHILADELPHIA, 17 W. Sixth St.
HARTFORD, 14 State St. ST. LOUIS, 823 Locust St. CHICAGO, 302 Insurance Exchange Building.

CORRESPONDENCE SOLICITED WITH CENTRAL STATIONS AND INDIVIDUAL USERS.

AUTOMATIC SWITCH CO.,

No. 8 KEYSER BUILDING,

BALTIMORE, MD., U. S. A.

Sole Manufacturers of the

WHITTINGHAM AUTOMATIC SWITCH.

The only reliable protector to the Armature of an Electric Motor.

Applicable to Constant Potential Motors of all sizes and patterns.

SEND FOR CATALOGUE.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

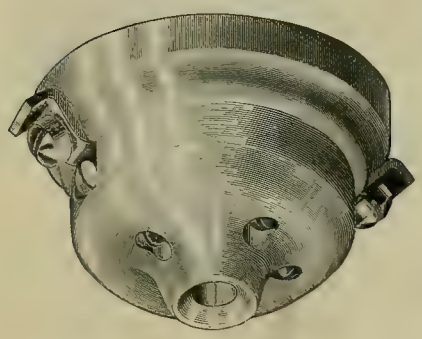
WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

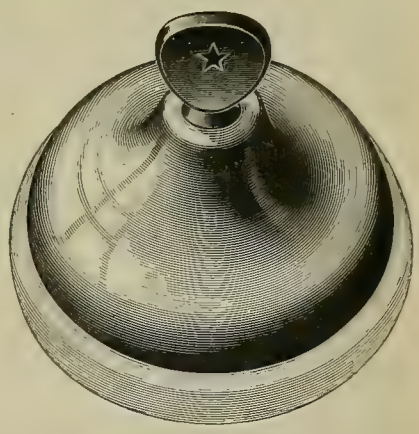


The day is rapidly passing when Electric Light Companies will be reproached with using "cheap," "crude," "unsightly" and "bungling" devices, in the installation of plants.

There is a demand for switches, cut-outs, etc., equal in design, workmanship and service to other hardware articles of interior finish, and this demand can now be supplied.

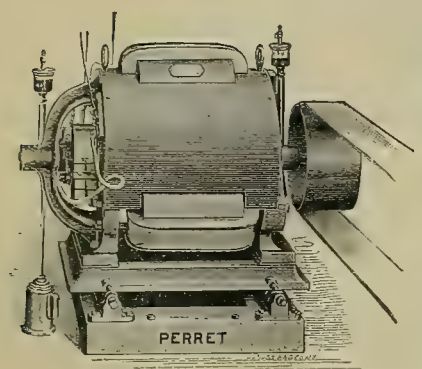
If your dealer does not handle this class of goods, write to us.

THE STAR ELECTRIX CO.,
1320 Wallace Street,
PHILADELPHIA, PA.



THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



Perret 20 H. P. Motor, Speed 550. Weight 1,300 lbs.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power.
Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., C. M. Barclay, 205 Canal St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
BALTIMORE, MD., W. W. Donaldson, 215 N. Calvert St.
ST. PAUL, MINN., F. J. Renz, 327 Minnesota St.
PHILADELPHIA, PA., Cleverly Electrical Works, 1018 Chestnut St.

UNITED
Electric Traction Co.

ELECTRIC RAILWAYS.

STREET OR TRUNK LINES.

ELEVATED OR UNDERGROUND.

Central Stations for Power Distribution.

STATIONARY MOTORS.
STORAGE BATTERIES.

Executive Offices: 115 BROADWAY, NEW YORK.

AGENCIES, 926 Drexel Bldg., Philadelphia; 456 Rookery Bldg., Chicago.
111 Water St., Pittsburgh, Pa.

FACTORY: JERSEY CITY, N. J.

TRADE MARK REGISTERED.

For 20 years the superiority of the Gonda Trade Mark Batteries has been recognized all over the world in repeated triumphs over all competitors. Beware of imitations. When you buy a cell for Telephones, Call Bells, Electric Clocks, Gas Lighting, Burglar Alarms, Medical Batteries, Etc., Etc., be sure that it is marked with the word Gonda.

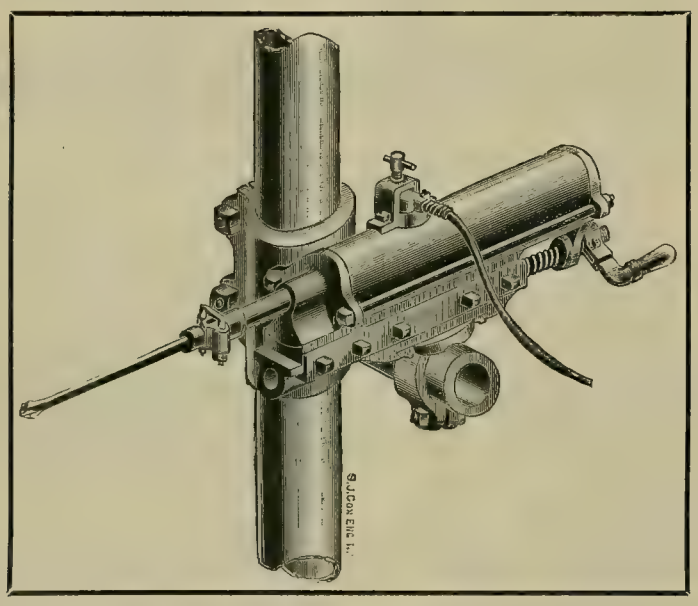
The LECLANCHE BATTERY CO., NEW YORK.

EDISON GENERAL ELECTRIC CO.

EDISON BUILDING, BROAD ST., NEW YORK.

ELECTRIC PERCUSSION DRILLS

(THE MARVIN SYSTEM OF PERCUSSION TOOLS.)



This Drill contains no Commutator, nor Moving Contacts.
All Circuits are protected in closed Metallic Cases.
More Economical, Simpler, and More Easily Handled than Steam or Air Drills.
Safe and Reliable; Not Affected by Moisture, Dampness or Dripping Water.
Can be Operated by ordinary Miners and Quarry Men.
Weight of Drill with Tripod, about 400 pounds.
Speed of Drilling in Hard Granite, 2 inch hole, 2 inches deep per minute.

Please address all communications for Circulars and Prices to nearest District Office as indicated below.

MAIN DISTRICT OFFICES:

Canadian District, Bank of Commerce Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 38 Pearl Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, Cotton Exchange Bldg., New Orleans, La.

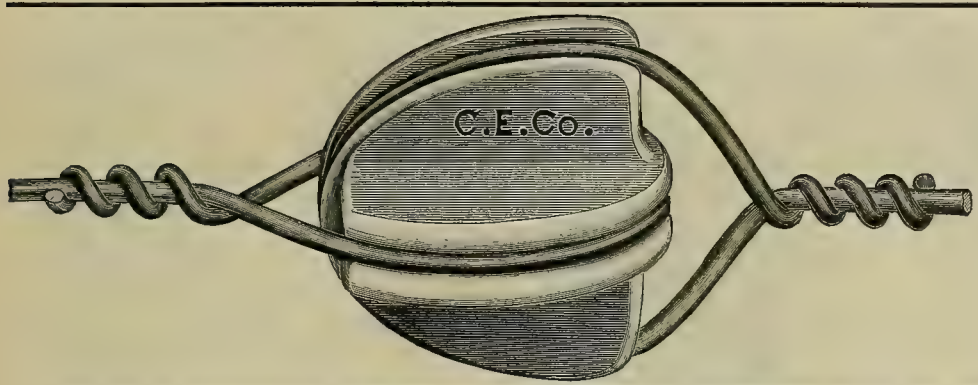
OKONITE
TRADE MARK.
General Western Agents
— FOR —
OKONITE WIRE.

Central Electric Co., CANDEE

116 & 118 Franklin St., CHICAGO.

General Western Agents
— FOR —
IMPROVED
CANDEE WIRE.

We take pleasure in presenting to the trade two new specialties in Insulators that must commend themselves to every practical construction man as being the best things of their kind in the market.

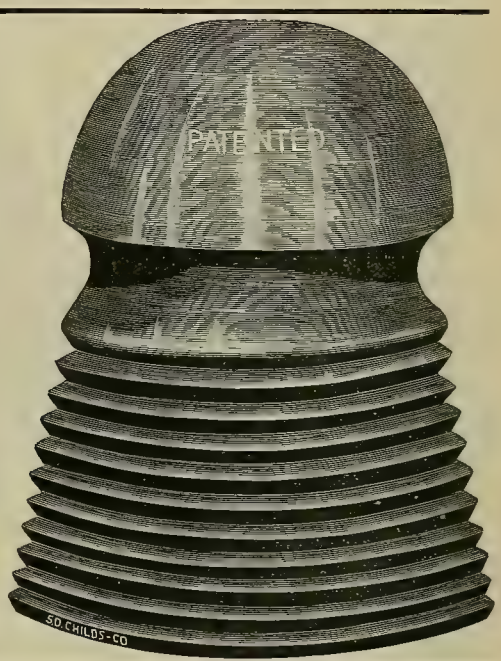


THE
Bain Break Insulator

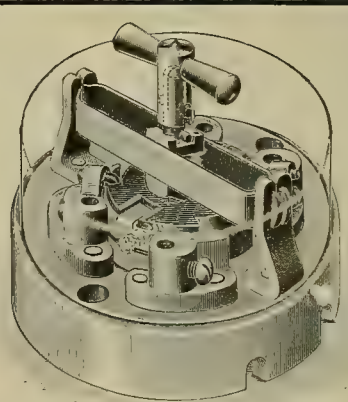
For Suspending Arc Lamps, Insulating Guy Wires, Insulating Span Wires in Electric Railroad Work, is so simple and perfect in construction as to need no explanation.

THIS NEW
HIGH RESISTANCE GLASS
INSULATOR

Is made of extra heavy glass, and is especially designed for large Electric Railroad Feeder and Primary Electric Light Wires. The glass surface between the Wire and Pin is more than doubled as compared with the ordinary Insulator.



We can also offer attractive prices in specially prepared Fuse Wire, Perkins' Switches, K. W. Cut-Outs, and everything Electrical worth having.



CENTRAL ELECTRIC CO.,

116 & 118 Franklin Street, CHICAGO.

Connected by Private Wire with Postal-Telegraph Cable Company System.

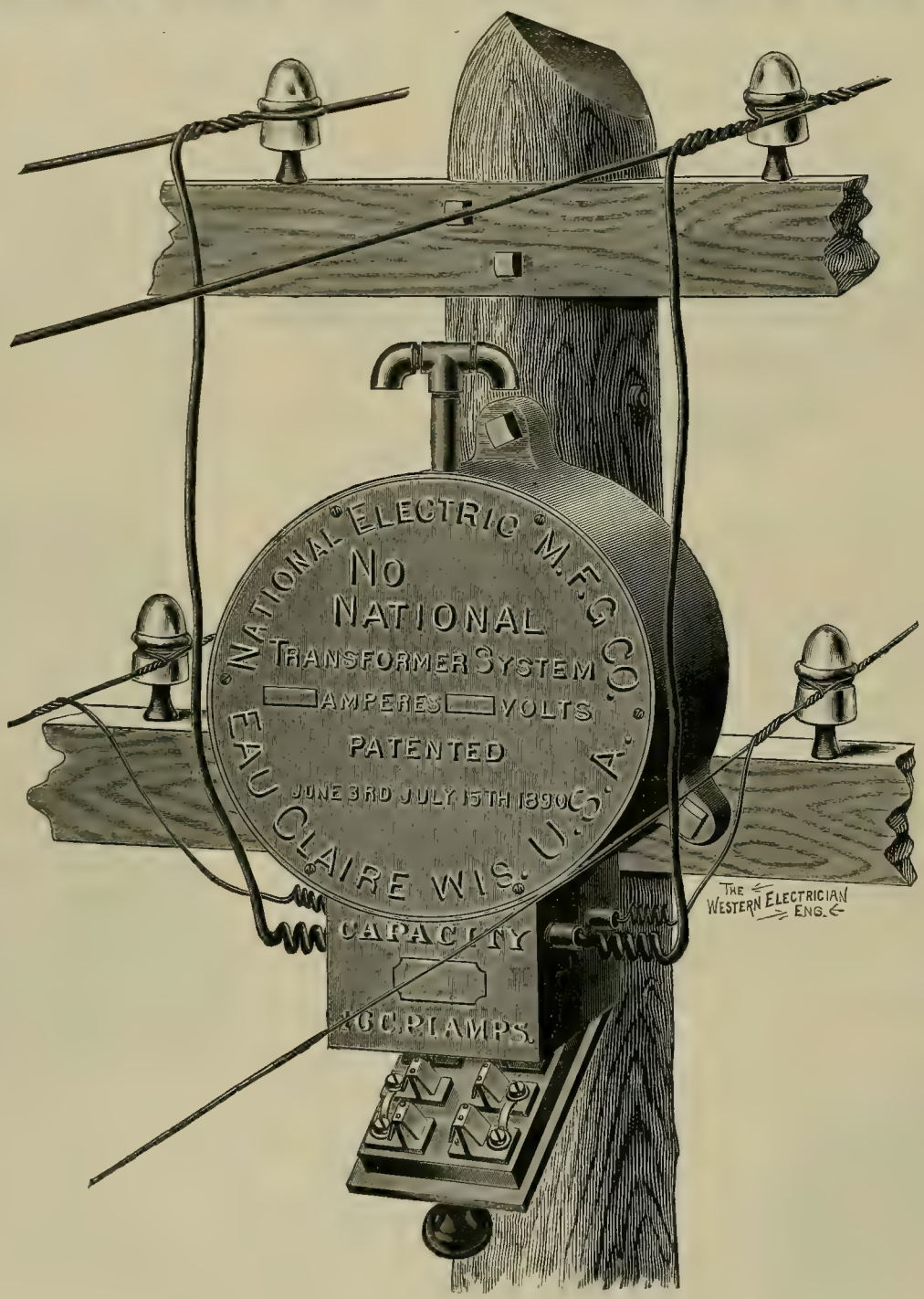
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



Transformer on Pole Showing National Safety Fuse Box.

No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, {95.2%.} They are absolutely safe. Their regulation is practically perfect.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

BAKER, BALCH & CO., Gen'l Agts., - - - - - - Seattle, Washington.	W. N. GRAY, Special Agt., - - Room 12, Chamber of Commerce, Cincinnati, O
THOMAS WOLFE, Southwestern Agt., - - Union Depot Hotel, Kansas City. Mo.	NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Tower Bldg , 50 Broadway, N. Y. City.
LITTLE, McDONALD & CO., Gen l Agts., - - 141 East Seneca St., Buffalo, N. Y.	NATIONAL ELECTRIC DEVELOPMENT CO., - 314 California St., San Francisco, Cal.
METCALF, REED & CO , Western Agts., - - - 1517 Larimer St.. Denver, Colo.	SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Agts., - Winnipeg, Manitoba.
CHAS. M. BLANCHARD, Agt., - - - - Girard Building, Philadelphia. Pa	A. IRVINE, Agt., - - - - - - - Emilie Building, St. Louis, Mo
L. N. COX, Agt , - - - - - - - 16 Fifth St., S. E., Washington, D. C.	

POWER

LONG DISTANCE TRANSMISSION.

WATER POWERS MADE PROFITABLE.
STEAM PLANTS SUPERSEDED.

240 Horse Power furnished at a point seven miles from Generator over a circuit of No. O. B. and S. Wire, loss 15 per cent.
Send us data and we will furnish full estimates of

ELECTRICAL APPARATUS.

WESTINGHOUSE ELECTRIC AND MFG. CO.,

PITTSBURGH, PA., U. S. A.

Boston. New York. Chicago. St. Louis. San Francisco. Charlotte, N. C.

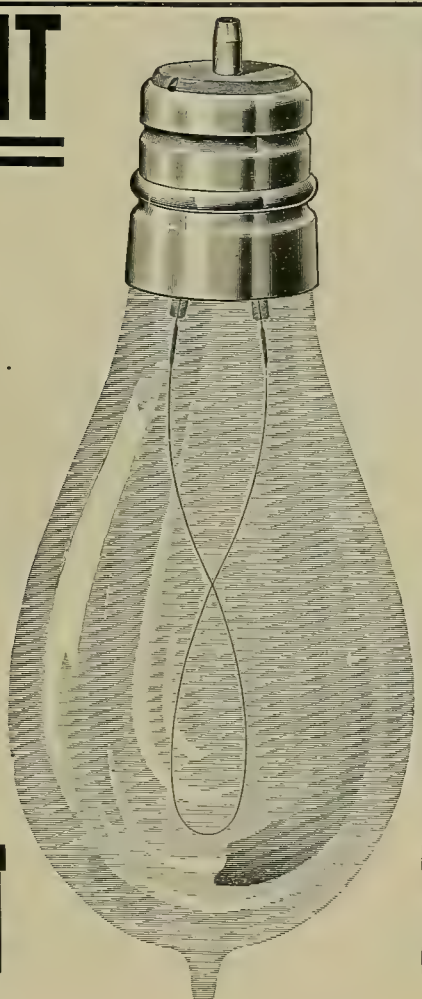
INCANDESCENT LAMPS.

To Fit any Socket.

FROM 8 c. p. to 150 c. p., AND ANY VOLTAGE.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.

Even Diffusion of Light by twisted filament.



THE BEST IS

THE CHEAPEST.

General Electrical Supplies of Superior Designs and Finish.

Send for our CATALOGUE of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

510-534 West 23d Street, **NEW YORK.**

620 Atlantic Avenue, **BOSTON, MASS.**

217 La Salle Street, **CHICAGO, ILL.**

BURNLEY DRY BATTERY

PATENTED January, 1890.

STRONGER than any open circuit
BATTERY on the market.
BETTER than any Dry Battery yet produced.

The most Compact and the Cheapest. 90c per cell. Discounts in quantities and to the trade.

CHICAGO:--Central Electric Co.

J. H. BUNNELL & CO., Sole Mfrs. and Gen. Agents. 76 Cortlandt St., N.Y.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

DUST-PROOF BELLS.

None Genuine Without the Washer.

STANLEY & HALL,

(Formerly **HAZAZER & STANLEY,**)

32 and 34 Frankfort St.,

NEW YORK.

NEW YORK BELTING & PACKING CO

JOHN H. CHEEVER, Treas., 15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES.

RUBBER BELTING PACKING AND HOSE.

ENDLESS BELTS

Particularly adapted for Dynamo uses; made of any width or length to order, at a week's notice.

SALESROOMS:
PHILADELPHIA, 308 Chestnut St.
BOSTON, 52 Summer St.
CHICAGO, 151 Lake St.
DENVER, 1601-1611 17th St.
CHARLESTON, 160 Meeting St.
GRAND RAPIDS, 4 Monroe St.
MINNEAPOLIS, 28 South 2d St.
CLEVELAND, 176 Superior St.
SAN FRANCISCO, 17 Main St.

SALESROOMS:
ATLANTA, 16 Decatur St.
DETROIT, 16-24 Woodward Ave.
BALTIMORE, 12 N. Charles St.
BUFFALO, 124-128 Washington St.
NEW ORLEANS, 8-12 N. Peters St.
KANSAS CITY, 1311 and 1313 W. 12th St.
ST. LOUIS, 616 Locust St.

FOR INSIDE WORK USE "BISHOP" WHITE CORE WIRES.

"ELECTRIX" INCANDESCENT SNAP-SWITCHES, CUT-OUTS, ROSETTES, SOCKETS, INSULATING JOINTS, GAS ATTACHMENTS, ETC.

ALL FIRST-CLASS GOODS. REASONABLE PRICES.

THE ILLINOIS ELECTRIC MATERIAL CO., 339-341 Rookery Bldg., CHICAGO.

THE TUBES OF THE INTERIOR CONDUIT & INSULATION CO.

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A simple solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and in all places where Insulation is required.

INTERIOR CONDUITS { Indorsed by the leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Board of Fire Underwriters.

UNDERGROUND CONDUITS { Are equally successful and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, Address

INTERIOR CONDUIT & INSULATION CO., 16 & 18 Broad St., New York.

Edw. H. Johnson, President.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

CHARLES MUNSON, PREST.
FRANK G. MOSS, SECY & TREAS.

Charles Munson Belting Co

MANUFACTURERS OF

EAGLE and DYNAMO BELTING.

PITTSBURGH. NEW YORK. CHICAGO. SAN FRANCISCO. NEW ORLEANS.

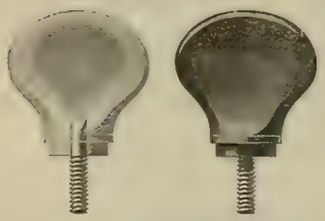
28,30,32,34 & 36. S. CANAL ST.

Every Belt adapted to its special work, and guaranteed to be pure Oak-tanned, short lap, and to give perfect satisfaction.

ALL PAISTE SWITCHES

Are Now Furnished With the

NEW HANDLE.



Made of **STEEL**, and covered with a coating of hard rubber.

Strongest handle ever made.

Old handles replaced when broken with new style without additional cost.

H. T. PAISTE, 12th and Market St., PHILADELPHIA, PA.

THE PAISTE SPECIALTIES kept in Stock and for Sale by all Prominent Supply Houses.

GET THE BEST!

P. & B. INSULATING COMPOUNDS, ARMATURE VARNISH, INSULATING TAPE. INSULATING PAPERS, MANUFACTURED ONLY BY

The Standard Paint Co., RALPH L. SHAINWALD, President.

NEW YORK, N. Y. 59 MAIDEN LANE.

Western Electrician.

EVERY SATURDAY.

Vol. VII. CHICAGO, DECEMBER 27, 1890. No. 26

The First Electric Street Railway in Chicago.

The first electric street railway employing the overhead system within the city limits of Chicago, is now in operation. The construction of this road was the outcome of a desire on the part of a number of Chicago capitalists, to develop into a desirable residence district certain territory lying west of South Chicago. The incorporators of the enterprise are: N. K. Fairbank, S. E. Gross, W. B. Jacobs, the Calumet Dock company and J. D. Harvey. The road was incorporated in June, 1890, and the construction work was commenced in July. The section of the system now in operation extends about three miles. The road runs at present from the South Chicago rolling mills by way of Eighty-ninth street, Mackinaw avenue, Harbor avenue, Ninety-third street and Stony Island avenue to Ninety-fifth street. The construction of two additional miles of line is now under way, extending from Ninety-third street and Stony Island avenue, on Ninety-third street to Cottage Grove avenue. The shortest curve on the present system has a radius of fifty feet. The steepest grade is 6 per cent.

These lines are but the beginning of an extensive system at South Chicago to connect the manufacturing and residence suburbs which now lack proper means of communication. It is stated that a connecting line will be opened from South Chicago to the Pullman line at Cottage Grove avenue and One Hundred and Fourth street. As soon as practicable the system will be extended to One Hundred and Fifteenth street, through One Hundred and Fifteenth street, Michigan avenue, One Hundred and Eleventh street, and Vincennes road, around Washington Heights and Morgan Park. The Calumet company, it may be mentioned, secured its franchise before the territory it traverses was included in the city proper, and it therefore obtained the advantage of an "overhead ordinance."

The electric system used is that developed by Frank B. Rae of Detroit, Mich. Mr. Rae, it will be remembered, was one of the pioneers in electric street railway work. The Rae system is now being exploited by the Detroit Electrical Works, and this company constructed the electrical equipment. The accompanying engravings show the most interesting features of the new line.

The power house is located alongside the tracks of the C. & W. I. Railroad. The steam plant consists of two tubular 100-horse power boilers. The coal used is Indiana block and the boilers take water from the city mains.

Beginning with the generating plant, it will be seen, Figs. 1 and 2, that the machinery in service at the present time is one 65,000-watt Rae generator driven directly by a 125-horse power Armington & Sims engine. As the reader may be interested in the construction of this most important factor in the equipment, a few details are given: The Detroit Electrical Works build generators in sizes of 40,000, 65,000 and 80,000-watts. The e. m. f. of 550 volts is maintained throughout the Rae system. The generators are all compound wound. The field magnets are made with wrought iron cores, and the cast iron yoke pieces are made of a section equivalent in magnetic capacity to that of wrought iron. The compound winding consists of a flat ribbon of copper, which is made equal in section to that of the armature conductors. These series coils, it will be noticed, are placed at the ends of the magnet cores, and against the cast iron yokes.

FIG. 1. THE FIRST ELECTRIC ROAD IN CHICAGO.—CALUMET STREET RAILWAY GENERATOR ROOM.

The Siemens armature is built up of soft iron disks .007 inch in diameter, covered with shellacked tissue paper. At every 20 disks a layer of shellacked cloth is interposed in order to thoroughly provide against the generation of Foucault currents. The core is mounted on four brass splines, let into the shaft, and so arranged that an air space is left between the shaft and the inner edges of the disks. The commutators of all the machines have 80 sections, and the following are the electrical dimensions of the 65,000-watt machine: Armature wire 1,000 feet of No. 4 B. & S., resistance, .061 ohm; shunt winding, No. 17 B. & S., resistance, 250 ohms. The series coil has a carrying capacity equivalent to that of the armature, and consists of 60 turns complete, 15 in each coil.

Mr. Rae employs but a single motor on his car, gearing it to both axles. The two cuts, Figs. 3 and 4, give a general idea of the appearance of the Rae motor and gearing as seen through the two trap doors in a car on the South Chicago road. One engraving shows the back end of the motor and the other is a view of the commutator end of the machine.

The reduction of the motor equipment to a single machine brings with it advantages which, it is claimed, cannot be denied. Such construction involves the equal distribution of power, irrespective of the load on the axles, and a reduction in the number of gears and frictional surfaces, also the possibility of employing larger diameters of gears and pinions, with larger wearing surfaces. The frame on which the motor and gears are mounted is made of channel iron bars planed square and true and put together with hot rivets, and finally tested for spring. The frame is absolutely rigid, in contradistinction to the usual practice of flexible construction of the motor support. The axles are mounted in rigid bearings and side motion is prevented by the use of graphite friction collars, which are taken up as they wear. The motor is entirely insulated. It is supported at the sides by two and one-half inch oak pieces saturated in asphalt. The raw hide pinions employed are additional insulation. The motor is of 30-horse power and is mounted on the Sheffield truck. The motor has fields and poles of wrought iron with the end yokes only of cast iron. From the sides of the pole pieces extend brass arms which support the armature. A pinion at one end of the armature shaft gears directly with the gear of a countershaft, which transmits the motion to both main axles by a bevel gear at each end. By this arrangement the speed of the motor does not exceed 900 revolutions at the full speed of the car. The motor is series wound. The regulation of speed is effected by the interposition of four resistances through the medium of a very simple switch. These resistances are successively connected with the circuit in parallel, and finally short-circuited. The resistances are located under the car, entirely out of the way, and on the platform of the car the single handle is placed. This is moved in one direction or the other, for going ahead, or reversing. At the center point a stop is provided to prevent accidental reversal.

The trolley wheel for each car is mounted upon a tubular steel pole, made in one piece, and drawn to three reductions. It is one-half inch in diameter at the top and one inch at the bottom. The trolley stand is so designed that the tension on the springs is equalized throughout the range of motion of the pole. This is accomplished by an arrangement which changes the leverage between the spring and the stub end of the pole. The trolley wheel has a bearing of phosphor bronze, the flanged sides which maintain the wheel in contact with the wire be-

ing of steel. In order to avoid oiling of the trolley wheel, graphite bearings are employed. The metal of the pole is used as a conductor leading from the line wire to the motor.

In the overhead work the use of solder for connecting the various parts was avoided, as experience has shown that the heat required to

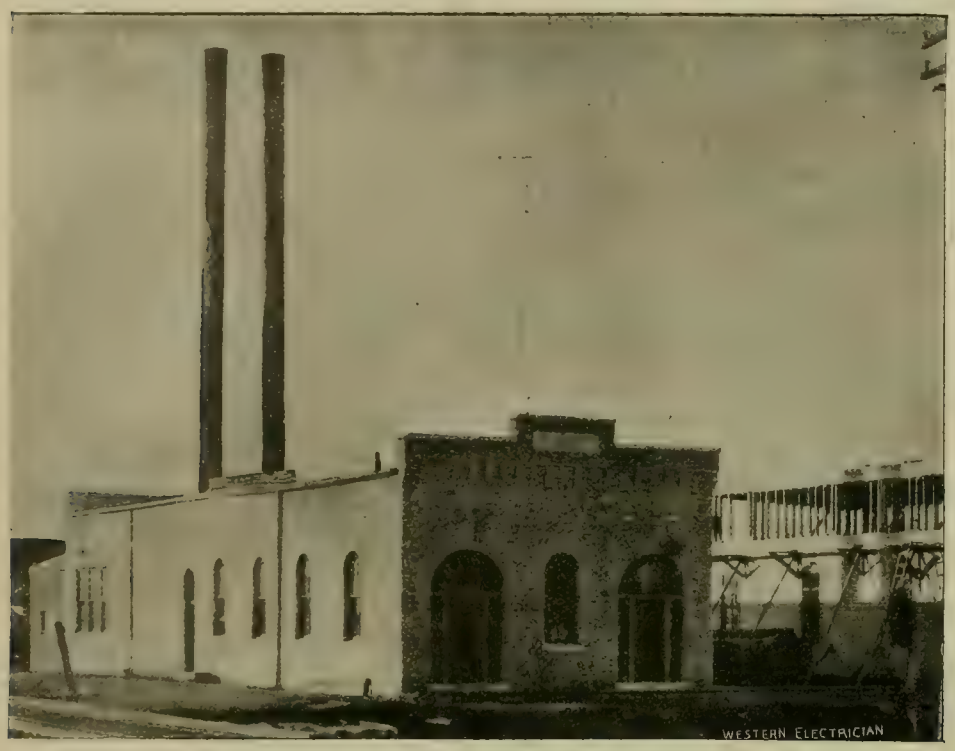


FIG. 2. FIRST ELECTRIC RAILWAY IN CHICAGO—POWER HOUSE.

sweat the parts together softens the copper, and when, later on, the slack is taken up, the copper draws at the point where the heat has been applied. To avoid this, therefore, screw clamps were employed. Thus the wire is clamped to the No. 0 trolley wire and the lower edges of the clamps brought down to a knife edge, so that the wheel passes under the insulator without jumping.

The number of cars now in operation on the line is three, with two more to be put on shortly.

W. P. Harvey is superintendent of the Calumet system. N. J. Wheeler is chief engineer at the generating plant.

Mt. Carmel Air Ship.

For the last few weeks Chicago papers have contained many notices of a new air ship which, the projectors say, will soon fly from Chicago to St. Louis. The aerial craft is now in course of construction at Mt. Carmel, Ill. Many new features are claimed for the craft. The inventors state that they have been able to overcome one of the great difficulties in the construction of airships by substituting aluminum for iron and steel, thus greatly reducing the dead weight. They say they have discovered a means of reducing aluminum at a cost of not over ten cents a pound. If that claim is substantiated, it would seem that they had found means for amassing large enough fortunes without encountering the perils of aerial navigation. In the ship now building, electricity plays a part. Storage batteries are used on quite an extensive scale to supply current for electric motors employed to perform a number of important functions.

In Favor of the Brush Company.

In the suit of the Brush Electric company against the Fort Wayne Electric company an injunction has just been granted restraining the defendant corporation from manufacturing or selling the so-called Wood clock-work double carbon lamp. The court decides that the clock-work mechanism of the Wood lamp, now being made and sold by the Fort Wayne Electric company is covered by patent No. 219,208, granted to Chas. F. Brush, Sept. 2, 1879. The feature of manually latching up one of the carbons when the lamp is trimmed, is held not to be an evasion in any degree of Brush's claims.

Alleged Wire Tappers in the Toils.

Thomas P. Dudley and Miss Maggie Thompson were arrested at Chicago last week by Deputy United States Marshal Charles on a charge of tapping the wires of the Western Union company at Washington, D. C., Sept. 17 last, with intent to defraud the book-making concerns of Miller & Co., Jones & Co., and several other institutions of a like nature.

When brought before Commissioner Hoyne at Chicago they made no effort to procure a stay of proceedings. Bail was fixed at $1,500, but the prisoners expressed a wish to go back to Washington immediately and stand trial. Judge Blodgett issued a bench warrant and the prisoners were sent to Washington where they will be placed on trial. Dudley has been employed as a telegraph operator by the Western Union in Chicago for the last six weeks. He was manager of the Chicago office of the Baltimore & Ohio Telegraph company during the telegraphers' strike several years ago, and is said to be a thoroughly competent operator. He was a pool-seller at Washington when he, E. F. Getty and F. R. Burnell, it is alleged, conceived the idea of tapping the wires. Miss Thompson, it is claimed, rented a house on Seventh street, within a block of the book-makers' offices, which are on the same street, though outside the city limits. A line was attached to the book-makers' private wires which ran by the window. A complete set of instruments was placed in the rooms, and for two weeks, it is said, they regularly tapped the wires containing the results of eastern races which had come off earlier in the day. The suspicions of the book-makers were at length aroused by the frequent visits of the same persons in the office just a few minutes before closing time. Their suspicions were increased by the success which always accompanied the visitors' investments, and a watch was set on their movements, which resulted in the discovery of the wire and the arrest of the defendants. Pending the action of the grand jury they were let out on bail and it seems suddenly departed, in the interval, rather than stand trial. They are said to have cleared several thousand dollars as the result of the scheme.

Water Power at Minneapolis.

The Minneapolis correspondent of the WESTERN ELECTRICIAN has recently referred to the project for utilizing water power at Minneapolis. A New York paper contains the following interview concerning the project: "Do you know that one of the biggest schemes to furnish electric power from water power is soon to be put in operation out our way?" said the Hon. A. C. Brown of Minneapolis, when I met him at the Hoffman house last evening. "The Mississippi River for a distance of about five miles between St. Paul and Minneapolis is full of rapids and the land on each side of the river is suitable for the erection of manufactories. The idea is to utilize the water power by building a succession of dams in the river—using the water over and over again. This will furnish the power for electric plants that will use the electricity thus produced for street lighting and motor purposes. Henry Villard and several well-known Eastern capitalists are interested in the movement, and will begin work on the dams as soon as the spring opens.

FIRST ELECTRIC RAILWAY IN CHICAGO—VIEW ON THE CALUMET ROAD.

Newly elected officers of the Thirty-first Street Merchants' Electric Light company of Chicago are: J. M. Lyons, president; G. M. Greenebaum, treasurer; C. E. Acker, secretary and manager.

Electric Lights in a Vienna Palace.

The finest display of electric lighting ever seen in Vienna was made last Saturday when the Hofburg Palace of the emperor was lighted almost throughout, according to the cable. This necessitated the employment of the largest installation of the plant in any single building in Europe, and consists of 5,250 lamps in the rooms, and 1,800 lamps in the halls and galleries. Altogether more than 7,000 lamps are used, and this necessitated the employment of over 15 miles of wire. The introduction was rendered difficult because the emperor had given strict orders forbidding any attempt at altering the character or appearance of the candelabra, which were made of embossed gold and crystal by order of Emperor Francis I. In the great ceremonial salon in which the throne is placed there are twenty-seven candelabra with fifty-four lights each. The experiment was completely successful, and it was interesting to notice how well the magnificent ceilings are brought out, and what unsuspected wealth of color has been developed in the famous Flemish tapestries which are on the walls of the privy council chamber and the other apartments of the palace.

Buffalo Electrical Society.

At the last meeting of the Buffalo, N. Y., Electrical Society, Frank Kitton of the Western Union Telegraph Company read an interesting paper on "The Advance of Electric Traction." He said that less than two years ago he had addressed the society on the same subject, and at that time had predicted that public prejudice against the use of the trolley system in Buffalo would give way before the necessity for better street-car service, and that electric motors would eventually displace horse power as an agent in operating street cars. After speaking of the opposition encountered by the Street Railway company in obtaining the necessary permission to make the change, Mr. Kitton said that the danger which at that time was so much apprehended from the introduction of electricity did not appear to agitate the public mind so much as the question so often asked, and so seldom satisfactorily answered, when will the electric cars commence running?

From the statistics gathered up to date there were, it appeared, no less than 246 electric roads in this country, operating 2,024 miles of track and employing 3,830 motor cars, the single trolley system, with only a few exceptions, being that in general use. The storage battery he did not yet consider as altogether beyond the experimental stages, though it was not without some promise of ultimate success. Many devices were being constantly brought out with a view to perfecting a conduit system, but no practical demonstration affording a successful solution of the problem had yet been reached. Therefore the advance in electric traction, Mr. Kitton said, must be considered practically from the overhead trolley system.

Referring to the double trolley system, Mr. Kitton explained that this was a method by which the entire system was insulated from the earth. In one or two places cars were being operated on this principle, not because of any particular advantage derived from its use, but more from pressure brought to bear on the railroad companies by other electric corporations who claim a pre-existing right to the "earth," or at least urge the right to its use as an electric return circuit to the exclusion of others whose currents overpower their more feeble ones. As electric power currents cause serious interference in telephonic lines, the telephone companies are naturally opposed to the introduction of the single trolley system, and have carried their opposition into the courts, which in some cases have sustained the objections.

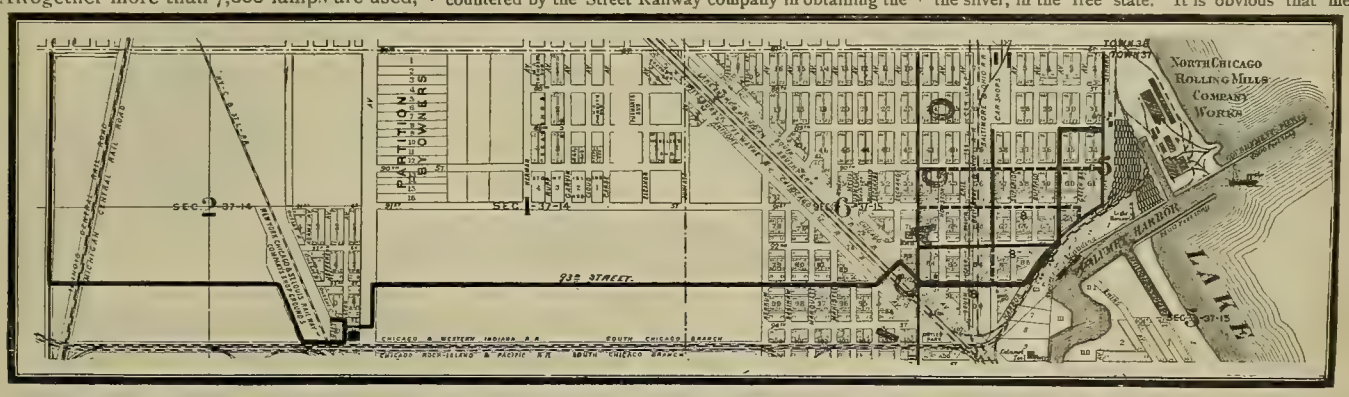
Mr. Kitton pointed to the recent proceedings of the American Street Railway Association convention at Buffalo as evidence of the great strides being made in the advance of electric traction, and concluded by quoting the language of retiring President Lowry, who was so thoroughly convinced that electricity is the coming power that he believed the Buffalo convention would be the last that would ever seriously consider horses for the operation of street railways.

Desilverizing Lead by Electrolysis.

Heretofore lead has been desilverized principally by the cupellation process. It is now generally admitted, however, that the cupellation process cannot be economically carried on in the case of lead which contains less than eight ounces of silver to the ton. For refining lead containing only a small quantity of silver, the usual process is to melt the lead and then allow it to cool until crystals of lead form. These crystals are then removed and the molten liquid that remains now contains the greater part of the silver. It is then cupelled in the ordinary way to obtain the silver, in the free state. It is obvious that methods similar to the above can only extract a certain proportion of the silver, and that they are attended with considerable expense in order to get out the last traces of the silver.

To completely desilverize lead and to obtain the silver pure in the solid metallic form, ready for the market, in one operation, and to simultaneously produce basic lead carbonate from the remaining lead, is the object of a method recently patented by T. D. Bothome of Hoosick, N. Y. Mr. Bothome describes his process as follows: It is known that lead carbonate is insoluble in a dilute solution of ammonium carbonate, while silver, on the other hand, is soluble in the same. An electrolyte, therefore, which will dissolve both lead and silver by the use of an electric current, and one that is synergistic to a chemical such as ammonium carbonate will accomplish the purpose.

In order to carry the process into practical effect, it is necessary that the chemical solution or electrolyte shall be composed of chemicals that will not decompose one another under the influence of the electric current. It has been found that a solution composed of one quarter of a pound of ammonium nitrate and the same quantity of ammonium carbonate dissolved in one gallon of water will best answer the purpose, although acetate of ammonium and the carbonate of ammonium in similar proportions will answer as well. There are other solutions that may be used for accomplishing the same result; but they all depend on a chemical that will precipitate lead and yet dissolve silver in the presence of carbon dioxide. Ammonium compounds do this in the highest degree, although the soluble thio-sulphates have the same action. Take, for example, a solution composed, as above described, of carbonate and nitrate of ammonia. Immerse in it pigs of lead connected, as anodes, to the terminals of an electrical generator and having suitable cathodes also electrically connected and immersed in the solution. Upon the passage of the electric current the leaden anodes are dissolved, the lead and silver both going into the solution. The lead, however, is immediately precipitated by the presence of free carbon dioxide, which is continually injected into the bath during the working of the process. The silver instead of being precipitated is deposited in the metallic state upon the cathodes.



FIRST ELECTRIC RAILWAY IN CHICAGO.—MAP OF THE ROAD.

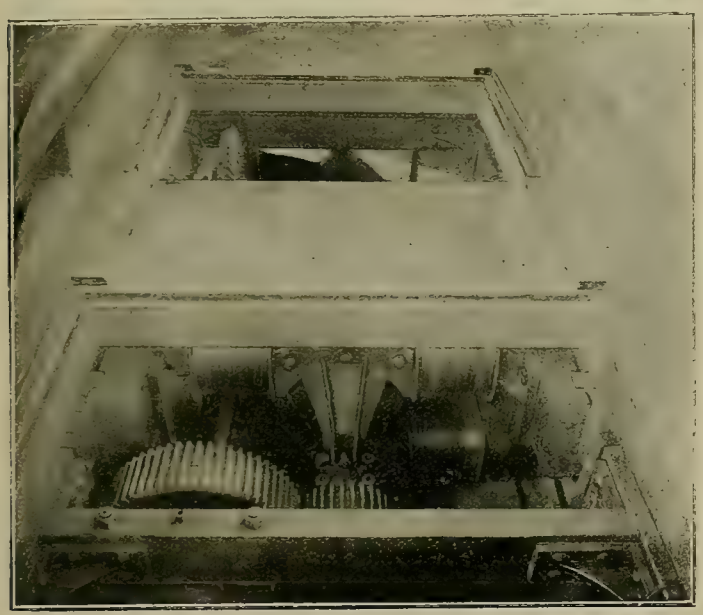


FIG. 3. FIRST ELECTRIC RAILWAY IN CHICAGO.

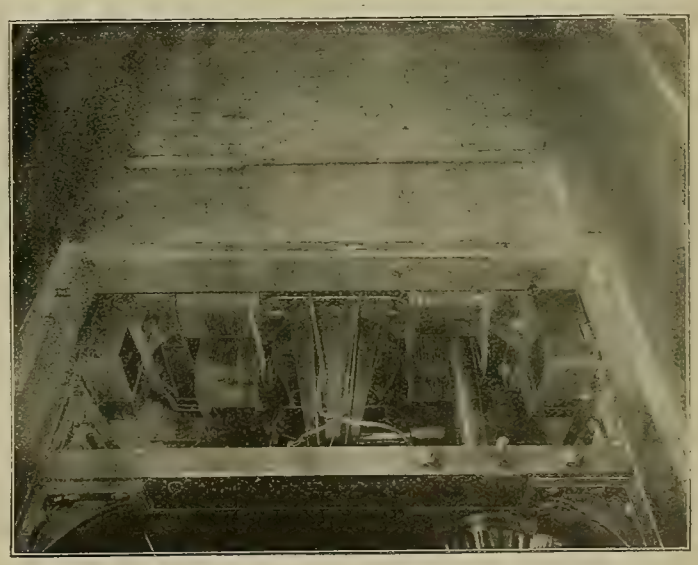


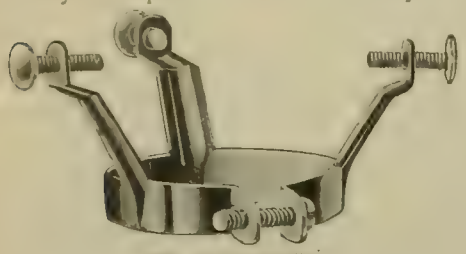
FIG. 4. FIRST ELECTRIC RAILWAY IN CHICAGO.

Burnap Automatic Telephone Exchange.

The Burnap Automatic Telephone Exchange of Chicago was incorporated last week. The corporation was formed to put on the market a telephone attachment of Charles E. Burnap. He is rather averse at the present time to stating anything in reference to his invention, but is quoted as saying: "The invention is destined to do away with the young woman at the main office who, nine times out of ten, says in answer to a ring: 'Number 9,999 is busy; I'll call you when they are through'; and never does call you. Every telephone subscriber in the future will make his own wire connections with the person to whom he wants to talk, and the result will be a large saving of time, and fewer fractures of the third commandment."

New Shade Holder.

The little fixture illustrated in the cut was recently put on the market by the Pittsburg Sheet Metal company of Allegheny City, Pa. The peculiar feature of the device is that it is made entirely of one piece of sheet metal. By this



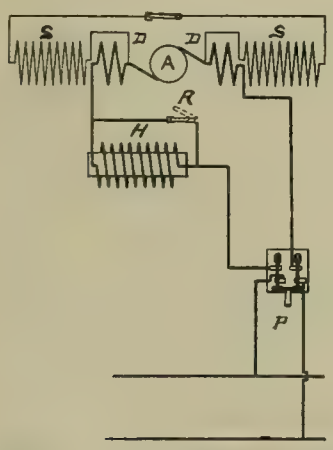
NEW SHADE HOLDER.

method of manufacture rivets are dispensed with and a holder of great rigidity is produced.

Starting Coil for Constant Potential Motors.

It is a common practice to place a resistance in the armature-circuit of a constant potential motor, to limit the current flowing through the armature upon starting. This resistance is gradually removed from the circuit as the armature attains an increased speed and generates of itself a counter electromotive force. E. W. Rice of Lynn, Mass, has recently devised a method through which he claims to be able to attain the same end without the use of wasteful resistance. His method consists of coupling in series with the armature when starting from a state of rest, what he calls a counter-potential generator. Then when later the speed of the armature becomes such as to render injury from the passage of excessive current no longer liable, the counter-potential generator is shunted from the circuit.

The diagram illustrates the connections employed in Mr. Rice's method. Referring to the cut, *A* represents the armature of the motor connected in multiple between the mains. The

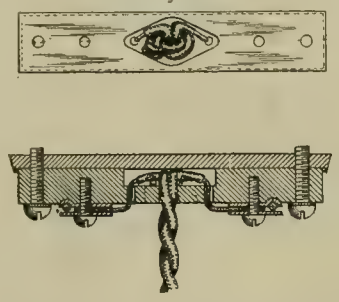


STARTING COIL FOR CONSTANT POTENTIAL MOTORS.

circuit is through the switch *P*, the direct or coarse wire coils of the field magnets *DD*, and the counter-potential generator *H*. The ordinary shunt-coils of the field-magnets are seen at *SS* connected around the brushes of armature *A*. A switch is provided for controlling a shunt-circuit around the generator *H*. If, now, the motor-circuit is closed when the armature is at rest, an excessive volume of current would tend to flow though the armature-coils, because practically no resistance would exist except that due to the ordinary or dead resistance of the armature-windings. As this is so little there would be danger of burning out. If, however, the switch *R* be opened, as shown in dotted lines, at the time that the switch *P* is closed, the current will be compelled to pass through the windings of the inductive-generator *H* and magnetize the iron core. Before the counter-induction from *H*, however, ceases to oppose the passage of the current, sufficient time, it is claimed, will elapse to allow the armature *A* to attain a rapid speed. The motor will then generate of itself sufficient counter-electromotive force to act as a resistance to the current, and the external generator *H* can be short-circuited with safety.

The Bush Pendent Cleat.

The improved pendent cleat shown in the cut is composed of two parts of mica or porcelain. The fixture was designed especially to be used as a substitute for the rosette, by which the incandescent electric lights are suspended. The lower portion of the device is made oblong in shape, and on its upper side near the center is a cavity or recess. The wires are tied into a knot within the recess, and the uncovered ends are passed out through holes and electrically joined to the mains by washers. The upper



BUSH PENDENT CLEAT.

cut of the two presented, is a plan view looking down on the lower portion of the sectional illustration. Although the cleat is composed of two parts it is evident that the ceiling itself may constitute the upper portion of the cleat. This cleat is the invention of A. R. Bush of Boston, Mass.

The Talmage Electric Oven.

The cuts illustrate the application of the Talmage electric heater to any ordinary oven, Fig. 1. The details of the heater proper will be more easily understood by reference to Fig. 2.

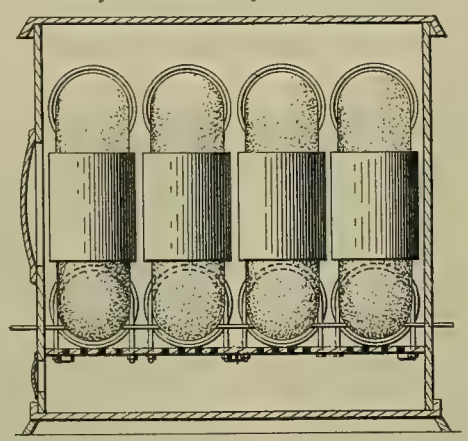


FIG. 1. TALMAGE ELECTRIC OVEN.

This device is the invention of Charles H. Talmage of Kansas City, Mo., and is intended for use on alternating current circuits.

Referring to Fig. 2, *A* represents the core formed of annealed wrought-iron wire wound into an oval shape, as shown, with a space at the center. Around the core is an insulation *B*, made of plaster of Paris. *C* represents the primary coil of wire wound around the core outside of the insulation. This wire is of sufficient size to carry the primary current without heating. Around the primary wire is an insulation

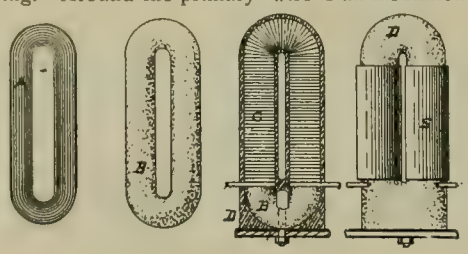


FIG. 2. TALMAGE ELECTRIC OVEN.

D and around this is wrapped one turn of very thin sheet metal *S*. This metal sheet constitutes the conductor for the secondary or induced current. This secondary circuit is closed upon itself or short-circuited, and all the energy of the current is spent in heating the conductor itself. As the secondary conductor is very thin and very wide it has a maximum radiating surface in proportion to its cross-section, and thus immediately radiates the heat produced in it by the passage of the large volume of current. It is easily seen from the construction of the heater that the length of the secondary circuit is exceedingly short, and thus a small electromotive force in it produces an enormous volume of current.

Bain Break Insulator.

The insulator illustrated in the cut is designed to take the place of the ordinary devices

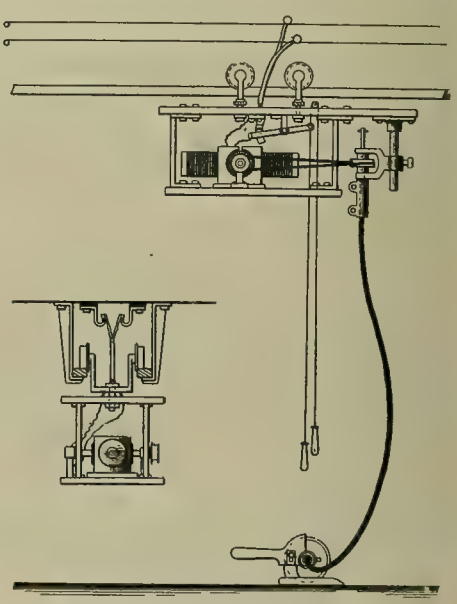
BAIN BREAK INSULATOR.

used as break insulators. It is made of one piece of porcelain, carefully glazed, and possesses great strength. The insulator will be found useful, also, for suspending arc lamps from iron cranes, insulating guy wires, and particularly, for insulating span wires in electric railroad work. The Central Electric company of Chicago, is introducing the device.

Electrical Cloth-Cutting Machine.

In cloak and other garment factories it is customary to have a number of tables upon which the cloth is arranged and marked in patterns, after which it is transferred to the cutting-table, where the usual cloth cutter is located. This involves a considerable loss of time as well as the employment of a number of workmen.

The object of the invention illustrated in the cut is to overcome the difficulty above mentioned. The device consists of a traveling motor so combined with a cloth-cutting machine



FIGS. 1 AND 2. ELECTRICAL CLOTH-CUTTING MACHINE.

that the cutter may be transferred from table to table indefinitely, and the cloth cut upon the different tables as fast as the patterns are marked.

A suspended track is secured to the ceiling of the room by means of brackets, Fig. 1. The rails are either in a straight line throughout the length of the room or they are arranged around it. Suspended from the tracks by means of rollers is a frame upon which is mounted a small electric motor. The terminals of this motor are connected by means of trolleys to electric cables which receive energy from the dynamo. A cut-out switch is interposed in the circuit. A cord attached to the free end of the cut-out lever is provided with handles so that the motor may be started or stopped at will. The motor pulley is connected by means of a belt to another pulley mounted in a bearing supported by means of a bracket. This last named pulley is attached to a flexible shaft arranged to operate a rotary cutting disk. By this arrangement the

motor may be moved as desired, and the cutting continued from table to table as fast as the cloth is prepared and the patterns marked.

This rigging is the invention of E. D. Weyburn of Chicago.

The Underground Metropolitan Railway System, Paris.

The question of the day in Paris, as one of the French papers puts it, is that of the "Metropolitan," a name which is given to the proposed underground railway systems. Such a project has been under discussion for years; in fact MM. Brame and Flachat discussed it as long ago as 1855; but it is only within the last few years that the matter has been seriously entertained. Now it is proposed to give to Paris as speedy means of transit as London enjoys in its Metropolitan railway. If, when the construction work is completed, an electric line is installed like that which is to be operated in London's last underground railway, Paris will have a metropolitan line that cannot be surpassed.

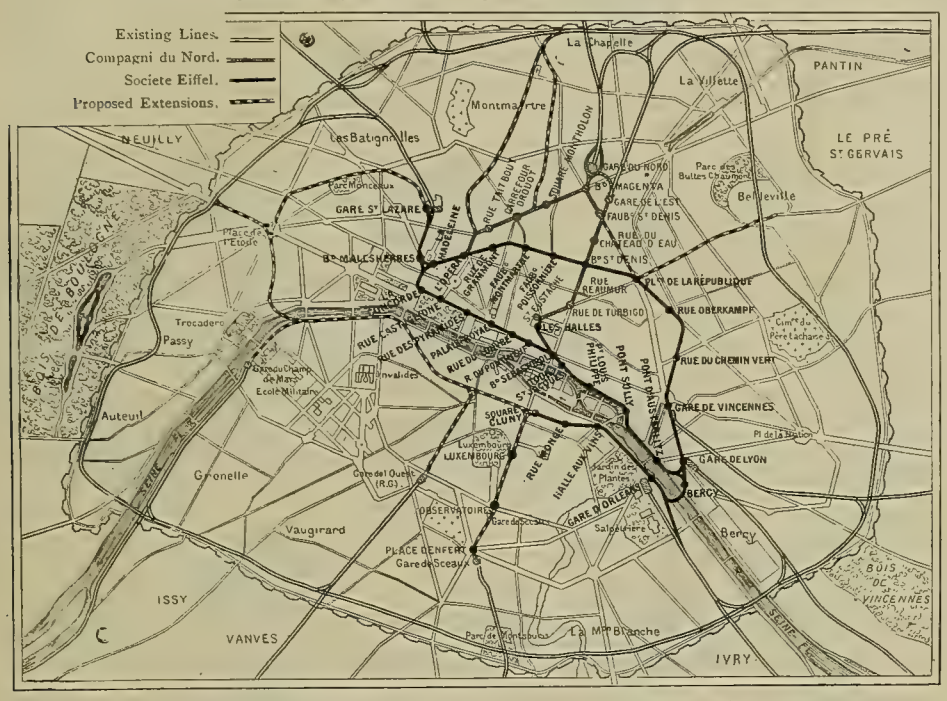


FIG. 5. UNDERGROUND METROPOLITAN RAILWAY SYSTEM, PARIS.

With all of its advantages the Metropolitan railway in London will always be objectionable on account of smoke. An electric road underground in many respects solves the question of rapid transit in cities very satisfactorily.

The metropolitan project in Paris has at last reached a definitive stage, and the time is not far distant when, after the consent of the authorities, the first stroke of the pick will be heard.

The proposed construction is to be undertaken by two companies, La Compagnie du Nord, and Societe des Etablissements Eiffel. The lines which it is proposed to build are denoted on the map which also indicates the location of certain routes recommended by the Paris Board of Public Works as parts of the metropolitan system.

When it was determined that the underground road should be built, the question arose, "How can this great work be accomplished without seriously interfering with the use of the streets for a considerable time?" The question was eminently a foreign one. That problem would not have given an American a particle of trouble. He would have worked for a franchise, and would not have devoted a thought to the matter of inconveniencing the public. But it is different in Paris. Until the public is well provided for, the petitions for rights to interfere with streets have a very slim show.

This part of the problem was given a great deal of thought by the engineers of the Eiffel company. It was of course impossible to construct a tunnel underground on the principle of cutting a passage through a mountain, for the simple reason that it was necessary to locate the line so near the surface that the danger of a cave-in would be imminent. The cuts show very clearly how the problem has been attacked.

An excavation is made at the side of the street, Fig. 1, and one of the side walls is constructed. Fig. 2 shows the construction of the second side wall. The first wall is covered by a movable bridge over which, as the illustration shows, teams may pass. After the construction of the second wall the teams are relegated to bridges on each side of the street and work commences on the arch and final excavation, Fig. 3. Fig. 4 shows the excavation completed in a portion of the tunnel. The cuts are reproduced from *L'Illustration*.

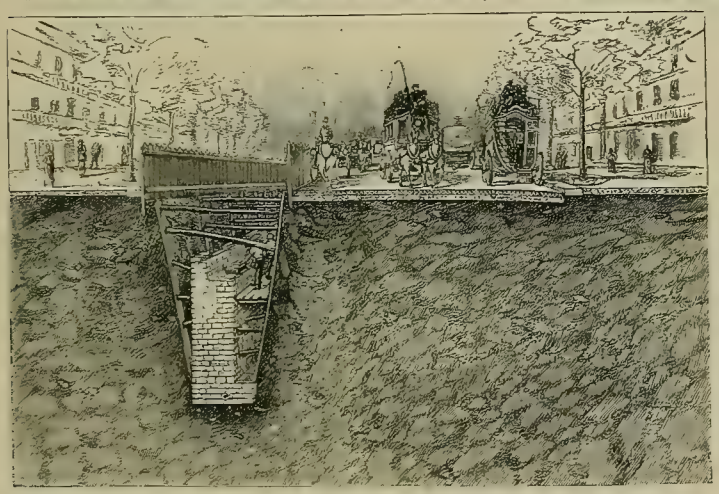


FIG. 1. UNDERGROUND METROPOLITAN RAILWAY SYSTEM, PARIS.

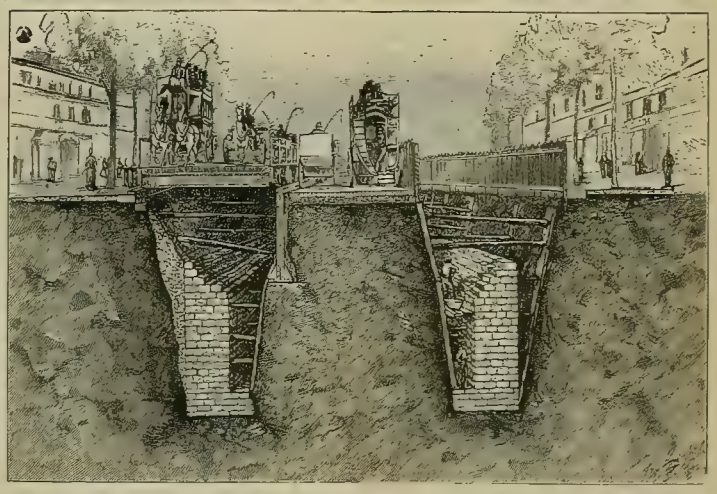


FIG. 2. UNDERGROUND METROPOLITAN RAILWAY SYSTEM, PARIS.

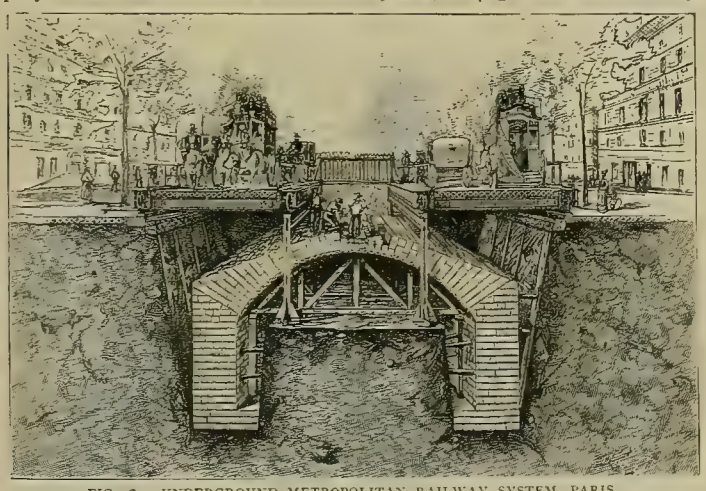


FIG. 3. UNDERGROUND METROPOLITAN RAILWAY SYSTEM, PARIS.

FIG. 4. UNDERGROUND METROPOLITAN RAILWAY SYSTEM, PARIS.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building. - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. W. DICKERSON, - - - - - - - - Associate Editors.
J. B. O'HARA, - - - - - - - - - - Associate Editors.
F. L. PERRY, - - - - - - - - - - Associate Editors.
A. C. DURBOROW, JR., - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.

W. H. TEMPLE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted.

This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
The First Electric Street Railway in Chicago. Illustrated	339, 340, 341
Mt. Carmel Air Ship	340
Alleged Wire Tappers in the Toils	340
Water Power at Minneapolis	340
Electric Lights in a Vienna Palace	341
Burnap Automatic Telephone Exchange	341
Buffalo Electrical Society	341
Desilverizing Lead by Electrolysis	341
New Shade Holder. Illustrated	342
Starting Coil for Constant Potential Motors. Illustrated	342
The Bush Pendant. Illustrated	342
The Talmage Electric Oven. Illustrated	342
Bain Break Insulator. Illustrated	342
Electrical Cloth-Cutting Machine. Illustrated	342
Underground Metropolitan Railway System, Paris. Illustrated.	343
Editorial	344
Electric Light Plant of Charles F. Brush. Illustrated	345
New Box Bell. Illustrated	346
Battery Connection. Illustrated	346
Globe Holder for Arc Lamps. Illustrated	346
The Electrical Treatment of Sewage, by W. Webster	346, 347
Interior Conduits	347
Inductance, and its Proposed Unit, the Henry, by A. E. Kennelly. Illustrated. (American Institute of Electrical Engineers)	347, 348, 349
Storage Battery Traction	349
American Institute of Electrical Engineers	349

DEPARTMENTS.

Correspondence	349, 350, 351
The Electric Light	351
The Electric Motor	351
Electrical Patents	352

THE severe snowstorms of last week wrought havoc with overhead electric wires in the East. Pittsburg seems to have been the greatest sufferer. The Pittsburg letter this week contains an account of the damages which the electric companies sustained. Under the circumstances they are inclined to believe they were fortunate in escaping as well as they did.

A PAPER on the electrolytic treatment of sewage, presented in this issue, will be perused with interest. While the experiments which are being carried on in England have as yet been brought to no definite conclusion, the results already attained would seem to indicate that progress is being made. It was hinted in the discussion of the paper in question, that there had been a tendency, when the method was first brought out, to be over-sanguine as to its merits. The cost of results claimed by the exploiter of the electrolytic process, in his paper, were questioned. As was stated, the practicability of the purification of sewage by electricity depends apparently entirely upon the question of the cost of the operation of the plant. The report of the chemists and engineers in charge of the Webster experiments is to be published shortly.

A DESCRIPTION of the equipment of the first electric street railway in Chicago on which the overhead trolley wire is employed, is given in this issue. This road, now only about three miles in length, is undoubtedly, but the beginning of a network of electric lines which we may expect to see extending in all directions about Chicago. Numerous other lines have been projected and one additional suburban road is almost completed. The Calumet road has been described in detail as there will undoubtedly come a day when all information concerning Chicago's first electric street railway will be a matter of historical interest.

PROBABLY no one ever met a telephone man more than twice without hearing some very vigorous language in condemnation of the practice of subscribers allowing every caller to use their instruments. Efforts to prevent the use of instruments by non-subscribers have, as a rule, proved rather discouraging. The government which controls the telephone service in France is now struggling with the problem. It has determined to charge all subscribers who permit outsiders to use the instruments 50 per cent. more than the ordinary rate. The regular charge is 400 francs, but the subscriber who is accommodating to his friends must pay 600.

IN this issue is published a description of an electric light plant operated by a windmill. The installation was made at the home of Charles F. Brush in Cleveland. Although much is said and written concerning the utilization of wind power for operating dynamos, extremely little has been done in the field. The description of the plant contains a statement which does not tend to encourage those looking for an extensive use of windmills in electric plants. It is remarked that the use of the wind does not make the electric plant an economical one; it is asserted that the contrary is true. It is suggested, however, that great satisfaction is found in subjecting to a useful purpose one of nature's unruly agents.

THE director-general of the World's Fair, George R. Davis, has already commenced work on the electrical department. He has issued a circular addressed to electrical manufacturers asking them three questions: First, if they propose to make an exhibit; second, what amount of space will be required, and third, how many horse power of steam they will need if they intend to make a display. Mr. Davis states that affirmative answers will not be construed as applications for space, but will constitute a basis for estimating the size of a building to accommodate electrical exhibitors. In a letter to the WESTERN ELECTRICIAN Mr. Davis says: "The object of this circular is to ascertain as nearly as possible at an early moment the probable amount of space which will be required to accommodate the exhibitors of this class. The idea is to erect upon the exposition grounds a special building entirely devoted to this class of exhibits, and it is hoped to make it one of the most useful and interesting features of the exposition. In drawing the plans for the building it is necessary to obtain as far as practicable an estimate of the space which will be required."

As we stated last week, we think that work on the electrical section should commence at once and it is a great satisfaction to note that an effort has already been begun. We trust it will be prosecuted vigorously with a full realization of the fact that the department will be perhaps the most interesting, instructive and popular feature of the entire fair. We have no doubt that manufacturers will be glad to co-operate with the World's Fair authorities, and extend them all the information in their power, on which the latter may base their estimates. We have stated heretofore that in our opinion, the directors of the exposition did not realize that the electrical department would assume gigantic proportions. A sentence in the circular tends to confirm us in that view. Mr. Davis in asking for replies to questions, says, "It is desirable that this information should be received within the next two weeks." While we wish him all the success in the world, we must state our belief that he will secure extremely little reliable information within that brief period.

PROF. A. E. KENNELLY discusses in this issue the "Henry," the proposed unit of inductance. Prior to 1887, says Prof. Kennelly, measurements were expressed in absolute units—centimeters. In this same year, however, Profs. Ayrton and Perry proposed the name secohm, provisionally for the practical unit. They advocated the term secohm in place of the "quadrant." In 1889 the Paris Congress adopted the "quadrant" as the practical unit of inductance, defining it as 1,000 million centimeters. In conformity with the absolute units of electromagnetism, explained Prof. Kennelly, an inductance is a length and theoretically can always be computed from the geometrical relations of a circuit; but it must be remembered that inductance is only conventionally and not essentially a length. The inductance, then, of a circuit may be taken as the ratio between the total induction through it to the current producing it. At first sight it might appear strange to refer to inductances in centimeters, but the quotient can be proved to be a length in the existing system of dimensions. The unfitness of the absolute unit of inductance for practical use is evident, and the institute has proposed to adopt the name "Henry" for the practical unit. In the selection of the practical unit, if the choice was only subservient to practical requirements, Prof. Kennelly thought that there was reason to believe that the thousandth of the earth-quadrant or myriameter would be most eligible. He deemed it inadvisable at the present time, however, to attempt the precedent of infringing a system supported by time, custom and International Congresses. In this practical system the unit of inductance must be 1,000 million centimeters, that is, an earth-quadrant or the distance from the pole to the equator measured on the meridian of Paris.

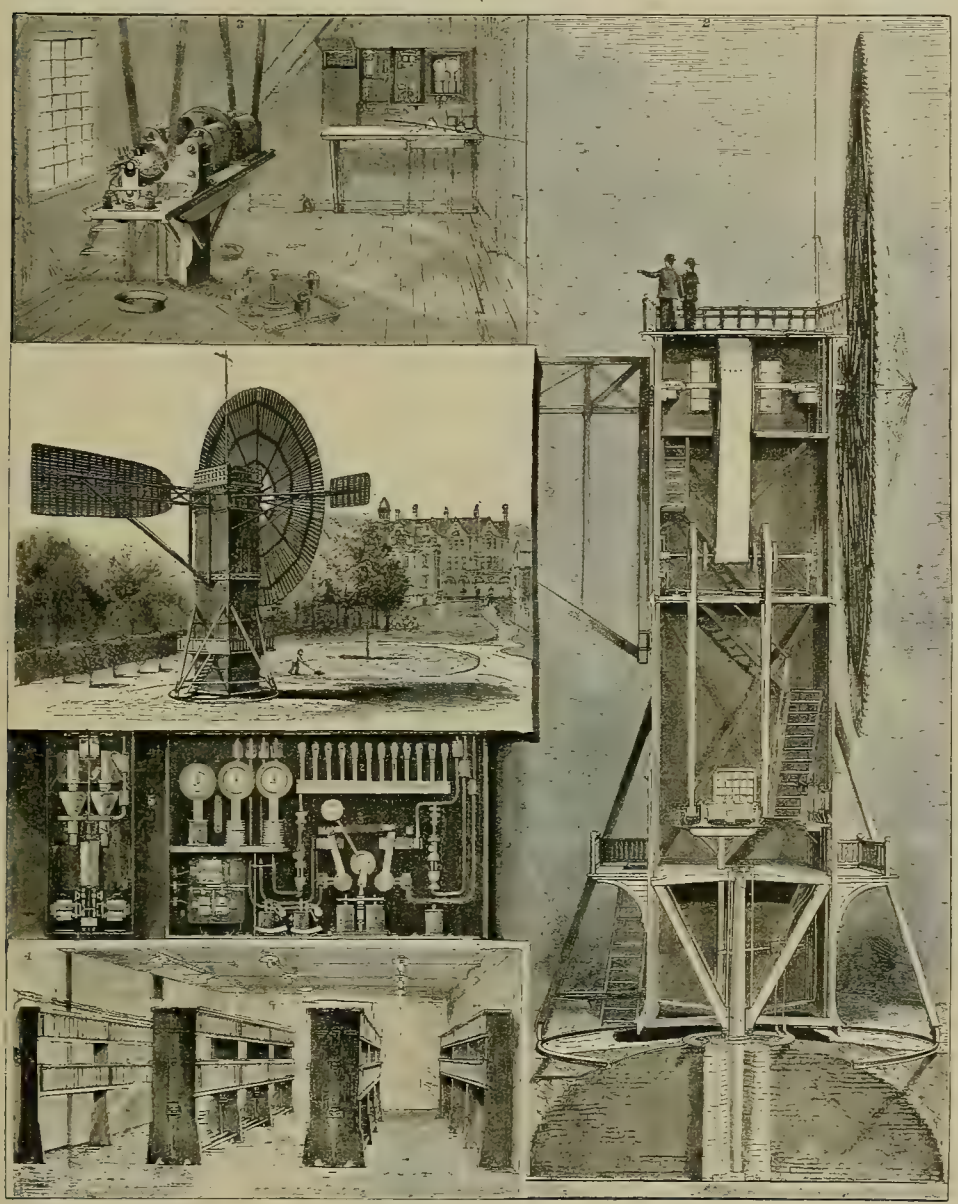
AN underground railway to provide rapid transit is a project which has been discussed in probably every great city in Europe and the United States. The expense connected with such a construction usually prevents the project from assuming a definite form. Certainly companies to build such roads have been frequently organized in Chicago. The incorporators of these companies come before the public with a flourish of trumpets, announce their plans, and soon they drop out of sight. Such has been the case in Paris for the last twenty odd years. Plans for constructing an underground railway have many times been brought before the public, but for one reason or another have been abandoned. At the present time, however, the project has reached the definitive stage, and after certain legal formalities have been complied with, work will be commenced. The routes which will be followed and the method of construction are described and illustrated elsewhere in this issue. The most striking feature of the proposed construction lies in the means which have been adopted to prevent inconvenience to the public while the work is in progress. The engineers who planned the work found this one of the most difficult problems to solve in the undertaking. The extraordinary precautions taken to prevent any interference with traffic on streets strikes an American as extremely curious. In our great cities when a corporation secures the right to build a railway it usually allows the public to get along as best it can and is supremely indifferent about interference with traffic. Those who remember the years in which cable lines were constructed in Chicago will, we think, corroborate very emphatically the assertion. In Paris the constructing company will be allowed the use of a small section of a street only at a time. The rest of the thoroughfare must be kept in such condition that teams may proceed without hindrance. Just how the problem is solved is shown by the cuts in the article referred to. After one portion of the work is completed it is entirely covered by temporary bridges, as they are called, over which vehicles may safely travel. In all probability, the underground road in Paris will be operated by electricity, if so it should prove to be as perfect a system as human ingenuity can devise.

Electric Light Plant of Charles F. Brush.[1]

The windmill here shown, as well as all the electrical apparatus used in connection with it, and the very complete system by which the results are secured, have been designed and carried out according to the plans of Charles F. Brush of Cleveland, O., and under his own personal supervision. As an example of thorough-going engineering work it cannot be excelled.

Every contingency is provided for, and the apparatus, from the huge wheel down to the current regulator, is entirely automatic.

The reader must not suppose that electric lighting by means of power supplied in this way is cheap because the wind costs nothing. On the contrary, the cost of the plant is so great as to more than offset the cheapness of the motive power. However, there is a great satisfaction in making use of one of nature's most unruly motive agents.



ELECTRIC LIGHT PLANT OF CHARLES F. BRUSH.

Passing along Euclid avenue in the beautiful city of Cleveland, one will notice the magnificent residence of Mr. Brush, behind which and some distance down the park may be seen, mounted high on a tower, the immense wheel which drives the electric plant. The tower is rectangular in form and about 60 feet high. It is mounted on a wrought iron gudgeon 14 inches in diameter and which extends 8 feet into the solid masonry below the ground level. The gudgeon projects 12 feet above the ground and enters boxes in the iron frame of the tower, the weight of the tower, which is 80,000 pounds, being borne by a step resting on the top of the gudgeon. The step is secured to a heavy spider fastened to the lower part of the frame of the tower.

[1] Scientific American.

In the upper part of the tower is journaled the main wheel shaft. This shaft is 20 feet long and 6½ inches in diameter. It is provided with self-oiling boxes 26 inches long, and carries the main pulley, which has a diameter of eight feet and a face of 32 inches. The wheel, which is 56 feet in diameter, is secured to the shaft and is provided with 144 blades, which are twisted like those of screw propellers. The sail surface of the wheel is about 1,800 square feet, the length of the tail which turns the wheel toward the wind is 60 feet, and its width is 20 feet. The mill is made automatic by an auxiliary vane extending from one side, and serving to turn the wheel edgewise to the wind during a heavy gale. The tail may be folded against the tower parallel with the wheel, so as to present the edge of the wheel to the wind when the machinery is not in use. The countershaft arranged below the wheel shaft is 3½ inches in diameter, it carries a pulley 16 inches in diameter; with a face of 32 inches, which receives the main belt from the 8-foot pulley on the wheel shaft. This is a double belt 32 inches wide. The countershaft is provided with two driving pulleys each 6 feet in diameter, with a face of 6½ inches, and the dynamo is furnished on opposite ends of the armature shaft with pulleys which receive belts from the drive wheels on the countershaft.

The dynamo, which is one of Mr. Brush's own design, is mounted on a vertically sliding support and partially counterbalanced by a weighted lever. It will be seen that the countershaft is suspended from the main shaft by the main belt, and the dynamo is partly suspended from the countershaft by the driving belts. In this way the proper tension of the belts is always secured, the total load on the dynamo belts being 1,200 pounds, and on the main belt 4,200 pounds. The ends of the countershaft are journaled in sliding boxes connected by equalizing levers which cause both ends of the shaft to move alike. The pulleys are so proportioned that the dynamo makes fifty revolutions to one of the wheel. The speed of the dynamo at full load is 500 revolutions per minute, and its normal capacity at full load is 12,000 watts.

The automatic switching devices are arranged so that the dynamo goes into effective action at 330 revolutions a minute, and an automatic regulator is provided which does not permit the electromotive force to run above 90 volts at any speed. The working circuit is arranged to automatically close at 75 volts and open at 70 volts. The brushes on the dynamo are rocked automatically as the load changes. The field of the dynamo is slightly compounded. The current passes from the dynamo to contact shoes of polished and hardened steel carried by a cross bar on the tower, which shoes slide on annular plates surrounding the gudgeon. Conductors extend underground from these plates to the dwelling house. To guard against extraordinary wind pressure, the tower is provided at each of its corners with an arm projecting downwardly and outwardly, and carrying a caster wheel very near but not in contact with the circular rail concentric with the gudgeon. Ordinarily, these caster wheels do not touch the rail, but when the wind is very high they come into contact with the rail and relieve the gudgeon from further strain.

In the basement of Mr. Brush's house there are 408 secondary battery cells arranged in twelve batteries of 34 cells each; these 12 batteries are charged and discharged in parallel; each cell has a capacity of 100 ampere-hours. The jars which contain the elements of the battery are of glass, and each cell has its liquid covered with a layer of "mineral seal" oil, a quarter of an inch thick, which entirely prevents evaporation and spraying, and suppresses all odor. The automatic regulating devices are shown in one of the views of the engraving. At 1 are shown the voltmeters and ammeters employed in measuring the charging and discharging currents; at 2 is shown a series of indicators, one for each battery; 3 represents an electrically operated switch by means of which the current may be turned on or off the house mains by pressing push buttons in different portions of the house; 4 represents a ground detector, which is connected with the center of the battery and with the ground, so that should the conductor upon either end of the battery be grounded, the fact will be indicated by the movement of the index in one direction or the other from the zero point of the scale, thus showing not only that the battery is grounded, but indicating the grounded pole; 5 is a leakage detector connected with the lamp circuits, and arranged to show any leakage from one conductor to the other; at 6 is shown a compound relay for operating the automatic resistance shown at 7. This resistance is placed between the batteries and the house mains, and is arranged to keep the voltage on the lamps constant at all times. In this device the resistance is secured by means of powdered carbon placed under the varying pressure, the necessary movement being made by means of hydraulic pressure under the control of the relays.

The house is furnished with 350 incandescent lights, varying from 10 to 50 candle power each. The lamps most commonly used are from 16 to 20 candle power; about 100 incandescent lights are in every day use. In addition to these lights there are two arc lights and three electric motors. It is found after continued use of this electric plant that the amount of attention required to keep it in working condition is practically nothing. It has been in constant operation more than two years, and has proved in every respect a complete success.

The Crisfield, Md., Electric Light company has been organized with G. T. Atkinson, president, F. H. Coulbourn, vice-president, and L. E. P. Dennis secretary, to erect an electric light plant. The capital stock is $10,000.

New Box Bell.

The Eureka box bell is shown in the cuts. In Fig. 1 the wood box form is illustrated. It is perfectly plain, but the rounding of edges and smooth polish of the natural wood make it hand-

FIG. 1. NEW BOX BELL.

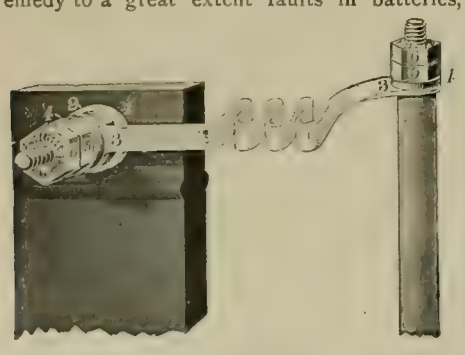
some in appearance. Inside, the bell is unusually compact and well made. The magnets are wound to about two ohms resistance; the armature is heavier and the platinum contacts larger than in ordinary bells. The bell is made in

FIG. 2. NEW BOX BELL.

walnut, oak and cherry with two and one-half and three-inch nickel plated steel gongs. The bell is also mounted with an iron box, Fig. 2, in which the same simplicity and neatness of finish are observed. Internally the two forms are identical. The bell is introduced by the Electrical Supply company, Chicago.

Battery Connection.

The battery connection shown in the cut is introduced by the Le Clanche Battery company of New York. It is claimed that its use will remedy to a great extent faults in batteries,



BATTERY CONNECTION.

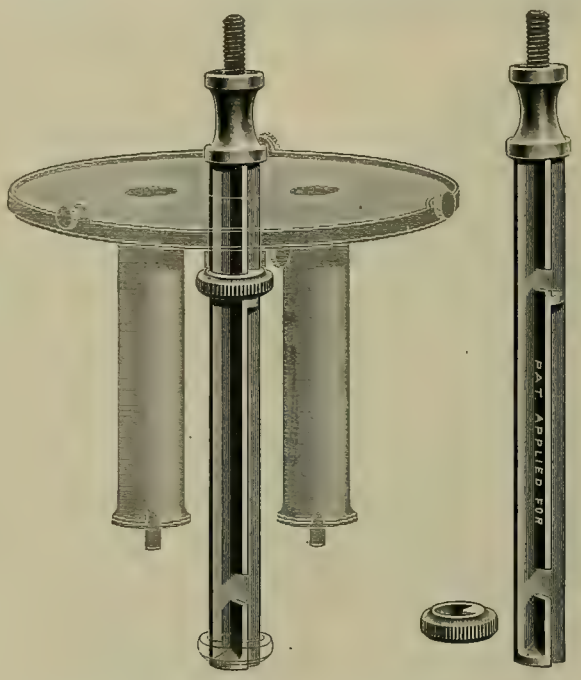
such as corrosion, local action, and development of resistance. Referring to the cut (1) is a washer made of a non-oxidizable composition which cannot be corroded with battery salts. A similar washer is placed on the opposite side of the carbon. Through these two washers and the carbon runs a zinc screw. A zinc nut (2) is placed on the screw and turned up tight against the washer (1) to bind the whole tightly to the carbon. A flexible metallic connecting strip (3) not subject to oxidation or corrosion is placed upon the zinc screw to connect the carbon pole of one with the zinc of another. Another zinc washer (4) prevents the strip (3) from being twisted when the nut (5) is screwed up. The zinc nut (5) screws up tight against the washer (4) to bind the connection, and a check nut of zinc (6) is used to reinforce the nut (5).

The screws on both the carbon and zinc are of the same size and thread, and the nuts of both are interchangeable. No local action is possible between the carbon and the zinc screw, it is stated, because they do not touch, the electrical contact being made through the non-oxidizable washers.

Improved Globe Holder for Arc Lamps.

Every lamp trimmer knows that frequently time is lost in renewing carbons because globes are in the way. Some late lamps have an arrangement for sliding or tilting globes, but this is not always put up in the simplest and best shape. Thus in one form of double carbon lamp the globe holder slides on a brass tube and is held in place by a screw pressing against the tube. The screw will jam sometimes perhaps, or the trimmer will want to give it an extra grip, and will use his pliers on the screw. As a result the screw is often bent out of shape, the tube is dented or even split, and the globe-holder no longer slides freely. This trouble is aggravated by successive trimmings until the tube and screw may have to be renewed. What is more, the lowering and raising of the globe, under such circumstances take considerable time and the annoyance does not tend to improve the trimmer's good humor on which the care taken with the lamps must always depend. Such being the case, a simple substitute for the tube and screw would seem quite timely. The cut shows a new device brought out by George Cutter of Chicago. The globe holder is supported by a ring which is knurled so that it can be readily turned with the fingers. The rod which takes the place of the tube has a star-shaped section, and as the cut shows, has a shelf on which the ring rests when the globe is in position. On raising and turning the ring slightly, it drops to the end of the rod, thus letting the holder and globe slide down out of the way. When the lamp is trimmed, the ring is raised to its former position and given a quarter turn, when it again rests on the shelf shown and safely supports the globe-holder. To remove this entirely, the ring is slipped down until opposite the notch in the rod and given a quarter turn, when both the ring and the globe-holder can be slipped off. The globe can then be replaced and the holder slipped back and clamped in place in an instant.

Both the rod and the ring are made of brass and will fit any Thomson-Houston double carbon lamp. By their use the globe can be lowered, raised or removed altogether in a few moments.



GLOBE HOLDER FOR ARC LAMPS.

The Electrical Treatment of Sewage.[1]

By W. Webster, F. C. S.

In the early days of the process experiments were made with electrodes of carbon and platinum, but the high cost of the latter and the disintegration of the former in the presence of the nascent element compelled their abandonment in favor of iron. The alteration brought other chemical reactions into play, and though the precise mechanism of the change was still somewhat obscure, a hypochlorite of iron appeared to be formed at the expense of the anode and the chlorides naturally present in sewage. The progress of the purification was attended with the production of ferrous hydrate and ferrous carbonate, the former of which acted as a precipitant. On the passage of the current the sludge began to separate as a flocculent precipitate. When this was done on a laboratory scale, the flocculent matter rose, being full of hydrogen bubbles, but in practice it went to the bottom The method now adopted consisted essentially in passing the sewage through a brick channel containing a large number of cast-iron electrodes connected in parallel. The cast-iron plates were from ½ inch to 1 inch thick and 6 feet long, and 25 pairs were connected in series the pressure between each pair being about 1.8 volts. The plates were placed in a chute 18 inches deep, 2 feet wide and 200 feet long. Favorable reports had been received from various well-known experts, one of whom, Sir Henry Roscoe, had had entire control of the experimental work for about a month He found from 70 to 80 per cent. of the organic matter precipitated, as the following figures, taken at hazard from his analysis, indicate:

	Oxygen absorbed. (Parts per 100,000.)		Albumenoid ammonia.
Raw sewage.....	5.64	.....	0.87
Unfiltered effluent..	1.92	.....	0.45
Raw sewage.....	5.49	.....	1.12
Effluent.....	1.48	.....	0.14

About 20,000 gallons were treated, samples being taken every five minutes. The nature of the effluent was most satisfactory; no tendency to subsequent putrefaction was detected even under severe conditions of testing. There was a small quantity of red hydrate of iron in suspension, giving a reddish color to the effluent; this would be an advantage when turned into a stream rather than otherwise, but it might very easily be removed by filtering through 6 inches of sand if required. Besides this experimental work which had been on London sewage, the process was being tried at Salford, the sewage from that town and Pendleton being treated. Efficient purification was of particular importance here, as the effluent would pass into the Manchester Ship Canal, and must be of reasonable purity.

The quantity to be dealt with was 10,000,000 gallons per 24 hours, and for this it was calculated about 400 indicated horse power would be requisite. The plant would consist of three boilers of 200 indicated horse power, any two of which would suffice to do the work, and four engines, any three of which would be similarly adequate.

In the estimate of working expenses no commercial value was credited to the sludge, though after being dried and ignited it might serve as a filtering material in the event of a clear effluent being required. The current required per gallon was .37 ampere-hour, which was equivalent to 37-horse power per million gallons. The annual cost of run-

[1] Abstract of a paper read before the London Section of the Society of Chemical Industry, Dec. 1st.

ning the process was reckoned at £2,500, with an additional sum of £2,500 for the deterioration of 5,000 tons of iron electrodes. If a clear effluent were necessary, a further charge of £1,200 to £1,500 would have to be met.

DISCUSSION.

In the discussion following the reading of Mr. Webster's paper reference was first made to the work of earlier experimenters on the resistance of the living organisms commonly present in sewage, to the effects of electrolysis. The outcome of their investigations was that a considerable voltage and a comparatively high temperature were necessary for complete sterilization. There was expressed some doubt as to whether the Webster process would succeed in this particular respect. In regard to the possible value of sludge obtained by various methods of purification an instance was mentioned where in another process some 10,000 tons of sludge had been sold in the course of twenty-five years for £34,000. One member dealt particularly with the scientific aspect of the process, asking for further information as to the reactions that took place during electrolysis. In reports that had been submitted to the meeting, nothing was said as to the degree of aeration of the effluent. He was of opinion that most, if not all, the dissolved oxygen—so potent a factor in water purification—was consumed to convert ferrous salts into the ferric state. It was pointed out that a patent had been taken out about ten years ago for purifying sugar solution by electrolytical means. This patent was worded so broadly that it seemed almost to cover the case of sewage. A cautious member recalled the furore that the advent of the Webster process had caused at the Institution of Civil Engineers and supposed it might be explained on the *omne ignotum pro magnifico* principle. It was remarkable, he thought, that the very considerable effect of mere agitation, aeration and subsidence upon sewage, had been overlooked by most of those engaged in its purification. The result due to these simple agencies was invariably credited to each several process as it was devised. Fear was expressed that electrolytic oxygen would prove a costly oxidant, and it was also doubted whether cast-iron plates could be used on account of their slow rate of solution. An attack was made, too, on the figures that had been given as to the cost of treatment at Salford. According to calculations the cost of one indicated horse power at one penny an hour, and allowing for the cost of oil, labor and maintenance, the necessary yearly expenditure for the treatment of 10,000,000 gallons per twenty-four hours, as at Salford, would amount to £21,000 to £24,000. These figures were about four times as much as the estimate. The whole value of the process turned on this question of cost.

In reply to the questions put by the members, Mr. Webster's substitute who had read the paper, stated that he did not think the complete diminution of organisms necessary or even desirable. A sterilized effluent, even if practicable, would be speedily swarming with life again. He could not point to a town where the process was in actual operation; but it must be remembered that the process was a young one, and had not been at work, as the A. B. C. process had, for twenty-five years. Still they hoped to have a town of their own, possibly as important as Kingston, before the elapse of another quarter of a century. Though considering the sludge from the Webster process at least equal to that produced by the A. B. C. process, he did not expect to get £3 10s a ton for it. It had been proved that fish would live in the effluent, though that was scarcely a criterion of its purity. The elimination of the whole of the organic matter was unnecessary for the production of a safe effluent. The figures objected to were calculated on the assumption that coal at 10s per ton could be used and give one indicated horse power for a consumption of two pounds per hour. It would be, he thought, better to suspend judgment on some of the points under dispute until the report of the engineers and chemists having charge of the Salford experiment was issued, as it was to be published very shortly.

Interior Conduits.

The Interior Conduit and Insulation company of New York gave a test exhibition last week before the Chicago fire underwriters and city experts. Among those present were Chief Swenie, fire marshal; Prof. Barrett, city electrician, and Messrs. Haskins and Borden and some twenty of the board of underwriters. The gentlemen conducting the tests were Messrs. Wirt of the Electrical Supply company, W. A Willard and H. M. Underwood, representing the Conduit company of New York. The exhibition embraced the following experiments, viz.: 1st, setting fire to a board by means of moisture where wires are run at the regulation distance apart without blowing the safety fuse in the circuit; 2d, making the same test with the wires in close proximity, showing the immediate action of a safety fuse, without igniting the wood; 3d, fusing a rubber insulated wire loop, one side running through the tube and the other side wrapped around a thin strip of wood, showing by comparison the value of the conduit over a wood insulation; 4th, placing two wires connected to a bank of lamps in the tube and fusing the wire; 5th, placing one wire in a tube and the other in a cap moulding, setting fire to the moulding without injuring the tube; 6th, short-circuiting a flexible cord inside of the tube without injuring it; 7th, short-circuiting a flexible cord outside the tube, setting fire to the insulation on the flexible cord. All the tests were highly satisfactory. A number of the experts present expressed themselves as willing to indorse the system. A similar exhibition was recently made before the Illinois Chapter of Architects by Messrs. Willard and Underwood. The architects were also enthusiastic over the results obtained by the experiments.

The Riverside Edison company, of Riverside, a suburb of Chicago, has been formed to furnish electric light and power; capital stock, $40,000; incorporators, W. W. Hutchinson, Lewis Lusk and M. C. Meyers.

Inductance and Its Proposed Unit, the Henry.[1]

BY A. E. KENNELLY.

Perhaps the greatest discovery of Faraday's long career of scientific research was that of electro-magnetic induction in the year 1831, when he first brought to light the influence exerted by a magnet or a current upon surrounding matter when subjected to a change of magnetic potential. Oersted had shown that a conductor carrying a current exercised electro-magnetic influence at a distance, and Ampere had enunciated those simple and beautiful laws this influence is admitted to obey, but Faraday's discovery was a great step; it revealed the action of magnetic force in apparently empty space; it inaugurated that deeper insight into the mechanism, still only dimly guessed, which connects matter with all other matter in space; and it invested the all-pervading ether with the dignity and power that in the hands of many great men since his time, has probably paved the way for our future comprehension of magnetism, gravitation and radiant energy, while making the hypothesis of action-at-a-distance a mere mathematical conception and process of thought.

The development of this discovery of electro-magnetic induction has practically created electrical engineering, for it is to machinery operating by electro-magnetic induction that we owe nearly every branch of electrical industry except, perhaps, telegraphy, the forerunner of all; and the condition of modern electrical engineering is such that the units and nomenclature relating to steady currents and permanent magnets are insufficient for practical requirements, and the conditions developed by variable currents and magnets demand the establishment of engineering-practical units for the purposes of convenience in expression and computation.

Foremost among these required units is that of inductance, or as it is commonly called, the co-efficient of induction. This inductance is a property fully as essential to every electric conducting circuit as resistance and electrostatic capacity, and the inductance of a circuit when conveying variable currents is often a far more important factor in regulating the flow than the ohmic resistance. In fact we know that Ohm's law does not apply to a circuit so long as the current is unsteady, unless the inductance of the circuit or the counter electromotive force it involves be introduced into the expression.

In conformity with the conventional and so called absolute units of electro-magnetism, an inductance is a length and theoretically can always be computed from the geometrical relations of a circuit; that is to say, if the distance of each point from all other points of a circuit be measured, or inferred, in inches or centimetres, the inductance of the circuit will be some definite number of inches or centimetres, capable of being determined by a possible if not a convenient process of summation. If the circuit, however, be associated with iron or other magnetizable matter, then the magnetic permeability of the environment will enter the terms of summation as a multiplier. In the absolute centimetre-gramme-second system of units, inductance will be necessarily expressed in centimetres, and the centimetre is thus the natural scientific unit, although unsuited to the requirements of electrical engineering.

It may be well to notice that inductance is only conventionally and perhaps not essentially a length. Professor Rucker has pointed out[2] that the multiplication of the permeability factor with the length factor is always tacitly, if not expressly involved, even when the circuit considered is far from magnetizable matter in the ordinary sense; that is to say when residing in a medium of unit permeability, and therefore the nature of inductance is not merely length, but length multiplied by permeability, while physics has not yet decided whether permeability is the simple numerical factor at present assumed, or a function of length, mass and time. Until this question is settled, the real nature of inductance must be considered as doubtful, and the fact that inductance will probably, in any event, be always measured by lengths is no more validly an argument as to its nature than the usual determination of a body's mass by the earth's gravitational force upon it is an argument that mass is a force. However, the question is one of theory only, and does not affect the consideration of the practical unit.

As has been pointed out by Dr. Sumpner,[3] there are no less than three ways of defining the inductance of a circuit or a portion of a circuit, and the three definitions are equivalent when the permeability of the magnetic medium is unity, but are not generally equivalent in the opposite event, being then only related in a definite manner by the magnetic properties of the medium. In other words, the inductance of a hollow solenoid of copper wire, placed in a vacuum and far from all iron, has the same numerical value in each of the three definitions, but if an iron core be inserted in it, its inductance will depend upon the definition selected, and will only be capable of interpretation from its value in one of its values in the others, by taking into account the characteristic permeability curve of the iron, and the conditions of the measurement.

For convenience and general use, however, the secondary definition of Sumpner and Fleming[4] is probably the best to adopt, and valuations in the other two can be reduced if necessary to this, when the data for so doing are available.

The inductance of a circuit or portion of a circuit is then the ratio between the total induction through it to the current producing it. Thus taking a simple helix of five turns carrying a current of two units, and assuming that 1,000 lines of force,[5] passed through the central turn, of which owing to leakage, only 900 thread the next adjacent on each side, and again only 800 through the end turns, there would be 800+900+1,000+900+800 or 4,400 linkages of lines with the wire, and this being with 2 units of current there would be 2,200 linkages with unit current, and consequently the self-inductance of the helix would be 2,200 centimetres. (Fig. 1.)

The fact that such helices are used in galvanometers and that the magnetic force at any point within them is admitted to be proportional to the strength of the traversing current, renders it evident that had the current in this case been one unit, 2,200 lines linked with the coil would actually have been produced. Supposing, however, that the helix had been wound upon an iron core, the total number of linkages with the same two units of current would have been greatly increased, perhaps twenty-fold or to 88,000, and the inductance then by the same rule would be 44,000. In this case one unit of current would not in all probability reduce the number of linkages to 44,000, the exact number would depend upon the characteristic curve of the iron core and the degree of saturation, so that it would now be necessary to state the conditions of the measurement along with the result, in order to convey a clear and definite meaning.

It appears anomalous at first sight to state the above inductances in centimetres when they are derived from the number of lines of force, but it is to be remembered that the total number of linkages is divided in each case not by a mere numeric, but by a current, and this quotient can be proved to be a length in the existing system of dimensions.

In the same way the mutual inductance of two conductors is the ratio of the total induction through one of them to the strength of current in the other producing it. Suppose two coils of copper wire to be held in free space far from iron, and let one of them be traversed by a steady current of say four units. Of all the lines of force issuing from this coil, suppose 500 pass through the other coil. For simplicity, imagine the second or recipient coil to be composed of eight turns so disposed that the 500 lines pass through, all in succession. There will then be 4,000 linkages of line with that coil, and the mutual inductance of the two will be 4,000÷4, or 1,000 centimetres. It is interesting to notice that the same result will be reached if the second coil had the current and the linkages were counted in the first, the pair being mutually conjugate in this respect, provided they reside in a medium of constant permeability.

Thus far we have only considered the centimetre or absolute unit, whose unfitness for practical use is evident, since the smallest inductance that is at present known to engineering amounts to several thousand, while the average values met with are counted in millions of centimetres. It

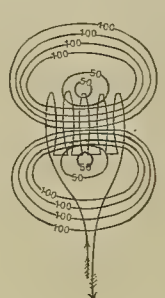


Fig. 1

would of course be possible to name suitable units from the metrical system of lengths, but it is the proposal of this institute to adopt the word Henry as the practical unit, in honor of the man who, beyond all doubt, was among the foremost to extend the knowledge thus far possessed of self and mutual inductance.

If the selection of the practical unit were entirely free and subservient only to practical requirements, so that its magnitude should express ordinary values in digits with fewest decimals on the one hand, or large numbers on the other, there seems most reason to believe that the thousandth of the earth quadrant or myriametre would be the most eligible.

Proposed Name.	Length.	Number of Centimetres.	Unit.
Henry.	Earth Quadrant.	1,000,000,000	Practical Unit.
		100,000,000	
		10,000,000	
Millihenry.	Myriameter.	1,000,000	
	Kilometre.	100,000	
	Hectometre,	10,000	
Microhenry.	Decametre.	1,000	
	Metre.	100	
	Decimetre.	10	
	Centimetre.	1	Absolute Unit.

Of course large iron machines employing many turns of wire linked by dense magnetic fields, would have inductances more appropriately expressed in earth quadrants, which might then be termed the kilo-henry just as we now have the watt and kilowatt, but there is one restriction which makes such a selection undesirable, and that is the hitherto unbroken system of practical units itself. This practical system is a sub-scheme of the great international C. G. S system and especially planned for adaptability to practical requirements. It is derived from that parent system by the substitution for the unit of length one thousand million centimetres in place of one centimetre, and for the unit of mass an impalpable entity definite only in thought, the one hundred-millionth of a milligramme in place of the gramme. By this substitution in the C. G. S. electro magnet units, we obtain the hitherto unbroken system of the volt, ohm, ampere, coulomb, joule, watt, and farad. Even these units are not always the most convenient; witness for example the micro-farad in common use, whose prefix is

[1] A paper read at the meeting of the American Institute of Electrical Engineers, New York, December 16, 1890.

[2] Phil. Mag: February, 1889. Vth series Vol. 27, p. 104.

[3] Phil. Mag: June, 1888. Vth series, Vol. 25, p. 453.

[4] "The Alternate Current Transformer," by J. A. Fleming, Vol. 1, p. 55.

[5] The term line of force here is used in the sense of a line of induction; the distinction being necessary when the lines pass through iron.

maintained simply in deference to the harmony of the system, for the farad is a capacity that exists only in imagination; the capacity of the earth itself being only about 700 microfarads, and of the sun, or rather of a sphere having the apparent dimensions of the sun only, about 76 000 microfarads. On the other hand a proposition has lately been made to infringe the system by making the volt, the ampere and the watt ten times their present value, on the ground of practical convenience.[6] However, at the present time, it would surely be unadvisable to attempt the precedent of infringing a system that has hitherto been supported by time, custom, and International Congresses.

In this practical system the unit of inductance must be 1,000 million centimetres. That is an earth-quadrant or the distance from the pole to the equator, measured on the meridian of Paris. Strictly speaking, it is only the quadrant of the French standard earth, which is about one-tenth of one per cent. shorter than the acknowledged actual earth quadrant, according to the best determinations, but the fact of the latter being 10,001 kilometres instead of 10,000 is a matter of precision in definition only, and in no way affects the practical unit.

As regards the history of the subject, it would appear that prior to 1887 measurements and deductions were confined to scientific works, and were expressed in absolute units—centimetres. In that year, however, a paper was read before the British Institution of Electrical Engineers by Messrs. Ayrton and Perry,[7] who invented and developed a practical measuring instrument for the measurement of inductance, who, aided by Dr. Sumpner, made important contributions to the literature on the subject, and who proposed a name provisionally for the practical unit. That name was the secohm, a contraction of second ohm, implying the fact that the product of the two was the length equal to the practical unit. They drew attention to the fact that since the Paris Congress of 1884 had fixed the standard legal ohm as the resistance of a column of mercury at zero Centigrade, 106 centimetres long and one square millimeter in cross section, whereas the true ohm was in all probability 106.3 centimetres, or one-quarter of one per cent. greater, the inductances measured in the manner they suggested from seconds and legal ohms, would be in terms not of the standard earth quadrant of 10,000 kilometres, but of legal earth quadrants 9,778 kilometres in length. The difference practically is not very great, but to avoid error or confusion in definition they advocated provisionally the term secohm in place of quadrant.

The Paris Congress of 1889 adopted the "quadrant" as the practical unit of inductance, defining it as 1,000 million centimetres.

The practical range of inductances is second only to that of resistances, and the latter we know from a few microhms up to thousands of megohms. The smallest inductances are those of Hertz resonators which descend to the order metres. Excluding these, however, the smallest are perhaps met with in measuring instruments intended to have negligibly small inductance, such as doubly wound resistance coils, Cardew voltmeters, and the like. These descend to the order of decametres, and can generally be expressed as such without prefixing decimal points. It is evident that the term microhenry would suitably apply to their designation. At the other end of the scale we find large induction machines linking dense fields with many turns of wire, and reaching inductances of hundreds or even thousands of henrys. Intermediate between these limits, there exists a large class of circuits having many turns, but little iron, or clad in iron with few turns of wire, and these seem to be best expressed by the term millihenry, equivalent to the myriametre.

With the object of setting forth the advantages to be derived from the use of this nomenclature, it may be permissible to adopt it provisionally in describing the measurements that follow. These measurements have been made on different types of apparatus at different times and by different methods, so that they represent mean values from several observations in many cases, but allowance must be made for the variations of standard and type.

In telegraphy the inductance of an ordinary Western Union 140-ohm relay is about three henrys with the armature drawn well back, and nine henrys with the armature pressed against the poles; in the latter case, of course, the magnetic reluctance of the iron circuit is a minimum, and the same current in the coils causes three times as many lines to circulate through the iron. At the position of the armature in ordinary adjustment the inductance is about five henrys.

The inductance of an ordinary standard 10 ohm relay is from 200 to 500 millihenrys, according to the position of the armature relatively to the poles.

The inductance of an ordinary sounder is similarly from 25 to 50 millihenrys. These inductions are the values obtained with only a few milliamperes through the coils, and since the path of the induction is largely through iron, the inductance varies with the strength of the current used. Practically, however, the variation is small within the range of current at which instruments usually operate.

Submarine Telegraphy.

The inductance of a mirror speaking galvanometer of the ordinary type having 2,250 ohms was found to be 5.6 henrys.

Telephony.

The inductances met with the ordinary long distance telephone apparatus are as follows:

The call bell 80 ohms and 1.4 henrys

The magneto armature 550 ohms, and from 2.7 henrys with the plane of the coil in the line joining the poles, to 7.3 henrys when the iron core joins the poles, the plane of the coil being then at right angles to the magnetic flux.

The induction coil primary 0.28 ohm and 3 5 millihenrys.

Secondary 164 ohms and 734 millihenrys.

The mutual inductance between the coils, 60 millihenrys.

The Bell telephone receiver 75 ohms and from 75 to 100 millihenrys. The removal of the diaphragm from an ordinary telephone of this type reduces the inductance about 35 per cent. All these inductances are to currents of a few milliamperes only. As regards the inductance of aerial line wires, it is to be regretted that measurements are not yet forthcoming, and indeed the experimental determination is attended with some difficulty, owing to static capacity and imperfect insulation. In the absence of direct measurements, theory indicates that the inductance of overhead copper wires depends upon the elevation above the ground as well as upon the diameter. In the case of iron wires as used in telegraphy, the permeability of the iron enters as an additional factor. The following table of inductances for copper wires is based upon a formula first given by Clerk Maxwell [8] It is to be hoped that experimental evidence may shortly be collected corroborating these results:

The inductance of iron wires, in the absence of measurements, is almost too doubtful to justify calculation, being perhaps ten times more than the inductance of copper wires under similar conditions. The difficulty in their case lies in assigning the proper value of permeability.

Electric Light and Power.

Dynamos and dynamo-electric machinery are of course generally characterized by large inductances.

The inductance of the field magnets of a dynamo may have any value depending on the size and voltage of the machine, from one henry up to 900 henrys.

The inductance of an armature may similarly vary from 20 millihenrys up to 50 henrys between brushes. One millihenry is a fair average value of the inductance of one section of an armature. Armature inductances depend not only on the strength of the measuring current, but also upon the strength of the field, and whatever influences the permeability of the core.

The inductance of an alternating transformer varies from a primary of 400 millihenrys, a secondary of one millihenry and mutually 20 millihenrys with a transformation ratio of 20 up to corresponding values perhaps one hundred times as great.

Apparatus. The Inductance of Ruhmkorff Coils.

The smallest medical coil in ordinary use has five millihenrys in its primary, 100 millihenrys in its secondary, and 20 millihenrys mutually between them.

A large induction coil 19 inches long and 8 inches in diameter has 0.145 ohm and 13 millihenrys in its primary, 30,600 ohms and 2,000 henrys (by two concordant methods of measurement) in its secondary, and 163 henrys mutually between them.

The inductance of a mirror galvanometer may vary from a few millihenrys up to ten or more henrys according to its resistance. Two henrys is a fair average for an astatic mirror galvanometer of 5,000 ohms

An ordinary electric bell of 2.5 ohms resistance was found to have an inductance of 12 millihenrys.

There is one point in connection with the self and mutual inductance of induction coils and transformers that deserves attention owing to the confusion that occasionally arises concerning it. It may be, perhaps, best represented by a numerical example. Let a closed Faraday ring of iron 100 centimetres in mean circumference and 20 square centimetres in uniform cross-section, be closely wound with a primary coil of 2,500 turns in one layer, followed by a secondary coil of 7,500 turns also in one layer. If now two amperes be maintained steadily through the primary, the magnetic force in the iron will be $4\pi/10$ times the ampere-turns per centimetre of the iron circuit or $4\pi/10\times2\times2{,}500\div100$ or 62.85. The permeability of wrought iron at this force being, say 250, the induction developed per square centimetre will be 250×62.85 or 15,713 lines, and the total induction inclosed by the primary coil, neglecting the space occupied by the wire itself will be $20\times15{,}713$ or 314,250 lines which traverse every turn of both windings. The linkages with the primary will be $2{,}500\times314{,}250$, or in round numbers 786,000,000 and referred to one ampere, half this number, or an inductance of 393 million centimetres, that is 393 millihenrys. Similarly the linkages of these lines with the secondary will be 2,358 millions, and per ampere of primary current 1,179 millions of centimetres mutual inductance or 1.179 henrys. Next suppose the primary current interrupted, and a current steadily established in the secondary sufficient to produce the same magnetic force in the iron, thus avoiding the complication of a changing permeability. As the secondary has three times as many turns, the current effecting this will be two-thirds of one ampere. The total induction through the iron will now be the same as before and therefore the linkages will be equally numerous. The self-inductance of the secondary will be $2{,}358{,}000{,}000\div2\text{-}3$, or 3,537,000,000 centimetres, that is 3.537 henrys. The mutual inductance will similarly be $786{,}000{,}000\div2\,3$, or 1 179 henrys as before. It will be found on carrying the reckoning to the necessary degree of accuracy, that this mutual induction 1.179 is the square root of the product of the two self-inductances, 0.393×3.537.

Examination of the steps in this calculation will show that this proposition must hold for all closed magnetic circuits uniformly magnetized to the same degree when the space occupied by the windings is not taken into account. Under the opposite conditions of open and especially of short iron cores, with large winding spaces, the condition usually fails, and the mutual inductance may be greater or less than the square root of the self-inductances multiplied together.

Another reason in favor of selecting 1,000 million centimetres as the value of the practical unit or Henry, is the desirability of having the time-constant of an electro-magnetic circuit expressed directly in seconds by its practical units as in the case of electrostatic circuits, rather than revert to a unit of inductance that would yield the time-constant in milliseconds or other fractional period of time. The time constant of a simple electro-magnetic circuit, a circuit having inductance and resistance but negligibly small electrostatic capacity, is defined as the ratio of its inductance to its resistance, that is of its henrys to its ohms It is an important function, and its consideration presents some remarkable analogies between inductance and electrostatic capacity that it is interesting to trace.

Imagine an inductance coil C without iron to be supplied with a steady current from an electromotive force E of 50 volts. Let the inductance of the coil be three henrys and its resistance 10 ohms, Fig. 2. Ohm's law determines the strength of the current to be five amperes. Now short-circuit the terminals of the coil very suddenly by a wire across its terminals of negligible resistance. The current in the coil C does not stop instantly, but under the name of extra current is maintained in the coil by reason of its inductance. According to theory, the last dregs of the current will never entirely vanish from the coil, although after the first few seconds the remainder is exceedingly small. The very first instant after short-circuiting, the current continues at five amperes by its electro magnetic momentum, but being unsupported, its energy is lost thermally in overcoming the coil's resistance, and it immediately falls. In falling, the lines of force linked with the circuit and sustained by the current, are drawn in, cutting the coil as they recede, thus creating a counter e. m. f. tending to prolong the current, and this process of dwindling current, with reduction of opposition from the reserve of inductance, descend together. The total quantity of electricity that will flow through the circuit under the conditions specified, may fairly be called the charge or discharge of the coil, and it can be readily proved that this charge is equal to the quantity that would be conveyed by the initial discharging current, acting uniformly during a time equal to the time-constant of the circuit. In this case the discharge commenced at five amperes, and the time-constant is 0.3 second, so that the total discharge will be that due to the flow of this current in 0.3 second, that is 1.5 coulombs.

To represent the case graphically, suppose the curve of discharge in time to be plotted as in the figure. Let the axis OX be divided off into seconds, and the axis OY into amperes. (Fig. 3) The discharge commences at five amperes, subsides rapidly at first, but at last so slowly that an indefinitely long time must elapse before it altogether disappears. The area inclosed between the curve and the axes represents ampere-seconds or coulombs to the amount of the total charge, and the proposition just stated asserts that if the current had continued at five amperes steadily for 0.3 seconds, the area of the dotted rectangle so generated $YDTO$ would be equal to the total area inclosed between the curves and the axes prolonged to the ultimate point of union.

Curiously enough, exactly the same law applies to the discharge of a condenser through a circuit of resistance but negligibly small inductance, the time-constant of

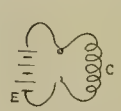


Fig.2

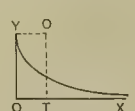


Fig.3

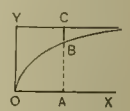


Fig.4

the circuit in this case, however, being its capacity in farads multiplied by its resistance in ohms.

The curve of discharge is of the same type for inductances or capacities. It is logarithmic, and finds its prototype in the case of the discharge of water in time, from a tank having a faucet at the base, assuming that the rate of escape through the faucet at any moment is directly proportional to the pressure or level of water then remaining in the tank.

The laws which control the outline of this discharge curve are identical for condensers or short-circuited inductances, and are combined in the following enunciation:

The natural logarithm of the ratio { full charge / initial current } to the { residual charge / discharging current } at any instant is the quotient of the time during which discharge has been in progress by the time-constant of the circuit.

In this statement two reservations are necessary.

The electrostatic circuit must be free from all appreciable inductance, and the electro-magnetic circuit must contain negligibly small electrostatic capacity. It was first pointed out by Sir William Thomson that the discharge of a condenser through an inductance circuit becomes oscillatory when the inductance exceeds a certain critical value.

When an inductance discharges through a break instead of a closed circuit, the conditions become complicated to a degree that eludes complete practical solution in the present state of knowledge.

At the period of natural discharge equal to the time-constant, an inductance or capacity charge or current will have fallen to 36.8 per cent. of its initial value.

Similar propositions relate to the charging currents and quantities. In the above instance, after the coil has completely discharged, remove the short-circuiting wire. The current will immediately enter the coil, and the curve of its arrival in time is represented in Fig. 4, this curve being only an inversion of the preceding. For this reason it is evident that the area above the curve now represents the charge, and by an extension of meaning the deficit from full current, such as BC, may be called the charging current, since on discharge and reversal of the diagram this will be the discharging current at the same lapse of time. In fact, the current AC is doing work in heating the coil, the deficit from ultimate current BC being only active in increasing the electro-magnetic momentum of the circuit, and work is really stored in the coil as though the deficit

[6] "The Electrician" of London, Sept. 19, 1890, p. 558, Report of British Association Discussion.

[7] Journal of the Institute of Electrical Engineers, London, April, 1887, Vol. XVI., p. 291.

[8] Clerk Maxwell. "Electricity and Magnetism," 2d Edition, Vol. I. p. 293.

current did exist. A similar but inverted curve of current in time represents the charge of a condenser. In each case and under the above restrictions the following propositions hold:

The natural logarithm of the ratio { full charge / initial current } to the { deficit from full charge / charging current } at any instant is the quotient of the time during which the charge has been in progress by the time-constant of the circuit.

When the charging interval reaches the time-constant, the charge will have attained 63.2 per cent. of its full value.

Another relation between simple electrostatic or electromagnetic circuits and their time-constants is in their stores of energy. The energy of the charge in each case is half the energy that would be developed by the initial charging or discharging current against the ohmic resistance of the circuit in the time equal to the time-constant. In the above instance, for example, five amperes being the initial charging or discharging current, and the resistance 10 ohms, the circuit energy of this current per second would be 5×5×10=250 joules, and during half the time constant the energy thus developed would amount to 0.3× 250÷2 or 37.5 joules. This is the electro-magnetic energy stored up in the charge.

These are not the only analogies that exist between inductance and capacity, but there are remarkable points of diversity. The discharge of extra current of a coil is in the same direction as the circuit current; with the condenser it is the reverse. In a great many practical instances the electro-magnet and the condenser are used to annul each other's influence.

The time-constant of an inductance circuit is generally small for the reason that a coil of large inductance has generally many turns and therefore high resistance, so that the ultimate ratio of the henrys to the ohms is not large. For examp'e, the time-constant of a Bell telephone, considered in itself or on short circuit, is from the measurement above described, about 0.09÷75 or 0.0012 second, and therefore a steady e. m. f. of say, two volts, impressed directly upon such a telephone would produce in this interval of time 63.2% of 2/75 ampere, namely 169 milliamperes. By adding inductanceless resistance to the circuit, however, and raising the e. m. f. proportionately, the time constant would be lessened, and the arrival of current accelerated. Strictly speaking this reasoning is inaccurate, since the telephone coil surrounds iron, but with the small currents usually employed, the iron probably does not greatly influence the arrival curve. In the case of dynamo field magnets, and large ironclad inductances generally, the divergence of the arrival curve from that of a corresponding simple electro-magnetic circuit is considerable.

There are several methods by which self and mutual inductance can be measured, the selection depending on the magnitude to be determined and its nature. The Ayrton and Perry secohmmeter or double revolving commutator is perhaps the most generally useful. It may be employed in connection with a standard condenser, a standard inductance, or apparent change of resistance with speed. Being used in the Wheatstone bridge, the currents it can alternate are necessarily limited in strength.

For small inductances, [9]say less than one tenth of a millihenry, the method of Professor Hughes[10] or its modification by Lord Rayleigh is probably best suited, using two coils of mutual inductance and a telephone as the observing instrument.

The inductance coils are usually in the form of two concentric rings, the inner being capable of rotation about the common vertical. The mutual inductance of such a pair of coils is a complex function of the dimensions and the angle between the planes at which the coils may be set. It is usual to calibrate the instrument by separate measurements of the inductance at different angles. A simpler arrangement, however, for mutual inductance is a short solenoid in the bridge circuit superposed coaxially upon a long solenoid in the battery circuit Adjustment to silence in the telephone for interrupted currents is then made by including in the bridge circuit a greater or less number of turns in the outer solenoid. The mutual inductance is then very nearly proportional to the number of turns so included, and by suitable proportions in construction, the accuracy can be carried as far as the telephone for the receiver will permit.

For the measurement of inductance in coils on iron machinery, the ballistic galvanometer is frequently employed, either by the method of discharge for self-inductances, or induced quantity with mutual inductances.

Mutual inductances connected by closed iron circuits present no difficulty when great accuracy is not required, since, as already observed, the self-inductances are calculable in these cases when the mutual inductance and the number of turns in the coils are known. It is much more difficult, however, to measure the self-inductance of the field magnet of a dynamo when the armature is removed, and when currents of the normal exciting strength are used in the measurement. The best attempt has been made apparently by observing the discharge effects of gradual small changes of a strong current passing through the coil, in circuit with a specially arranged Wheatstone bridge.[11] If it were of sufficient practical importance, however, to measure such inductances with powerful currents, a recording instrument might be tried, having a very light and swiftly moving pointer, leaving a trace of its motion on a strip of moving paper like Sir William Thomson's siphon recorder. If such a pointer were arranged to give an amplitude of movement at right angles to the paper strip, in proportion to the current traversing the coil, it would register the curve of discharge when the coil was short-circuited, in the manner described above.

On a sufficiently enlarged scale, corrected perhaps for residual inertia in the moving parts, this curve would give not only the total quantity of discharge, but its deviation from the logarithmic line of simple electro-magnetic discharge, would give the means of determining the characteristic of magnetization in the iron.

Of far lesser importance than the selection of the practical inductance unit, but still well worthy of separate consideration, is the selection of appropriate symbols to represent the unit briefly. It might perhaps be advantageous to represent the henry by a capital H, and the millihenry by the plain letter h. This notation would enable such an inductance as 50 henrys to be written as 50 H, and 50 millihenrys as 50 h. The microhenry occurs so seldom that it would probably not need a symbol.

All measurements of precision should employ true ohms and not legal ohms in the computations. The best existing value of the true ohm is 1.0028 legal ohms.[12]

The correction is practically so small that it can best be carried out by altering the nominal standard temperature of the resistance coils adopted. These temperatures should be increased by 9.4°C for platinum-silver, 6 5°C for German silver, and 13.5°C for platinoid. Thus a resistance box with platinum coils standardized for legal ohms (of 106 0 cms) at 15°C would give true ohms of 106.3 cms at 24.4°C as the best approximation, and this would be the standard temperature of the box for use in precise measurements of inductance.

TABLE OF INDUCTANCES OF COPPER AERIAL LINE WIRE, PER KILOMETRE AND MILES, FOR DIFFERENT DIAMETERS, AND ELEVATIONS ABOVE THE GROUND.

Diameter of Wire.		Elevation Above Ground 400 cms or 13.1 feet.		Elevation Above Ground 700 cms or 23 0 feet.		Elevation Above Ground 1,000 cms or 32.8 feet.		Elevation Above Ground 1,300 cms or 42.7 feet.	
		Millihenrys or Myriametres.		Millihenrys or Myriameters.		Millihenrys or Myriametres.		Millihenrys or Myriametres.	
Centimetre.	Inches.	Per Kilometer.	Per Mile.	Per Kilometer.	Per Mile.	Per Kilometer.	Per Mile.	Per Kilometer.	Per Mile.
0.10	0 039	1.086	3.106	2.109	3.393	2 170	3.493	2.222	3.576
0.20	0.079	1.848	2.974	1 960	3.154	2.031	3.268	2.083	3.352
0.30	0.118	1.765	2.842	1.878	3.022	1.950	3.138	2.002	3.222
0.40	0.158	1.709	2.750	1.821	2.930	1.892	3 045	1.945	3.130
0.50	0.197	1.664	2.678	1.776	2.858	1.847	2.973	1.900	3.058
0.60	0.236	1.628	2.621	1.740	2 800	1.811	2.914	1.863	2.998
0 70	0.276	1.595	2.569	1.709	2.750	1.780	2.865	1.833	2.950
0.80	0.315	1.570	2.527	1.682	2.706	1.754	2.823	1.806	2.906
0.90	0.354	1.547	2.489	1.659	2 069	1.730	2.785	1.783	2.870
1.00	0.394	1.526	2.456	1.683	2.635	1.709	2.750	1.761	2.834

Storage Battery Traction.

Pedro G Salom, secretary of the Consolidated Electric S orage Battery company, has written a communication to the Philadelphia *Evening Telegraph* in reference to storage battery traction. Among the advantages of the storage battery system he finds the following:

"First. It is admitted that a storage battery car will run well even under unfavorable and difficult conditions.

' Second. That the mechanical construction from the motor to the wheels is practically the same (and can be made, f desired, exactly the same) as the now generally admitted successful overhead system

"Third. This being the case, if it can be shown that a certain weight of battery, at a given price, can propel a car a given number of miles, and that the cost for battery in doing this work does not exceed a certain maximum fixed price, which, together with the other operating expenses, is less than the cost per car mile with horses, then it must be evident to the dullest comprehension that there is a field for storage battery traction."

He also makes this statement: "We are now prepared to prove, and to guarantee under proper conditions, that the cost per car mile for renewals shall not exceed a certain maximum rate per mile based on the amount of work required for any given installation."

American Institute of Electrical Engineers.

At the regular monthly meeting of the Council of the American Institute of Electrical Engineers, held December 15 at New York, the following associate members were elected:

P H. Alexander, New York City; Charles E. Dressler, New York City; E. L. French, Manchester, Conn; Artbur Handey, Dublin, Ireland; George Mayer, New York City; Wm. F. Murphy, Spartanburg, S. C.; F. B. H. Paine, New York City, Chas. Lane Poor, New York City; Samuel Sheldon, A. M. Ph. D., Brooklyn, N. Y ; Wilfred J. Spruson, Sydney, Australia; M. C. Sullivan, New York City; John Waring, Manchester, Conn.

At the same meeting the following associate members were transferred to full membership, their applications having been approved by the board of examiners at its meeting held December 3:

Harold Binney, New York, N. Y.; William Herbert Donner, Lynn, Mass.; Reginald A. Fessenden, Newark, N. J.; Dr. Cary T. Hutchinson, New York, Dr. Frederick A. C. Perrine, Trenton, N. J.; Herbert Laws Webb, New York; Townsend Wolcott, Brooklyn, N. Y.

CORRESPONDENCE.

New York Notes.

NEW YORK Dec. 20.—The subway contracts have been rather thoroughly discussed during the week and the courts have had them under consideration. It is still uncertain whether this remarkable city government is able to settle the disputes and compel the fulfilment of the law of 1884 which requires that all light wires in cities having a population of over 500,000 be placed underneath the streets and avenues. The Board of Electrical Control has failed to provide proper subways, and it is hard to tell just what its last resolution will accomplish. At the last meeting a resolution with an extended preamble was adopted, stating that the contract with the Consolidated Telegraph & Electrical Subway company had become ineffectual and providing that new contracts with this corporation, and in addition with the Empire City Subway company, ' be made, executed and delivered by this board."

Following the resolution of the board, the injunction suit restraining it from making any contract with the Empire City Subway company came up for argument. Through an agreement between the electric lighting companies and the city, it has been arranged that all the bids for electric lighting shall come within 40 cents, but the formal steps in the matter will not be taken until the new bids of the electric companies are opened December 24. It looks as if electricity would again take the place of gas in the districts where the subways are laid, and something of the old brilliancy at night will be re-estabished in the streets which have for months been in almost total darkness.

The formal opening of the Amsterdam electric railway occurred to day at ten o'clock. In the absence of E. H. Johnson, president, J. H. McClement, vice-president of the company which installed and owns the railway, was on hand to take the initiative and turn on the current. Five cars were ready to start off with and the Amsterdam public is proud of its latest enterprise. The adoption of electric traction in the small towns throughout the country in many instances can be traced to the efforts of such pioneer electrical personages as E. H. Johnson and J. H. McClement.

The preliminary injunction obtained by Neil Burgess against a theatrical manager for using a contrivance similar to that used in his production of the "County Fair," in which by a combination of electrical and mechanical machinery the illusion of a horse race is produced, has been sustained in the United States Circuit Court. Judge Colt said, "Without entering into a detailed discussion of these prior stage devices, this can be said, that no one before the comp'ainant ever constructed an apparatus to produce the effect of a horse race upon the stage."

President Seth Low of Columbia College announces in a circular letter that the following course of evening lectures on "Practical Electricity," fully illustrated by experiments, will be given at Columbia College by Francis B. Crocker, E. M., and Michael Pupin, Ph D., the instructors in electrical engineering, on successive Thursdays, at 8 o'clock, commencing January 15. General principles of electricity, showing the principal ways of producing it and effects produced by it; electro-magnetism; electrical units and ways of measuring electricity; dynamo electric machines; electric motors and transmission of power; electric lamps; alternating current electricity; the telegraph; the telephone; storage batteries. These lectures are intended to give a reasonably intelligent idea to professional and business men of the most important practical applications of electricity. The fee for the course has been fixed at $10 payable in advance. Persons desiring to avail of this opportunity must register their names in the president's office on or before January 10 and pay the fee at the time of registration. Should the number of applicants exceed the accommodations of the lecture room, preference will be given to those who register earliest. Tickets will not be issued to a greater number than can be accommodated with seats. It will not be possible to obtain admission to single lectures or to a part of the course at a reduced fee.

A lecture on "Electrical Units of the Present and Future," was given before the New York Electric Club, by Prof. Francis B Crocker of Columbia College last Thursday. Changes in the dues were also decided upon, active members to pay $40 a year and associate members $20. Life membership in the club costs $500, and about twenty have qualified, including F. W. Roebling, Thomas A.

[9] Journal of Institution of Electrical Engineers, London Journal, January, 1886.

[10] For another method of measuring small inductances with an alternating current, see an article by C. Steinmetz in the "Electrical Engineer" Vol. X. Nos. 130, 131. November, 1890.

[11] Phil. Mag: Feb 1889 Dr. Sumpner.

[12] Report of the committee on Electrical Standards read before the British Association, September, 1890. See the London Electrician of Sept. 26th, 1890.

Edison, Theo. N. Vail, Gen. O. E. Madden and E. T. Gilliland.

The American Bell Telephone company and the Metropolitan Telephone & Telegraph company entered a complaint in the United States Circuit Court this morning against John J. McAdams and Richard F. Duane, who they claim are infringing the patent of Alexander Graham Bell obtained in 1876 for the Bell telephone. The complainants aver that the men named are using a telephone other than the Bell, and that it is an infringement of the patent which they now hold. They ask that the new telephones be delivered up, and that Messrs. McAdams and Duane be restrained by an injunction from using or selling them any more, and that all the profit which they have made from them be given up to the complainants.

W. H. T.

Minneapolis, Minn.

MINNEAPOLIS, Dec. 20.—An interesting bit of litigation has just been terminated by a decision of Judge Young in the case of the city of Minneapolis against the Brush Electric company. The suit was brought on the bond of the Brush company to recover $2,100 collected by the Minneapolis Gas Light company for 100 street lamps run several months in the district lighted by the Bridge Square electric light mast. At the time the city made the contract with the gas company, arrangements were made for shutting off certain lights at its option, but when the electric light contract was entered into with the Brush company, the Gas company continued the light in question, collecting the money therefor until they were prevented by an order from the court. The court allowed the Gas company pay for the time the light ran and the city's suit against the Brush company was to recover the amount thus paid. The Brush company wins by the decision.

Thirty thousand dollars' worth of stock in the Medicine Lake & Golden Valley Electric railway has been subscribed and the remainder of the $50,000 issued will be taken within a short time. The projectors are engaged in the work preliminary to commencing the construction of the line early in the spring. A meeting of the subscribers will be held this evening, at which it is expected the organization of the company will be perfected.

George G. Smith of St. Albans, Vt., assisted by J. M. Leonard, of Leonard & Izard, electricians of this city, on Tuesday made a successful test of a new electric fire alarm invented and patented by the former gentleman in 1887. The contrivance had never before been subjected to a practical test, but worked successfully. The alarm is operated on the thermometer principle, thermostats fusible at 125 degrees Fahr. being suspended from the cornices of the rooms it is designed to protect, connected with electric wires. When the heat reaches the point named the melting of the thermostat causes a weight attached to it to fall. The circuit connecting with two alarm gongs, one in the house and the other at fire department headquarters, is closed. The same current registers the number of the house, street and fire division at the fire station. In the same manner the room in the house where the fire is at work is designated at any point desired on the outside of the building. By the action of two balance relays, one of 100 ohms, and one of 5 ohms resistance, wherever the current becomes grounded or broken, bells attached to the gongs at the house and fire department headquarters are set ringing and do not stop until the fault is remedied. The inventor estimates the cost of placing his system in each house furnishing all rooms necessary, at $2,500 per mile of distance covered.

A petition to the Minneapolis Street Railway company asking that a line be constructed to Fort Snelling, was presented to the city council at its last meeting and filed as adopted, and an order to this effect will follow in due course of time. Such a line ought to do a good business. An enterprise of more popular interest and importance is also under consideration, this being no less than the building of a line from Minneapolis to Lake Minnetonka, reaching all the hotels at that beautiful resort. The immense patronage enjoyed by the new inter-urban line has stimulated a great variety of new projects, not all of which will be realized; but the two herein mentioned are reasonably certain to be carried out.

A St. Paul car on the inter-urban line collided with an express wagon on Washington avenue in this city Tuesday, completely demolishing it. This is the first accident of any description that has occurred on that line since its opening.

There was an interesting debate in the Minneapolis city council at its last meeting which resulted in the adoption of a resolution designed to limit the speed of all traffic, electric and steam, to six miles an hour within the city limits. The resolution instructed the committee on railways to draft an ordinance to that effect, and also stipulated that an electric car must be brought to a standstill within ten feet of any car on the opposite track which is receiving or discharging passengers. The latter proposition is the result of the death of the young son of Gen. Hahn, who was killed by a First avenue car, which struck him as he alighted from one standing at a street crossing.

The plant of the Grand Forks Light & Power company at Grand Forks, N. D., was considerably damaged by fire Dec 16, the principal injury being to the engine and dynamos. Spontaneous combustion was the cause.

J. A. Holman of the Northwest Thomson-Houston Electric company of St. Paul, delivered an interesting and instructive lecture on electricity, before the Brotherhood of Locomotive Engineers at an opening meeting in that city. He confined himself principally to the discussion of electrical machinery.

A mortgage for $100,000, given in 1886 by the Duluth Street Railway company to the Farmers' Loan & Trust company of New York, has been paid and released. This company is now in good shape to undertake its proposed electric construction next season.

N. O. F.

Milwaukee, Wis.

MILWAUKEE, Dec 20.—The big Pabst brewery is more than half a mile away from any railway and hence is put to a great deal of expense in teaming its supplies from the freight sheds and hauling its product to the boats and trains. In the spring an electric railway will be built from the brewery to the railroad tracks at Third street, from which point most of the shipping is done. The brewery is located on Ninth street, between Poplar and Prairie streets. The line will run along Poplar street most of the distance. All the loading and unloading of cars will be done at the brewery after the road is completed, and it is estimated that the saving will be great. The Pabst company intend to put in a very large electric plant, which will furnish power to run the cars and provide lights for the brewery. The company will soon apply to the common council for the necessary franchise.

C.

Cleveland, O.

CLEVELAND, Dec. 20.—The Brush Electric company has recently adopted for its dynamo bearings and frames the new alloy made by the Cowles Electric Smelting & Aluminum company, called silver bronze.

The Central avenue motor line is now in operation. A branch will soon be built on Mayfield street.

The Buckeye Electric company has perfected its incandescent lamp. A new material for filament is used.

Manager O'Neil of the Electric Supply and Manufacturing company is devoting his time to his highway safety signal, several of which are now in use in the Rockies.

The Cleveland Construction company, formerly representing the Sprague company, has secured the local agency for the Wenstrom dynamos and motors.

A corporation called the Woodland Electric company is erecting an electric light plant and will subsist by furnishing stores on the outer portion of Woodland avenue and neighborhood with light.

The District Telegraph company has established branches all over the city proper, and has thereby increased its business very considerably.

The assets of the defunct Electric Novelty Manufacturing company of Cincinnati have been sold at auction.

The Time Electric company has secured a patent on its electric call, lighting and alarm system, and is hard at work to keep up with orders.

R.

Pittsburg, Pa.

PITTSBURG, Pa., Dec, 19.—According to the authority of the local signal service bureau this city has just gone through one of the heaviest and severest snowstorms of this century.

The storm was particularly destructive to the electric wires, and the damage done in that direction is not easy to be estimated. One thing, however, redounds very creditably upon the companies that string their wires along the streets, and that is the fact that they had taken great precautions to meet the storm and thus prevent any fatal accidents. The result has been that only two horses were killed, which is certainly incomparably small, if it is taken into consideration, that there are two local electric light companies with a capacity of 100,000 lights in this city besides the overhead wires of several electric street car companies and the wires of the Telegraph & Telephone company. All the wires with few exceptions are overhead, strung on poles along the streets.

The damage to the Western Union Telegraph system was rather severe, the estimated amount being $30,000. One hundred linemen are now employed in fixing up the wires and replacing the poles that were broken on account of the heavy strain caused by the weight of the snow upon the wires.

The Central District Printing and Telephone company had one thousand, out of a total of three thousand five hundred wires, down.

The Allegheny County Light company suffered, however, hardly anything, in spite of the fact that it is one of the largest electric lighting plants in the country. The management is now congratulating itself because it uses nothing but the best and strongest insulated wires, which, although they cost more in the beginning still are cheapest in the end.

The Pleasant Valley Electric Street Railway company and the Second Avenue Electric Line are both in bad shape. Owing to the breaking of a number of telegraph poles the wires got all tangled up, and in addition to the slush and snow on the heavy grades, of which there are many, both in Pittsburg and Allegheny, traffic was considerably impaired, However, they made every effort to surmount the trouble, and the companies have been more successful than it was first supposed they could be, considering the great amount of snow. Twenty-six inches fell in less than forty hours.

But the storm did not only do damage in this city, the electric wires in all the towns of Western Pennsylvania were damaged more or less. In Greensburg business had to be suspended on account of the totally disabled condition of the telegraph and telephone wires.

As usual the cry is now heard again from all directions, that the wires ought to be underground, and the finance committee of the Pittsburg council will ask the city at the next meeting for the appropriation of $20,000 to put all the police telephone and fire alarm service underground. All the city officials are in favor of this plan of putting the city's wires underground first, because they will be more than ever justified in compelling other corporations using electric wires, to put theirs underground also.

Thomas A Edison and the McKeesport Electric Light company were refused a mandamus in the Pittsburg court yesterday by Judge Ewing against a minority of stockholders in the company, who refused to call a meeting for the election of officers.

Judge Simonton rendered a decision yesterday at Harrisburg, Pa., in which he held that electric light companies are not manufacturing corporations, and consequently are liable to a tax on their capital stock. The commonwealth of Pennsylvania was the plaintiff, and the Brush Electric Light company of Philadelphia was the defendant. The company maintained that it was not only exempt from taxation, but that the revenue act of 1889 was unconstitutional, because of alleged inequality and lack of uniformity. Evidence was offered, showing the taxes paid by a large list of companies and showing that many which paid dividends of less than 6 per cent. were required to pay heavier taxes than those which paid larger dividends, owing to the fact that the law requires an appraisement of the stock if the dividend is less than 6 per cent., but if it pays 6 per cent. the tax is on the par value. The capital stock of some companies is worth more than par, although their dividends are worth less than 6 per cent.

One company named in the list paid tax on an appraisement several times greater than par, although it paid no dividends whatever. A third point of minor importance was that stock invested in patent rights granted by the United States is not taxable. This point was decided in favor of the defendant, which was represented by Morgan & Lewis of Philadelphia and M. E. Olmstead of Harrisburg. Upon the other points, however, the commonwealth wins. On the subject of exemption Judge Simonton says: "It is never to be presumed that the legislature intended to lay unequal burdens upon the people, and therefore, if a corporation claims exemption from the ordinary burdens of taxation, which at present bears so heavily upon the mass of the people, it must be able to show that the legislature elected by the people has conferred this exemption upon it by unmistakable terms. Corporations to which defendant belongs do not come within the policy of the legislature in exempting manufacturing corporations."

But what is still more important to the commonwealth is the sustaining by the court of the constitutionality of the tax on capital stock under the twenty-first section of the revenue act of June 1, 1889. After enumerating the numerous constitutional objections raised by that section, and declining to sustain them, the judge affirmed the validity of the tax, which, as shown by the auditor-general's report, amounted for the year ended Nov. 30, 1890, to almost one million dollars, all of which would have appeared to have been illegally collected had this decision been otherwise. The opinion just filed directs judgment to be entered in favor of the state. The case is to be made a test case and it will be taken to the Supreme Court.

E. H. H.

Denver, Col.

DENVER, Colo , Dec. 20.—That it costs money to light the city of Denver is evident from the estimate for 1891, submitted to Mayor Londoner last week by M Jarecki, light inspector. The number of lights in the estimate provides for more lamps than are at present in use in the city, but Mr. Jarecki says there should be 800 arc lights instead of 600 which he asks for. His estimate of the number actually needed for the year and the approximate cost is as follows:

600 all night arc lights at $120 per year	$ 72,000
1,600 incandescent lights at $26	41,600
46 tower arcs at $210 per year	9,936
Various departments (inside)	5,000
Inspector's salary	1,800
Total expense light department	$130 336

The inspector remarks that as all the lights will not be installed until some time after January 1, $120,000 will be ample for the year's expenses.

The city is at present lighted by seven towers of six arc lights each, one tower of four arcs, 174 arc lights on streets and bridges, besides a large number of incandescents, so it can be seen that the service will be largely increased. The cost of street lighting for October, the heaviest in the history of the city, was $6,398 83.

The South Denver Electric Light company is negotiating for the necessary dynamos and other machinery for lighting that town. The service will be put in immediately and will be largely increased in the spring.

The formation of a new electric light company by a union of the Western Electrical Construction company and the Denver Consolidated company is alleged to be assuming definite shape, though officers of both companies are very reticent regarding the matter.

The sale of the University Park Electric road to the Denver Tramway company for a consideration of $32 000 is reported. It will be run in connection with the Tramway company's present line. The University Park company operated about four miles of suburban road in the southern part of the city.

Articles of incorporation for the Denver, Lakewood & Golden Electric Railway company with a capital stock of $800,000, have been filed. The company will build a line from this city to Golden, a distance of about nine miles. Several hundred men have been at work on the proposed road for two weeks.

The Berkeley motor line, a suburban road running five miles northwest through the town of Highlands, has recently been purchased by the Denver Tramway company, and will be transformed into an electric line at an estimated cost of $150,000.

Samuel Lesem, a Denver man, has just secured the exclusive franchise for an electric street railway system in the city of Mexico. He was working in the interest of an American-Mexican company in opposition to an English syndicate. The equipments of the road will be secured in the United States, the cars being built in this city Mexican capitalists own one fourth of the stock in the new company, the balance being owned here. C. W. C.

Nashville, Tenn.

NASHVILLE, December 18.—Owing to the delay in the construction of a bridge and its approaches over the line of the Nashville & Chattanooga railway, the Citizens Rapid Transit company has not yet been able to run cars through to the terminus of its line. A large force has been at work day and night for two weeks, and the road will soon be completed.

The engine of the electric light plant at Columbia, Tenn., owing to an accident to the governor, ran away last week. The fly wheel burst and wrecked the building badly, some of the pieces landing 200 yards away. The management telegraphed for machinists and for new machinery and the damage will be repaired at once. B.

Louisville, Ky.

LOUISVILLE, December 18.—The Postal Telegraph company will soon have the right of way through the streets of this city. Councilman Lyons, however, who was mayor in Mayor Jacob's absence last summer, offered an amendment, to the effect that the city should have the power to take away the grant if the line becomes non-competing. Philip Cook, who is to be the local manager of the company, said that he expected to begin business here some time this month.

The Consolidated Railway lines are finding it difficult to secure motor cars, on account of the delays at the factories. The Consolidated Lines have also been troubled with other delays, and, in consequence, the officers announce that the remaining lines on which electricity instead of horse-power will be used, can not be changed now until next April or May. On Market, Second, Fourth, Eighteenth, Shelby, and other streets, poles have already been put up and the ground wires are down along the tracks. The building of the two power houses has also been delayed. One house is to be located at Logan and Campbell streets and the other at Seventh and Hill. The former will be used for the Market street lines and the other for east and west lines. The latter will supply current for the Fourth, Second and other north and south lines. Each of the power houses will have from 1,200 to 1,500 horse power.

A large number of men are still engaged in construction work. J. W. L.

THE ELECTRIC LIGHT.

The Western Electric company of Chicago, has a contract for the erection of the electric light plant at Ashville, Ala.

The Rochester, N. Y., Electric Light company has enlarged the capacity of its station by the addition of two 50-light arc machines.

East Tawas, Mich., is advertising for bids for street and commercial lighting by electricity. Bids will be received until December 31st.

Mansfield, Pa., is one of the latest towns in Western Pennsylvania to operate a central station plant of electric lighting. The Westinghouse alternating current system will be installed in the plant.

The Albion Electric company, of Albion, N. Y., where an electric light plant of five hundred lights has been operated about a year, is now compelled to increase its capacity The central station is operating the Westinghouse alternating current system and the Westinghouse company, of Pittsburg, Pa., has received an order for apparatus of 750 lights' capacity, which will be immediately installed at the Albion plant.

The Windsor Locks, Ct., Electric Light company commenced operations last spring with a 500 light dynamo of the Westinghouse alternating current system; since then the capacity of the plant has been increased twice, and today the company is able to furnish more than four times the amount of lights of its original capacity. The Westinghouse Electric & Manufacturing company is now engaged with the installation of a 750 light alternating current dynamo.

The isolated lighting department of the Thomson-Houston Electric company, has sold to the National Distilling company, Milwaukee, Wis., a 100 light incandescent plant, to the St. Louis Railroad company of St. Louis, Mo., a plant of 200 lights for the cable power house, located at Broadway and Lemi streets. A few days ago there was sold to the same company a 400-light plant which is now being installed at another power station located at Broadway and Sillsbury streets

The House of Delegates of St. Louis has three ordinances for underground conduits under consideration. The Bell ordinance was amended by council so as to require the company to give the city all the telephone services needed free of charge, and also pay into the city treasury 5 per cent. of its gross receipts. The St. Louis Conduit company's measure is a far better one from the standpoint of the projectors, and the St. Louis subway, the Dorsett bill, is an amendment of the one under which a mile of conduit was constructed more than a year ago. The program is now to pass all three bills in the House. It will then be a question of money and management which of the enterprises gets control of the wire-carrying business in St. Louis The three bills referred to have been kept in a pigeon hole by the House Committee on Public Improvements for six months notwithstanding the expressed anxiety of the Board of Public Improvements and the mayor to have them disposed of. The Chief of the fire department and the Superintendent of fire alarm telegraph have also earnestly advocated the disposal of the electric wires in the manner indicated, it now lies solely within the power of the Municipal Assembly to grant the desired legislation.

THE ELECTRIC MOTOR.

The East Chattanooga Land company will build an electric street railway.

The Capital Railroad company has been formed at Atlanta, Ga., to build electric street railroads

The Prouty Street Car Motor company of Chicago has been incorporated to manufacture motors and establish motor street car lines; capital stock. $300,000; incorporators, Enoch Prouty, J. L. Francis and W. S. Gooding.

The Citizens' Traction company, of Pittsburg, Pa., a street car corporation which operates about seven miles of cable lines in that city, has decided to extend one branch of its line from Butler street to Sharpsburg, for a distance of three miles. This extension will be operated by the electric overhead wire system. The contract for the equipment of the cars with motors has been awarded to the Westinghouse Electric & Manufacturing company. As the power house will not be completed for some time yet, the road will not go into operation until spring.

The Metropolitan Street Railroad company of Washington, D, C., has decided to substitute electricity for horse power. The new system will be used on all lines of the company which extend from one end of the city to the other. This important change of power was decided upon at a meeting of stockholders held December 7th, and the directors have been instructed to take steps at once to raise the money, not to exceed $500,000, to put the new system into operation. The motive power is to be furnished by storage batteries.

Personal Mention.

General E. H. Broadhead of the Wisconsin Telephone company, Milwaukee, died Sunday, Dec. 14.

Chas. L. Harding, of the Harding Electric Railway company, president, of Atlantic, Ia., was in Chicago last week.

A dispatch from Ludington, Mich., Dec. 16, says: N. C. Griffis, manager of the telephone exchange, started about 5 P. M. to cross Pere Marquette lake to Buttersville, and not returning, search was instituted. His tools and hat were found near a hole in the ice.

Business Mention.

The Thomson-Houston Electric company of Boston, is reported as having secured a site for an electric light and power plant in Chattanooga, Tenn.

The Electric Merchandise company, of 11 Adams street Chicago, has just issued an illustrated circular calling attention to several of its most popular specialties, including the Stevens gravity switch, fuse box, Mason lightning arrester, etc.

H R. Hixon, well-known throughout the West as buyer for the Great Western Electric Supply company, has returned to Chicago after a month's trip to Philadelphia and vicinity. He is again associated with George Cutter, 333 the Rookery.

Frederick Sargent, consulting and contracting engineer, has accepted the Western agency for the MacIntosh & Seymour engines. Mr. Sargent's office is in the Owings' Building, Chicago. His experience in electrical work will prove valuable to him in his new line.

The Electrical Supply company, 171 Randolph street, Chicago, has introduced a new low-resistance bell, which it is claimed combines all the virtues of its class. It is made both in wood and iron box form, is handsomely finished externally and of exceptionally good workmanship throughout.

The Crosby Electric company of New York announces that it has been awarded medals of superiority, being the highest given, for its Crosby dry battery, Hussey bluestone battery, the Eclipse battery and the Duplex battery, at the recent fair of the American Institute, held in New York, November, 1890.

Partrick & Carter have removed to more spacious quarters at 125 South Second street, Philadelphia. The firm will have in its new place of business more than 20,000 square feet of floor space to be used as factory and store rooms. The working force will be increased, and new machinery will be added.

The Columbia Incandescent Lamp company of St. Louis, has issued a catalogue illustrating the incandescent lamp manufactured by that company. These lamps are made to fit all sockets. The company announces that it makes a specialty of street railway lamps in which the filament is so mounted as to prevent mechanical injury from vibration.

The Electrical Supply company of 171 Randolph street, Chicago, Ill., recently received the following dispatch: "How soon could you ship 110 miles No. 6 Shield brand wire?" The single word "To-day," was sent in reply. The order was received and before 5 o'clock in the afternoon three cars loaded with the 55,000 pounds of Shield brand were ready to start westward.

The Elektron Manufacturing company of Brooklyn, N. Y., has recently sold to Messrs. Warfel & Geist, of Lancaster, Pa., 30 horse power in Perret electric motors. These machines will be supplied with current by the Edison Electric Illuminating company of Lancaster, and will furnish power for all the machinery in the large brick building recently completed by Messrs. Warfel & Geist, including large Hoe presses for printing the daily and weekly *New Era*, as well as all the job presses, which go to make up one of the best and largest printing establishments in the state. Messrs. Warfel & Geist after a thorough investigation and a visit to Brooklyn and New York, where they witnessed the motors in operation, placed their contract for Perret machines. F. G. Ward, manager of the Atlantic & Pacific Tea company of Minneapolis, writes to the Elektron company as follows: "I am so well pleased with the Perret motor in all respects that I will permit your people to write anything they see fit over my name, providing it is all in favor of the Perret."

R. T. White of Boston has just received a patent for his form of Eureka rail chair. He says he proposes to institute suits against persons who have, as he alleges, infringed the patent Mr. White recently received a letter from F. G. L. Henderson, superintendent of the Newton Street Railway company, in which the former's "Daisy" chair is spoken of in high terms Mr. Henderson writes: "I will say that we have recently laid in Newton and Waltham five and one-half miles of track, more than three of which are laid on your chairs and since they have been in use they have given perfect satisfaction. When laying track in Newton we gave them a severe test by running a seventeen-ton steam roller over our road bed, first filling it with ten inches of crushed rock. We found no evidence of any failure to hold this immense weight and consequently I have full confidence, that if the material of which it is made is kept up to the proper standard, your chair will do all that you claim for it. I see no reason why it should not meet with the approval of street railway managers who will give it a trial, as its low price and durability are points which ought surely to commend it to them."

The Shaw Electric Crane company has been organized at Milwaukee to manufacture traveling cranes and other lines of heavy electrical machinery. The company is capi-

talized at $150,000. A. J. Shaw, under whose patents the company will operate, has been building electric cranes at Milwaukee three years. These cranes have been fully illustrated and described in the WESTERN ELECTRICIAN. The company will erect a new factory at Milwaukee, and extend the business largely.

The Knapp Electrical Works, Chicago, have just completed an order for 50,000 pieces of different kinds of porcelain cut-outs, branch blocks and rosettes. The same shipment was accompanied by 10,000 sockets. The company makes a specialty of these lines and is prepared to furnish them promptly. It is also handling immense consignments of Grimshaw white core wire and Perkins lamps. The demand for these goods has been so great that the company has been obliged to keep an immense stock on hand to fill orders promptly.

Chandler & Littlefield, 40 Marine Building, Chicago, have been given the agency for Chicago and vicinity for the Triumph Compound-Engine company of Cincinnati. Both members of this firm are young men, but by their energy and integrity they have built up an enviable reputation, and the Triumph people have made no mistake in intrusting their interests to them. The engine represents a new form of construction, great claims being made for its efficiency, economy and durability, and in the hands of these gentlemen very large sales to the users of steam in Chicago are looked for.

The Chicago Rawhide Manufacturing company is meeting with great success in the sale of its celebrated rawhide belting to the electric street railway and electric light interests. For the running of a generator this belting is claimed to be superior to all other makes. The company is also manufacturing a rawhide pinion that has been adapted as "standard" by nearly all of the electric street railway systems in the United States, the object being to reduce the noise coming from the rapidly moving parts to a minimum. Many other advantages are claimed for this gearing, and its reputation appears to be firmly established.

J. E. Wilson with the Western Power Construction company, handling the McIntosh & Seymour engine, has severed his connection with that company and has associated himself with W. B. Pearson & Co., representing the Ball Engine company, at 403 Home Insurance building, Chicago. Mr. Wilson has been in the West but a short time, but he has become well known to the trade which wish him the success which he is sure to achieve in his new departure. Mr. Wilson, previous to the formation of the Western Power Construction company, was a partner of the deceased H. A. Glasier, who was then representing J. A. Grant & Co. of Boston.

The William D. Gibson company, 75 North Jefferson street, Chicago, have just placed on the market a spring of novel design, which is calculated to meet many of the objections offered by the electric street railway officials to the old forms used for holding the trolley to its work, but while intended particularly for this service, it will be found very efficient in any place where only a limited space is available. The coils of this spring are flattened so that a greater number can be provided in a given space, and in this manner, by the multiplication of the coils, a much less strain is placed on each particular coil, thus reducing the danger from breaking to a minimum. The Gibson company also manufacture a great variety of springs, of all conceivable designs for other purposes, and report an active demand for their specialties.

The board of directors of the Edison Electric Illuminating company, of New York, have declared a quarterly dividend of 1 per cent. payable Jan. 15, 1891. In addition, the directors have declared a dividend of 5 per cent. on their capital stock, representing surplus earnings, payable in certificates convertible into stock at par whenever the company shall increase their capital stock beyond the present authorized amount, or redeemable in cash at par, at the option of the company. Until so converted or redeemed, these certificates will bear interest at the same rate, and payable at the same time, and in the same manner, as dividends may be paid on the company's capital hereafter. These dividends will accrue to stockholders of record January 2. Convertible certificates will be delivered on and after February 2. Transfer books re open January 21.

The Cowles Smelting & Aluminum company has moved its business office from Cleveland to Lockport, N. Y., where the works are located. Eugene H. Cowles says the company is convinced that its new method will materially lessen the cost of placing the metal on the market. In the course of an interview Mr. Cowles said: "It is our determination now to immediately prepare plans for a plant that will enable us to sell the best grade of metal at not to exceed 50 cents per pound, and it is our ambition to have it displayed by the car load at the coming exposition or great World's Fair at Chicago. I feel confident that by perfectly natural steps the price will fall lower and lower, as fast as new plants can be built and the market adapts itself to the absorption of large amounts of pure aluminum, until eventually it will be selling at from $200 to $300 per ton. At these figures it will be the cheapest metal in use, next to iron and steel. When sold at 50 cents per pound it will be in actual competition with copper at 17 cents per pound."

The C. & C. Electric Motor company of New York, less than twelve months ago manufactured the first of its blower and motor combinations with which most people versed in electrical appliances are now familiar. This apparatus was primarily designed for use in dynamo and engine rooms of steamers and in other places where it is essential to produce a rapid and thorough ventilation and where the space is circumscribed. Owing to the extreme compactness of the machine it may be placed in the smallest room and proves a most powerful exhaust. The apparatus was first used on the U. S. steamer "Baltimore," and Capt. Schley commanding that ship declared in a letter to the C. & C. company, that it gave "perfect satisfaction." The installation on the "Baltimore" has been followed by others on the "Chicago," "Charleston" and "Petrel," and three more blower combinations are now under construction by the C. & C. company for other new cruisers. The Italian navy not to be left behind ordered two of these blowers some few months ago and after giving the apparatus a thorough test has recently through its agents in Milan placed a further order with the C. & C. company for nine including six of the No 7 or largest size machines.

The Taylor Manufacturing company of Chambersburg, Pa., report an increasing demand for the Beck automatic engines, both for electrical and general power service. A few of the recent sales are as follows: Six 10x10 inch cylinder, 50-horse power automatic engines, through Cooke & Co., of 22 Cortlandt street, New York, for the following steamers of the Erie line: Bavonia, John King, Jay Gould, Passiac, Erie and Delaware; also an 8½x10 engine to Cooke & Co.; one 14x15 engine to the Ft. Scott, Kan., Rapid Transit company, making the second engine sold the company for operating its electric railway generator; a 100-horse power complete steam plant for electric railway work to the Uniontown, Pa., Street Railway company; one 11x12 engine to the Rosenheim company of Nashville, Tenn; two 11x12 engines with boilers, etc., for the Chartiers Valley Electric Light company at Mansfield, Pa.; two 10½x12 engines with complete steamplant to the Thomson-Houston Electric Light company, for Bloomsburg, Pa.; one 12½x15 engine to Miller & Sibley, Franklin, Pa.; one 7x8 engine for the Allegheny County Work House, Claremont, Pa.; one 14½x18 engine to Burt Bros., Philadelphia, and one 9½x12 engine to the Pulaski Iron company of Philadelphia; one 9½x12 engine to the Millville, N. J., Schuyler Electric Light company; two 10x10 engines for a large hotel now building in Cincinnati, O.

The Thomson Houston Electric company has prepared at its Chicago office a tabulated statement comparing the number of arc and incandescent lights of the Thomson-Houston system with the number of lamps operated by the other systems combined throughout the country. The total number of stations in the country according to the published reports is 1,379, of these 666 or 48 1-5 per cent. are operating Thomson-Houston apparatus. There are 137,441 arc lamps in operation and 79,387 or 57¾ per cent. are claimed by the Thomson-Houston company. In the incandescent field an excellent showing is also made. The total number of incandescent lamps in use is 1,590,967 and about 25 per cent. of these are of Thomson-Houston system, or 398,555 According to the reports by states the Thomson-Houston company's system is operated in every central station in Tennessee and Montana, and the same is true of the District of Columbia. The company has a large percentage of the lights in these states also. In the District of Columbia it has 85 per cent. of the arc lights, Tennessee 91 per cent. and in Montana over 70 per cent. In the last named district 98 3 per cent of the incandescent lights are claimed by the Thomson-Houston company and 89.5 per cent. in Tennessee. In Nevada all the incandescent lights are those of the Thomson-Houston company and in South Carolina the same is true of both arc and incandescent systems Massachusetts naturally makes a good showing for the Thomson-Houston company. In that state alone there are 9,938 arc lamps of the Thomson-Houston type, while all the other systems have only 2,946. That state has 132,910 incandescent lights, of which 70,350 are of the Thomson-Houston system.

Electrical Patents.

Issued December 16, 1890.

442,610. Station Indicator. Louis Casper, Cheyenne, Wyo.

442,617. Electric Arc Lamp. John E. Giles, Hazleton, Pa.

The lamp is provided with main and shunt regulating coils and a cut-out controlled by a magnet in the main branch for completing the shunt or rupturing the same, according as current flows or ceases in the main branch.

442,623. Electric Trolley Switch and Trip. Richard C. Hopson, Saginaw, Mich.

442,649. Electric Heater. Charles H. Talmage, Kansas City, Mo.

442,654. Portable Electric Motor and Cloth-Cutting Machine. Elbert D. Weyburn, Chicago, Ill.

442,661. Process of Desilverizing Lead by Electrolysis. Turner D. Bottome, Hoosick, N. Y.

442,666. Bracket for Combined Electric and Gas Lighting. John Gunn, New York, N. Y.

442,668. Regulation of Electric Motors. Edwin W. Rice, Jr., Lynn, Mass.

442,685. Electric Light Holder. Joseph B. Moore, Minneapolis, Minn.

442,705. Electric Meter. Alexander W. Meston, St. Louis, Mo.

The invention comprises a solenoid and its core, a vibrating lever and a series of pendent weights arranged in the path of the lever.

442,734. System of Telegraphic and Telephonic Exchange. John R. Smith, Neosho, Mo., and Wallace Childs, Fort Smith, Ark.

The object of the invention is to furnish a system for telegraphs and telephones whereby connections and disconnections may be made at the central office by the operator at the local stations promptly, secretly and automatically, thus entirely dispensing with help at the central office.

442,744. Storage Battery Electric Car. John Stephenson, New York, N. Y.

442,746. Pendent Cleat. Arthur R. Bush, Boston, Mass.

442,797. Stage Apparatus. Neilson Burgess, Highlands, N. J.

442,800. Reversing Key. Edward A. Colby, Newark, N. J.

442,808. Telegraphy. Adolph G. Hummel, New York, and Frank A. Graham, Brooklyn, N. Y.

442,816. Safety Device for Overhead Conductors. Robert A. Morgan, Jr., Boston, Mass.

442,843. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

The invention consists in the construction embodying a fixed coil, and a movable coil suspended in the field of force of said fixed coil by a filament, the said coils being electrically connected. On the establishment of a current through the coils the movable coil is deflected to an extent depending upon the difference of potential existing between the terminals of the device, and the amount of deflection is indicated by a needle moving over a suitable scale.

442,849. Automatic Recording Apparatus for Vehicles. Josef Bellussich, Capo d'Istria, Austria-Hungary.

442 856. Means for Reducing Inductive Disturbances in Telephone Circuits. John J. Carty, New York, N. Y.

442,868. Underground Conduit for Electric Conductors. Josiah S. Du Bois, Camden, N. J.

442,870. Dynamo Electric Machine or Motor. Nathan H. Edgerton, Philadelphia, Pa.

442,879. Metallic Thermometer. Henry J. Haight, New York, N. Y.

442,880. System for Indicating Thermometric Records. Henry J. Haight, New York, N. Y.

442,881. Means for the Transmission of Meteorological Indications. Henry J. Haight, New York, N. Y.

442,882. Multiple Circuit Closer. Henry J. Haight, New York, N. Y.

442,883. Combined Electric Indicating and Telephone System. Henry J. Haight, New York, N. Y.

442,925. Ship's Course and Position Indicator. Theophilus Tanner, Ponts de-Martel, and Ernst Lutz, Zurich, Switzerland.

442 932. Electric Cooking Apparatus. Ernest Abshagen, Chicago, Ill.

The first claim reads as follows:

"The electrical cooking apparatus consisting of a closed vessel or receptacle filled with an oily fluid and provided with suitable cooking compartments heated by said fluid, and a resistance piece immersed in said fluid and in circuit with a generator of electricity."

442,933. Electric Steam and Hot Water Generator. Ernest Abshagen, Chicago, Ill.

The last claim is given:

"The stove or other heater containing a body of oil or oily fluid, and a packing of mineral wool, asbestos, or similar material, in combination with a resistance coil and its electrical connections for heating said fluid."

442,954. Method of Welding Metals Electrically. Charles L. Coffin, Detroit, Mich.

The method consists in connecting each article with one pole of a generator of electricity, making contact between the ends to be welded and an electrical conductor of equal or less resistance and passing a heating current through said articles and said conductor.

442,956 Shut Off Device for Engines Thomas Conroy and Lewis P. Fuhrman, Kansas City, Mo.

442,969. Portable Electric Lamp. Desmond G. Fitz Gerald and Arthur H Hough, London, England.

442,996. Electric Switch. John O'Brien, New York, N. Y.

443,004 Trolley Line Switch. William M Ramsey, Allegheny, Pa.

443,005. Trolley Line Insulator. William M. Ramsey, Allegheny, Pa.

443,019. Magnetic Shield for Electric Motors. Charles J. Van Depoele, Chicago, Ill.

443,042. Magnetic Ore Separator. George S. Finney, Chicago, Ill.

Claim one:

"A magnetic wheel for a separator, comprising a series of electro-magnets having a common core and having the poles extended from opposite ends of the series crosswise of the plane of the wheel's circumference and forming elements of its cylindrical surface."

443,043 Magnetic Separator. George S. Finney, Chicago, Ill.

443 044. Magnetic Ore Separator. George S. Finney, Chicago, Ill.

443,048. Method of Protecting Buildings from Lightning. Nathaniel D. C. Hodges, Plainfield, N. J.

The method consists, first, in receiving the atmospheric electricity as it collects in the neighborhood of a building upon a conducting surface; second, in diffusing said electricity upon a large surface of finely divided badly conducting substance; third, scattering said badly conducting substance and thus reducing the charge, and lastly, in conducting the residue of said charge to the ground.

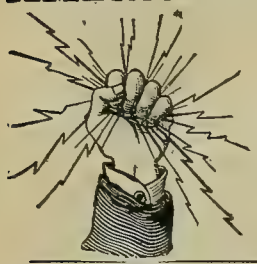
443,068. Electric Cut-Out. David J. Cartwright, Boston, and John S. Potter, Newton, Mass.

443,074. Electric Signaling Device for Moving Vehicles. Otis J. Depp and Schuyler J. Munn, St. Louis, Mo.

443,081. Trolley Switch for Electric Railways. John Jones, New York, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

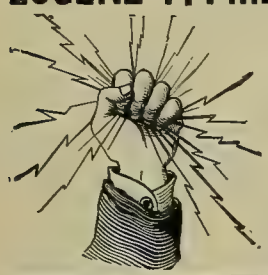
New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

EUGENE F. PHILLIPS, President. JOHN CARROLL, Sec'y. Treasurer.

EUGENE F. PHILLIPS ELECTRICAL WORKS,

(LIMITED.)



Office and Factory, St. Gabriel Locks, Montreal, Canada.

—MANUFACTURERS OF—

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

THE TURNER BRASS WORKS

4 LASALLE AVE

CHICAGO.

MAKE ANYTHING IN BRASS.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

---

JEWELL BELTING CO., HARTFORD, CONN.

Manufacturers of SHORT LAP, PURE OAK LEATHER BELTING.

Our light Double Dynamo Belts are always made from centers of whole hides extra stretched.

WESTERN AGENTS:

W. H. SALISBURY & CO., Chicago, Ill.
A. H. GARDINER CO., Milwaukee, Wis.
TODD & STANLEY CO., St. Louis, Mo.
ENGLISH, MORSE & CO., Kansas City, Mo.
E. C. ATKINS & CO., Main House, Indianapolis. Branch House, Memphis, Tenn. " " Chattanooga, Tenn.

TRADE **FIBRONE** MARK.

Is the recognized **Best Substitute** for Hard Rubber in the market, and used by the leading Electrical Houses in the country. We manufacture all kinds of

INSULATING SPECIALTIES,

also Sheets (which can be sawed, drilled, turned in a lathe, etc.), Jar Covers and Fittings, Switch Bases and Handles, Cut-Outs, Bell Boxes, Annunciator Dials and Handles, Push Buttons, etc.

We Claim to Manufacture THE VERY MATERIAL Wanted by the Electric Trade. Send for Estimates and Prices.

THE FIBRONE MFG. CO.,

Office, 35 Warren St. Factory, 300 and 302 Monroe St., NEW YORK

FOR SALE --- CHEAP.

Two new **Thomson-Houston Electric Motors,** one 10 and one 15-horse power. Will sell cheap. Address

J. W. CALKINS & SON,
Chicago Office Rockford Electric Mfg. Co.
356 Rookery Bldg.

DO YOU USE

THE LAW BATTERY?

IF NOT, WHY NOT?

The Cheapest Battery and the Best.

LAW TELEPHONE CO.,

85 John St., New York.

ELECTRIC LIGHT POLES FOR SALE.

Proposals for all or any part of the following cedar poles will be received at office of the

CINCINNATI ELECTRIC LIGHT CO.,
Cor. 4th and Plum Streets, Cincinnati, Ohio:

5	cedar	poles	30	feet	long.
44	"	"	34	"	"
389	"	"	35	"	"
682	"	"	40	"	"
46	"	"	45	"	"
12	"	"	50	"	"
63	"	"	assorted sizes.		

FOR SALE.

VERY CHEAP.

Several 10, 15, 25 and 50-H. P. Van Depoele Electric Motors, made for Street Cars; also Gear and Attachments for same; also one 150-H. P. Van Depoele Electric Generator; also two Street Car Trucks, with 4½-inch Axles and Bemis Gear; also a lot of Pulleys and Hangers.

For particulars address

W. A. STILES,

Room 1028, 112 CLARK ST., CHICAGO.

To Directors of Electric Light or Power Central Stations.

POSITION WANTED

By a manager, at present in charge of a large electric light central station, who wishes to change for satisfactory reasons. Can demonstrate by results his ability as a mechanical and electrical engineer, and as business manager. Prospects of future growth of company will be considered with salary, but only those whose business will warrant the payment of at least $3,000 salary to the right man, need answer.

Address **"K,"**
Care of WESTERN ELECTRICIAN.

FOR RENT.

Basement 75x100, light and dry—suitable for manufacturing; also 200 horse power; also two stores suitable for electrical supplies.

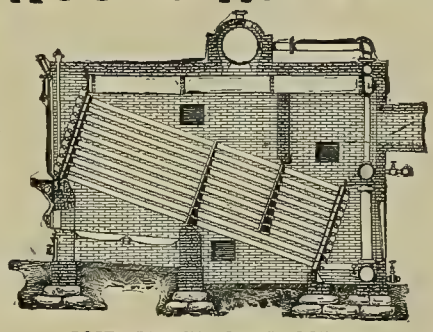
Will make arrangements with proper parties who wish to put in electric power or lighting plant, and can furnish 150 horse power electric generator.

W. A. STILES,

1028 Opera House Bldg., - Chicago.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

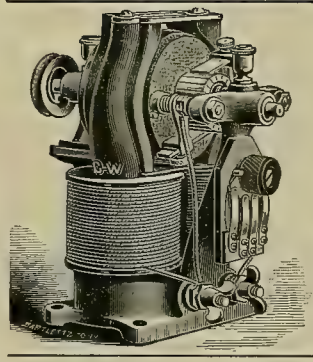
Electric Plant Boiler.

Adopted by the **Edison Electric Light Companies** at Philadelphia, Detroit, St. Paul, Columbus and Cincinnati; also the Brush Electric Light Co., of Louisville, and others.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.



THE CROCKER-WHEELER PERFECTED MOTORS.

Very Slow Speed—Full Power—Perfect Regulation Forged Fields, Let into Base-Self-Oiling Bearings—Self-Centering Bearings—All Sizes Both Arc and Incandescent —For All Power Purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

430-432 WEST 14TH St., NEW YORK

S. S. WHEELER, President. F. B. CROCKER, Vice-Pres't.

LONG LIFE, High Efficiency, **A CONSTANT** And Beautiful LIGHT.

The SUNBEAM is a SUCCESS.

THE SUNBEAM INCANDESCENT LAMP CO., CHICAGO, ILL.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

Electric Light, Telephone, and Telegraph,

For Aerial, Submarine, and Underground Use.

CANDEE AERIAL WIRES, OKONITE WATER-PROOF TAPE, MANSON PROTECTING TAPE.

AWARDED A GOLD MEDAL AT THE PARIS EXPOSITION.

—THE— INTERNATIONAL **OKONITE COMPANY,** Limited, - - 13 Park Row, NEW YORK.

BRANCHES Chicago, Boston, Philadelphia, Omaha, Minneapolis, Cincinnati. Louisville, St. Louis, Kansas City, San Francisco, London and South America.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

EDISON LAMPS REDUCED TO 44 CTS.

16 CANDLE POWER LAMPS.

Lots of 25 to 150 .....44 cents each.
Lots of 150 to 500.....42 cents each.
Lots of 500.....40 cents each.

Other sizes in proportion. All sizes in stock, with bases to fit any make of lamps or sockets.

Full Line OKONITE WIRES in Stock. Safest and best wire made.
Full Line of Edison Sockets and Appliances.

STANDARD ELECTRICAL WORKS, CINCINNATI, OHIO.

EXPERIMENTAL, MODEL AND ELECTRICAL Work, Intricate and Special Machinery, and anything that can be done in a first class experimental machine shop is solicited.

E. D. STIFF, 67 & 69 So. Canal St., Chicago,
Light Manufacturing under Contract.

HENRY HUTTON,

Consulting and Contracting Electrical Engineer.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

MINING AND SPECIAL MACHINERY.

MANUFACTURERS' AGENT.

TACOMA, WASH.

BLECKERT & NELSON,

MANUFACTURERS OF

Electric Light and Combination Fixtures,

We make a specialty of furnishing the trade with Electric Brackets, Electroliers, Portables, Combination Brackets, and small fixtures of all kinds. Being manufacturers we can give lowest prices.

OFFICE AND FACTORY:

85 and 87 FIFTH AVENUE, CHICAGO, ILL.

Send for New Descriptive Circulars.

Pittsburgh Sheet Metal Tool Co.,

H. H. HIPWELL, Prop.

Mfrs. of Electric Specialties of Every Variety, TOOLS, DIES, Etc.

202, 204 & 206 Robinson St., - - Allegheny, Pa.

ELECTRIC RAILWAY LIGHT AND POWER.

JAS. McLAUGHLIN.
14 Years' Experience.
A Pioneer in the Business.
Repairs and Parts for all Systems.

48, 50 and 52 NORTH CLINTON ST.,
CHICAGO, ILL.

FOREE (4a) BAIN,

84 MARKET ST., CHICAGO,

Electrical Expert,

DESIGNER AND MANUFACTURER.

Special and Experimental MACHINERY.

Large Dynamos and Motors for Special Work built to Order. Coal Mining Haulage a Specialty.

ELECTRIC LIGHT REPAIRING.

INCANDESCENT LAMPS.

50 TO 110 VOLTS.

TO FIT STANDARD SOCKETS.

THE BUCKEYE ELECTRIC CO.,

P. O. Box 123, CLEVELAND, OHIO.

WRITE FOR CIRCULAR.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

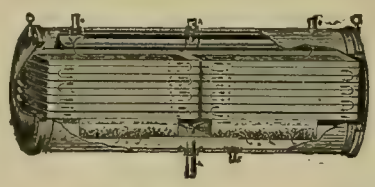
HARD PORCELAIN ELECTRICAL SUPPLIES,

—INCLUDING—

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

AYRTON & PERRY, AMMETERS and VOLTMETERS.

CHIEF CHARACTERISTICS:

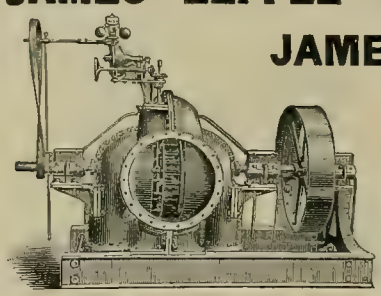
Portability. No Permanent Magnets. Direct Reading Scale. Uniform Divisions. Unaffected by Dynamos and Motors.

It makes no difference which way the current enters. The ammeters may be left in circuit continuously.
Each Voltmeter has a special contact key.

Send for Catalogue 1-66 of Electrical Test Instruments.

QUEEN & CO., PHILADELPHIA.

JAMES LEFFEL WATER WHEELS



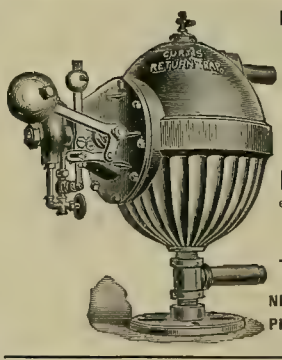
BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,
FOR
ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.
SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.



THE CURTIS

PATENT RETURN STEAM TRAP.

IT is noiseless, positive, rapid, will return all condensation back into the boiler, and works equally well in connection with reduced pressure or exhaust steam, also when the return is below the water line of the boiler.

THE CURTIS REGULATOR COMPANY,
90 BEVERLY ST., BOSTON, MASS.

GENERAL AGENCIES.

NEW YORK, 109 Liberty st. CHICAGO, 218 Lake st.
PHILADELPHIA, 2035 N. Front st. MINNEAPOLIS, 210 N. Third st.

C. B. HOLMES, Pres't. & Genl. Mgr.
WM. C. NICHOLS, Secretary & Treasurer.
G. W. GRIFFIN, Superintendent of Construction.

THE

Hazelton Tripod Boiler.

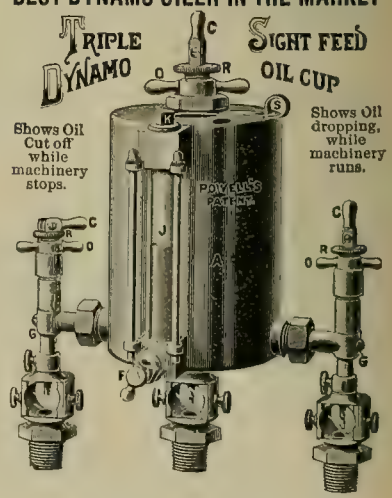
Is the quickest generator of steam, needs less repairs than any other, and is the most economical boiler in use.

ADDRESS

Hazelton Tripod Boiler Co.,

170 TWENTY-SECOND ST.,
CHICAGO, ILL.

Endorsed by all users as the
BEST DYNAMO OILER IN THE MARKET

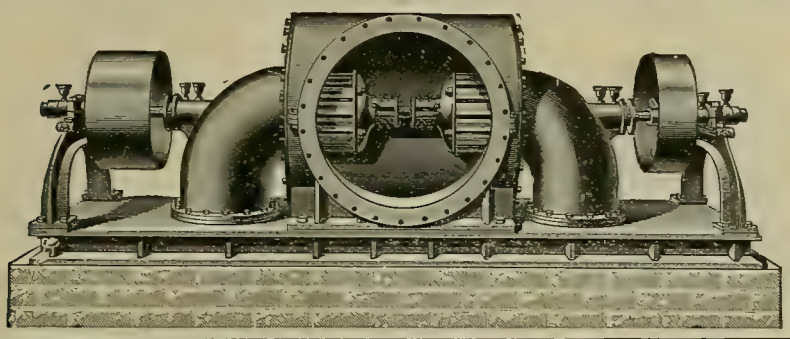


UNIQUE APPEARANCE. | *Can be instantly started or stopped at will of operator* | EASILY REGULATED. CONVENIENT TO FILL.

MANUFACTURED ONLY BY
THE WM. POWELL CO., CINCINNATI, O.
SEND FOR CIRCULARS AND PRICE LISTS.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO., CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

SYNOVIAL DYNAMO OIL.

SECOND TO NONE.

Free from gum or acids. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agt., 45 River St., Chicago.

Write for Prices and Samples.

AS A METALLIC INSULATOR

THE COWLES ELECTRIC SMELTING & ALUMINUM CO., Cleveland, O.,

Offers its new Alloy Silver Bronze. Three times the resistance of German Silver guaranteed. Color, strength, toughness, casting qualities, all superior to German Silver. Costs less. Furnished in ingots or casting.

HARRISON CONVEYOR

FOR HANDLING

Grain, Coal, Tan Bark, Seeds, Etc.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illus. Catalog. **BORDEN & SELLECK CO., 48 and 50 Lake St., Chicago, Ill.**

You make a mistake if you don't buy Electrical Supplies from F. & F., Cleveland, Ohio. Send for the latest "List of Bargains for Bell Hangers" and "rock bottom prices" on Medical Batteries. We undersell all. Address Fletcher & Fletcher Electric Co., Cleveland, O. Mention this paper if you want bottom prices.

WM. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE & TURNER,

Electrical Engineers and Contractors.

COMPLETE EQUIPMENT OF ELECTRIC RAILWAYS.

Steam Plants for Electric Light and Power. Arc and Incandescent Lights Installed.

Designs and Estimates Submitted.

74 Cortlandt Street, New York.

FOR SALE.

One 15-light 50 volt Dynamo
One 25-light 50 volt Dynamo
One 50-light 50 volt Dynamo
One 75-light 110 volt Dynamo
One 100-light 110 volt Dynamo
One 150-light 110 volt Dynamo
Including Lamps and Holders.

I. W. COLBURN & CO.,

FITCHBURG, MASS.

LAMINAR FIBRE

A perfect substitute for Hard Rubber for insulating and mechanical purposes. Thoroughly homogeneous, and practically indestructible. Furnished in sheets and tubes of various lengths and thicknesses. Can be cut, turned or drilled into any desired shape. Will take a very high degree of polish. Is also a perfect bearing for light running machinery.

LAMINAR FIBRE GOODS CO.,

180 Summer St., Boston, Mass.

COLUMBIA Incandescent Lamp Co.,

1912--1914 Olive Street, St. Louis, Mo.,

MANUFACTURERS OF

INCANDESCENT LAMPS.

Lamps Made to Fit any Socket.

Send us a trial order. Satisfaction Guaranteed.

EUREKA TEMPERED COPPER CO.,

Only Manufacturers of Pure Copper Tempered for

Brush Copper, Commutator Bars, Copper Wire, Gear Pinions, Trolley Wheels, Bearings.

General Office and Factory, NORTH EAST, PA. **Western Sales Office, 225 Dearborn St., CHICAGO.**
Eastern Sales Office, 35 Broadway, NEW YORK. **North Western Sales Agent, G. W. Williams, DETROIT MICH.**

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

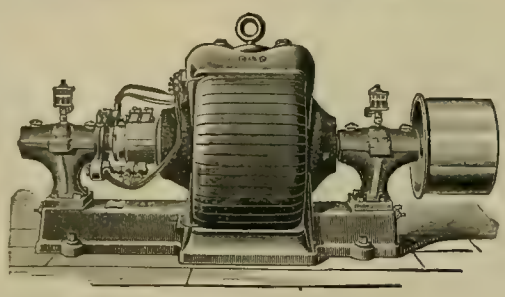
THOS. L. SCOVILL, New York Agent,
25 PARK PLACE, NEW YORK.

C. & C. ELECTRIC MOTORS.

The only motors in which the magnetic circuit forms a perfect circle around the center of the armature shaft, thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth H. P. to fifty H. P. in stock.

Over 10,000 Motors in actual operation.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

Motors for Hoist and Mining Tramways.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings with Electric Power.

NEW ENGLAND OFFICE, 63 Oliver St., BOSTON. PHILADELPHIA OFFICE, 38 S. Fourth St. CHICAGO OFFICE, Phoenix Building.

C. & C. ELECTRIC MOTOR CO., 402 AND 404 GREENWICH ST., NEW YORK.

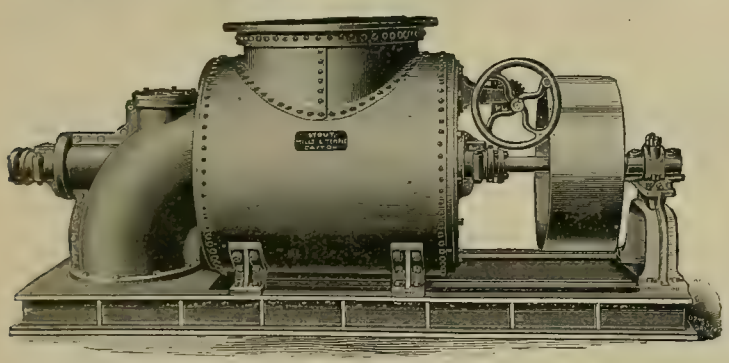
Correspondence regarding Underground and Overhead Cables, Insulated Wires, Electric Lights, Telegraph Instruments, House Goods, and other electrical apparatus solicited. Our new Illustrated General Catalogue will be furnished to the trade on application.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

STANDARD ELECTRICAL WORKS, Agents, CINCINNATI, OHIO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

ANTIQUATED!

THE OLD STYLE DOUBLE CARBON LAMP of all makes, a relic of the Past, that vanishes before the new

"Triple" Carbon Lamp

ADAPTED FOR ALL DAY OR ALL NIGHT LIGHTING.

First cost much less, and far cheaper to operate and maintain, having but one carbon rod and one mechanism.

OLD LAMPS OF ALL STYLES, SINGLE OR DOUBLE,

Can be changed over at very small cost.

Fully protected by U. S. and Foreign Letters Patent.

SEND FOR FURTHER PARTICULARS TO THE

SPERRY ELECTRIC CO., 195 to 207 CANAL ST., CHICAGO.

SPEAKING TUBES and WHISTLES,

Oral, Electric, Pneumatic, and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

21, 23 and 25 Ann St. New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for New Catalogue, out August 1st.

The Empire City Electric Co.,

15 and 17 DEY ST., NEW YORK.

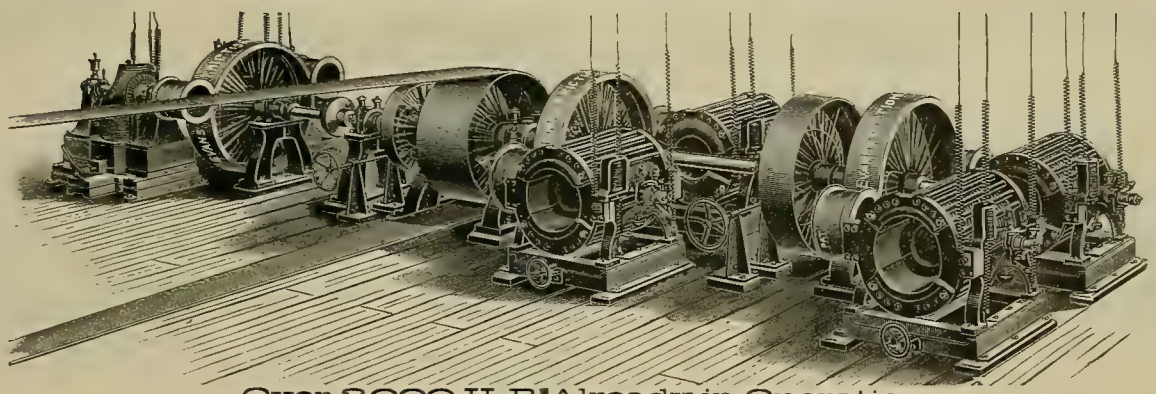
ELECTRIC RAILWAY SUPPLIES.

SEND FOR PRICES.

THE EVANS SYSTEM OF DRIVING DYNAMOS.

(STATION OF THE NORTH ATTLEBORO STEAM AND ELECTRIC CO.)

This Station has been in Successful Operation Since March, 1890.



Write for Full Particulars and List of Parties who are Using.

Over 3,000 H. P. Already in Operation.

Send for Catalogue "D" to THE EVANS FRICTION CONE CO., 85 Water Street, BOSTON.

ST. LOUIS ELECTRICAL SUPPLY CO.,

403 NORTH EIGHTH STREET, - - ST. LOUIS, MO.

Habirshaw, Safety, and K. K. Wires; Poles, Cross-Arms, Pins, Brackets and Insulators. Electric Railway and Electric Lighting Supplies of all descriptions.

WRITE FOR QUOTATIONS.

SOFT AS LEAD.

Cotton Wound Magnet Wire.

PUREST COPPER.

Try a Sample.

Manufactured by

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

WAREHOUSE, 171 and 173 LAKE STREET, - - CHICAGO.

GEO. C. BAILEY, Manager.

ARMATURES REPAIRED and REWOUND
COMMUTATORS TRUED OR RENEWED
SPECIAL FACILITIES AND AGILITY
DUPLICATES OF ALL KINDS
GENERAL DYNAMO REPAIRING & JOBBING
The JONES BROS. ELECTRIC Co. CINCINNATI, OHIO.

IMMENSE STOCK!!
BOTTOM PRICES!!

Electrical Supplies

OF ALL KINDS.

NORTHWEST
THOMSON-HOUSTON
ELECTRIC CO.,

403 & 405 SIBLEY ST., - ST. PAUL.

OUR POLICY:

First Class Goods, Small Margins and Quick Delivery.

LARGE STOCK OF

Grimshaw White Core,
Holmes, Booth & Hayden's "K. K."
Underwriters' Line Wire & Magnet Wires.

FULL LINE OF PORCELAIN GOODS.

"ELECTRIC BLOCK", 403 & 405 SIBLEY STREET, ST. PAUL, MINN.

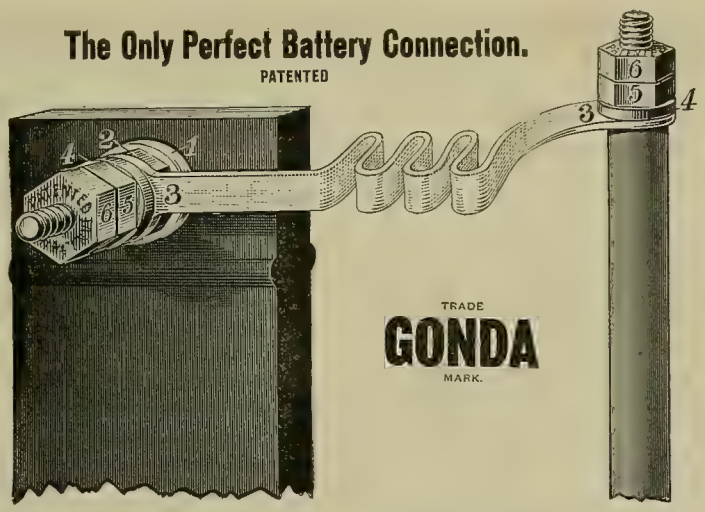
NO CORROSION.

NO LOOSENING.

NO DEVELOPMENT OF RESISTANCE.

The Only Perfect Battery Connection.

PATENTED



TRADE **GONDA** MARK.

NO OXIDATION.

NO LOCAL ACTION.

NO TROUBLE OF ANY KIND.

Users of batteries are well aware of the faults existing in all Connections in common use, and of the endless trouble and expense caused thereby, and will understand and appreciate the value of a connection which is free from these faults.

PLEASE EXAMINE THE ABOVE CUT,

And You will at Once Recognize Its Merits, which are Self-Evident.

1 is a washer made of a composition practically non-oxidizable, and which cannot be corroded by the battery salts. A like washer is on the other side of the carbon. Through these two washers and the carbon runs a screw made of zinc.
2 is a zinc nut placed on the screw and turned up tight against the washer, 1, to bind the whole tightly to the carbon.
3 is a connecting strip of flexible metal, not subject to oxidation or corrosion, which is placed upon the zinc screw for the purpose of connecting the carbon pole of one cell to the zinc of another.
4 is a zinc washer to prevent the strip 3 from being twisted when the nut 5 is screwed up.
5 is a zinc nut to be screwed up tight against the washer, 4, to bind the connection, and
6 is a check nut of zinc to reinforce 5.

The screws on both carbon and zinc are of the same size and thread, and the nuts on both are alike and interchangeable. No local action is possible between the carbon and the zinc screw because they do not touch, the electrical contact being made through the non-oxidizable washers.

The Cylinder, the Gonda and the Axo Cells will in future be furnished with this connection, and it will not be necessary for purchasers to provide wires for connecting the cells.

This connection is Patented, and action will be at once commenced against all persons infringing the same.

THE LECLANCHÉ BATTERY CO., NEW YORK., 149 W. Eighteenth St.

A Good Light for Xmas,

THE "A. B. C."

INCANDESCENT LAMP.

ANY VOLTAGE.
ANY CANDLE POWER.
MADE TO FIT ANY SOCKET.

TRADE A.B.C. MARK

ELECTRIC LIGHT, POWER,

—AND—

TELEPHONE AND TELEGRAPH

SUPPLIES.

FIBRONE, ALEXITE, HERCULITE, INSULATING MATERIALS FOR ELECTRICAL SUPPLIES.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING, 20 Cortlandt St., NEW YORK.

JOHN STEPHENSON CO.,

LIMITED,

NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS

ADAPTED TO ALL SYSTEMS.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

— POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF —

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL. All operations of sawing, cutting, turning and polishing our new standards of

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

THE KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies.

SEND FOR PRICES AND ESTIMATES.

FOR SALE BY THE CENTRAL ELECTRIC CO., CHICAGO.

THE STANDARD CARBON CO., CLEVELAND, OHIO.

Manufacturers of Electric Light Carbons and Battery Material.

ESTABLISHED 1867.

FRANKLIN S. CARTER.
CHAS. M. WILKINS.
E. WARD WILKINS.
} TRADING AS

PARTRICK & CARTER,

MANUFACTURERS OF

ELECTRICAL SUPPLIES.

No. 125 South Second St., PHILADELPHIA.

REMOVAL NOTICE.—We have removed our offices, storerooms and factory to the large buildings, No. 125 SOUTH SECOND ST. and No. 131 GOTHIC ST.

DECEMBER 22nd, 1890. **PARTRICK & CARTER.**

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't. J. C. HOBART, Sec'y.

THE TRIUMPH

ECONOMY, SIMPLICITY, DURABILITY, SILENCE.

15 TO 300 HORSE-POWER. COMPOUND AND VALVELESS.

Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS. NO ECCENTRICS NO STUFFING BOXES.
NO PISTON RODS. INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

WRITE FOR CATALOGUE.

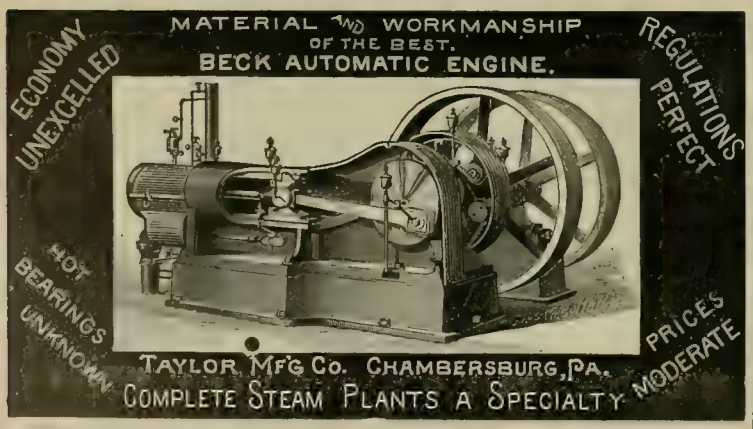
The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO.,

SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

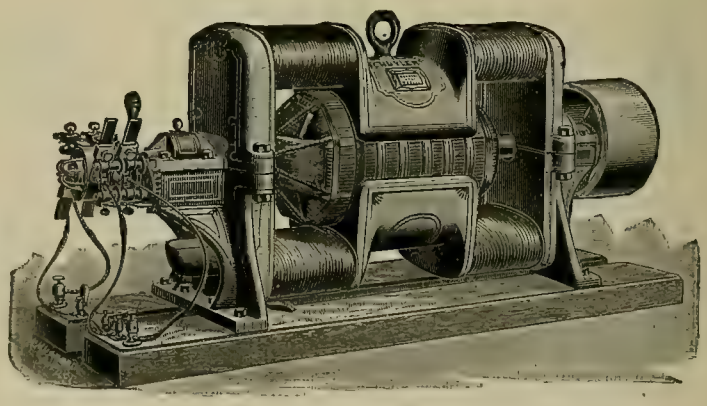


THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

OKONITE TRADE MARK.

PRICES TALK.

WRITE TO US FOR THEM.

Okonite and Candee WIRES.
Okonite and Manson TAPES.

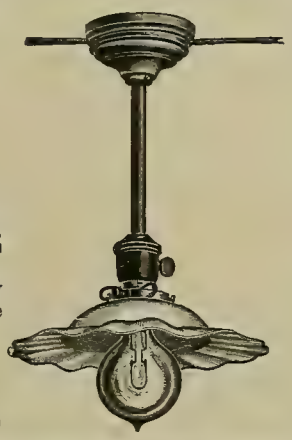
Dealers in Everything ELECTRICAL.

SOUTHERN ELECTRICAL SUPPLY CO., 823 LOCUST ST., ST. LOUIS, MO.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.

POND ENGINEERING CO.,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS, TEX., SEATTLE, WASH.

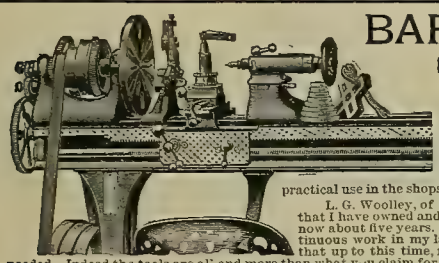
ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR.

ERECTED READY FOR SERVICE.

SPECIALTIES:—Armington & Sims Engines, Steel Boilers, Standard Rocking and Sheffield Grates, Lowe Heater, Hoppes Purifier, Pond Separator, Blake Pump, Korting Injector, Etc.

Send to the Nearest Office for Latest Catalogue.



BARNES' FOOT POWER LATHES.

Barnes' Foot Power Lathes, 16 different styles and sizes, suitable for all classes of work from the Blacksmith to the Jeweler.

There is no application of foot power equal to the Patent Velocipede, used with these lathes. Thousands of them are in practical use in the shops of metal and wood workers.

L. G. Woolley, of Grand Rapids, Mich., says: "I wish to say that I have owned and used two of your No. 6 foot power lathes now about five years. The tools have been put to hard and continuous work in my laboratory, and it gives me pleasure to say that up to this time, no repairs of any kind whatever have been needed. Indeed the tools are all and more than what you claim for them.

My time is devoted exclusively to invention and experimental work in electricity. In doing this it is necessary to have accuracy, and wide range of adaptation to different work. Your excellent lathes and superb foot power is all that could be desired by any one in need of a first-class tool."

Send for catalogue of wood and metal workers' outfits.

W. F. & JOHN BARNES CO., No. 761 Ruby St., Rockford, Ill.

PRIMARY BATTERIES

For Household, Experimental, Scientific and other Purposes.

JAMES H. MASON.

MANUFACTURING ELECTRICIAN,
Office, 63 Broadway, New York.
Factory, 118-120 Park Avenue, Brooklyn, N. Y.

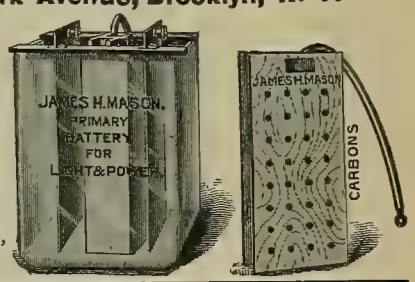
COMPLETE PLANTS FOR SMALL STORES.

Office and Domestic Lighting.

GREAT IMPROVEMENTS.

Guaranteed as represented.

These Batteries are in practical use, and giving perfect satisfaction.



PRINCIPAL DEPOT:
Chestnut St., cor. Twelfth, Philadelphia.

BRANCH HOUSES.
Nos. 767 & 769 Broadway, New York.
" 1260 & 1262 Broadway, New York.
" 160 Tremont Street, Boston.
" 151 & 153 Wabash Avenue, Chicago.
" 444 Fulton Street, Brooklyn.

Cable Address: White, Philadelphia.

The S. S. White Dental Manufacturing Co.

Founded by Samuel S White in 1844.

JAMES W. WHITE, President. J. CLARENCE WHITE, Secretary
HENRY M. LEWIS, General Manager. SAMUEL T. JONES, Treasurer.

Philadelphia November 4th, 1890.

Edison Mfg. Co.,

Orange, N. J.,

Gentlemen:

Yours of October 16th duly received, and sickness has caused the delay in answering it. As to the Edison Laland Battery, we have been using primary batteries to operate dental electric pluggers and motors since 1875, and am compelled to say that the Edison Laland Battery far excells all other batteries we have ever used.

Yours truly,

The S. S. White Dental Mfg. Co.

E J Starr

THE

THOMSON-HOUSTON ELECTRIC CO.

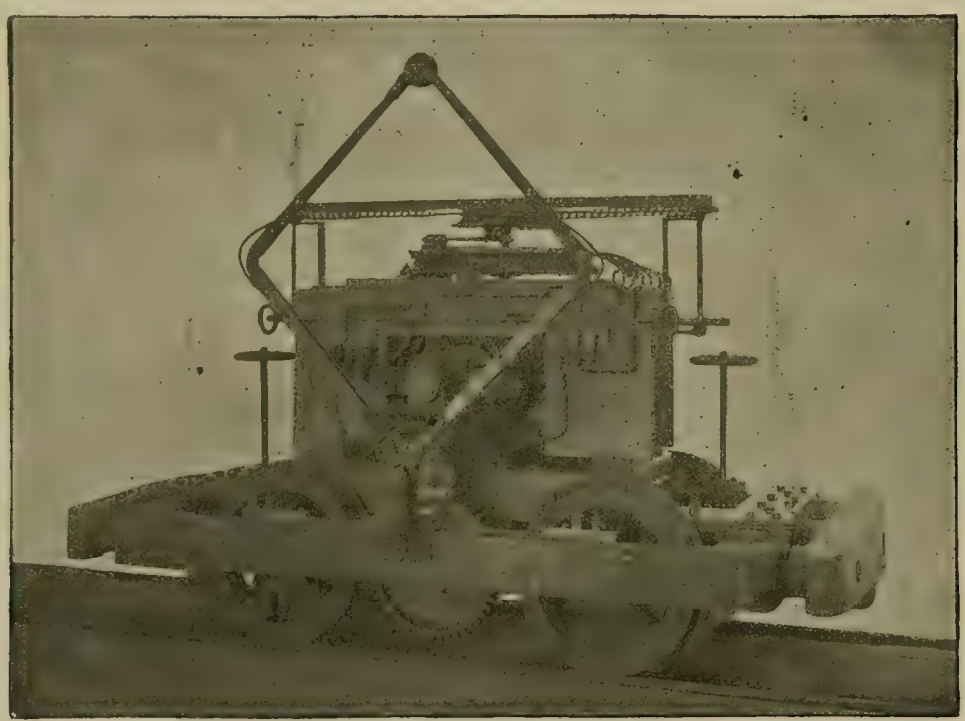
TO THE OWNERS OF WATER OR STEAM POWER:

LONG DISTANCE TRANSMISSION OF POWER
by Electricity is now successful and economical.

A greater efficiency, both as to first cost and operating expenses, is guaranteed than by any other method of power transmission.

Electric power transmitted for any purpose and to drive any class of machinery.

ELECTRICITY IN MINES may be used for Hoisting, Pumping, Tram Cars. Ventilation, Drilling, and Lighting.



THOMSON-HOUSTON ELECTRIC MINING LOCOMOTIVE.

THOMSON-HOUSTON GENERATORS AND MOTORS

Cannot be Excelled for Durability and Efficiency.

We will be pleased to furnish on demand full information on our electric appliances and make estimates for transmission of power plants, and for the equipment of mines with Electric Power and Lighting Apparatus.

COMPLETE INSTALLATIONS, OR ELECTRIC MACHINERY ONLY, FOR ALL KINDS OF ELECTROLYTIC WORK, ESPECIALLY FOR THE

Electrolytic Refining of Copper.

Illustrated and Descriptive Circulars cheerfully furnished on application at any of the following

PRINCIPAL OFFICES:

BOSTON, 620 Atlantic Ave.

CHICAGO, 148 Michigan Ave.

ST. PAUL, 403 Sibley Street.

KNAPP ELECTRICAL WORKS,

GENERAL WESTERN AGENTS

PERKINS ELECTRIC LAMP CO.

To Fit Any Socket, Any Candle Power,
Highest Efficiency.

GRIMSHAW WHITE CORE

Wires, Cables

and Tapes.

ANNUNCIATORS,

BURGLAR ALARM BELLS, BUTTONS, ETC.

PORCELAIN CUT-OUTS,

Main and Branch Cut-Outs, Rosettes and Switches, Underwriters' Weather Proof Wires and Line Supplies.

Write for Prices on these Specialties Our New Catalogue for 1891 Just Out.

54 & 56 FRANKLIN STREET, CHICAGO.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST.

CHICAGO.

"A LEAK IN THE AFT TOP-GALLANTS"

SANG OUT THE WATCH.

"LAND HO!"

ROARED THE CAPTAIN "AMPERES ALOFT PREPARE TO LIGHTEN SHIP."

If all would use "SHIELD BRAND," there would be NO GROUNDS for complaint.

EUREKA BELL.

WOOD BOX.

NOW IS THE TIME

—TO—

"RING OUT THE OLD, RING IN THE NEW"

EUREKA BELLS.

THEY ARE BEAUTIES, AND VERY CHEAP.

EUREKA BELL.

IRON BOX.

It begins to look as if it would become

THE UNIVERSAL ARC LAMP.

We are selling a great many and hear glowing accounts of them.

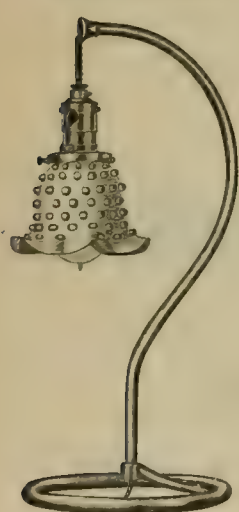
AJAX DRY BATTERIES FOR EUREKA BELLS OR ANY OTHERS.

We have a large number of New and Artistic Designs in

FIXTURES, SHADES

—AND—

General Finishing Materials.



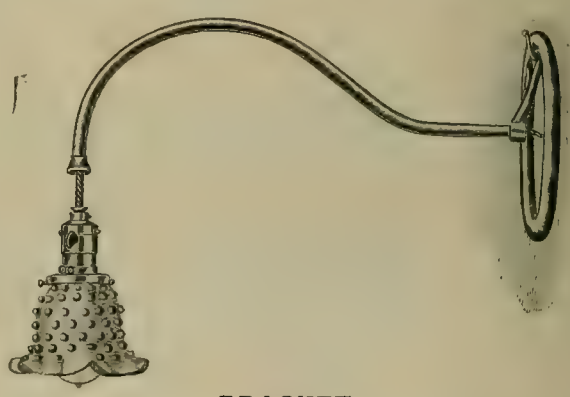
PORTABLE.

BASSETT COMBINATION PORTABLE and BRACKET.

HOUSE GOODS CATALOGUE, NO. 648.

E. L. & P. CATALOGUE, NO. 560.

——SEND FOR THEM.——



BRACKET.

THE RUBBER USED

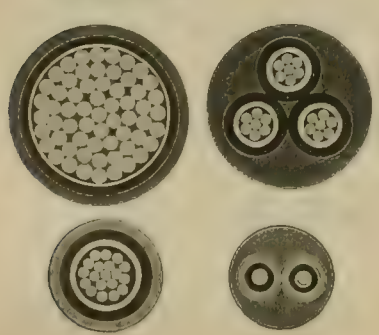
—IN—

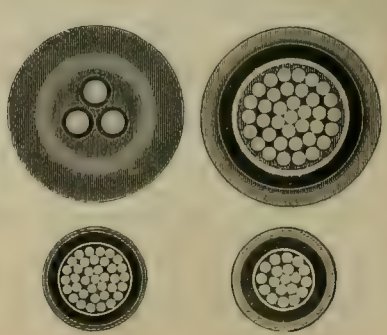
HABIRSHAW

INSULATION

—IS—

PURE PARA.





DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

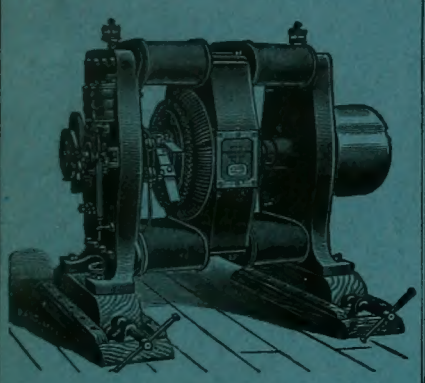
FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System of Long Distance INCANDESCENT LIGHTING,

AND THE

Wood Automatically Regulating Arc Lamps and Dynamos.



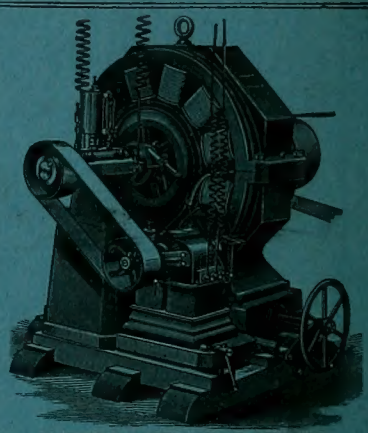
WOOD ARC DYNAMO.

MAIN OFFICE:
FORT WAYNE, IND.

BRANCH OFFICES:

NEW YORK,	115 Broadway.
CHICAGO,	185 Dearborn St.
PHILADELPHIA,	907 Filbert St.
PITTSBURGH,	533 Wood St.
DETROIT, MICH.,	57 Gratiot Ave.
SAN FRANCISCO,	35 New Montgomery St.
TORONTO, CAN.,	138 King St. W.
DALLAS, TEX.,	McLeod Bldg.

FACTORIES:
FORT WAYNE, IND., - AND - BROOKLYN, N. Y.



SLATTERY ALTERNATING DYNAMO.

WE MANUFACTURE MOTORS

THAT ARE

GOOD ONES

IF WE DO SAY IT OURSELVES.

OUR NEW MOTORS

Have many radical changes that it will pay you to investigate.

So wait a few days for an answer to your POSTAL to us, wherein you ask us to post you on the NEWEST and BEST DESIGN MOTOR on the MARKET.

The Answer Will Come Promptly

FROM THE

BAXTER ELECTRIC MOTOR CO.,

BALTIMORE, MD.,

Manufacturers of Arc and Incandescent Motors of All Sizes.

CHAS. H. CONE, Western Agent, 103 Adams Street, Room 8, Chicago, Illinois.

PHŒNIX GLASS CO

OF PITTSBURGH, PA.

MANUFACTURERS OF A FULL LINE OF

ELECTRIC LIGHT

GLOBES SHADES

BOTH ARC AND INCANDESCENT.

RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.

ADAPTED TO ALL SYSTEMS.

729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.